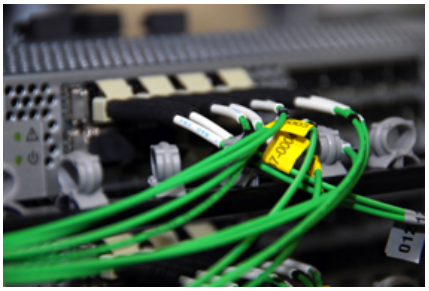
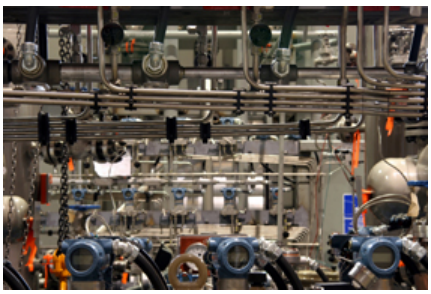
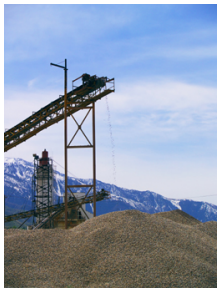
The IDC Technologies

Little Red Book

Compendium of Mackay's Musings

Useful ideas for your next presentation on the state of engineering and training, ranging from topics on design, engineering careers, renewable energy, technical training and education, and much more.

August 2006-June 2008

IDC TECHNOLOGIES

Technology Training that Works

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First published 2008

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Acknowledgements

IDC Technologies expresses its sincere thanks to all those engineers and technicians on our training workshops who freely made available their expertise in preparing this manual.

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2008

Concluded by a list of training courses offered by IDC Technologies

Preface


Steve Mackay - Technical Director of IDC Technologies at one of his favourite haunts at the Cape of Good Hope

Dear Colleagues

After some of you foolishly requested copies of my blogs and your responses to these postings (ranging from enthusiastic to acerbic and irritable), we have put the whole lot into one booklet. Named (tongue-in-cheek) after Chairman's Mao's Little Red book. Thanks so much for your contributions and I really look forward to continuing our relationship for many years to come. I am always grateful to you for going to the trouble to write. In some cases, the responses have been lengthy and thought-provoking, requiring considerable effort. I hope these are all faithfully echoed in this booklet. If I have left anyone out, please let me know. Needless to say, we shall keep updating the booklet.

Despite the vicissitudes of business today, I always count myself lucky to be working in engineering. And especially in engineering training.

Yours in engineering learning

Steve Mackay – FIE (Aust), CP Eng, B.Sc (Elec Eng), B.Sc (Hons), MBA, MMR
Technical Director

2006

Be foolish more often in engineering

Posted: 5 August 2006

As engineers and technical professionals we are all trained to be logical and rational and rely on proven facts in making decisions. The approach with engineers is to vigorously apply the blowtorch to any concept which is rather nebulous and stick to solid engineering design practice. However as Margot Cairnes, an Australian leadership strategist, recently pointed out: 'This often means being conventional, boring and underperforming (when creating solutions to difficult problems). In a changing world, creativity is essential, not only to keep pace with change but to be at the crest of the wave'.

I am sure you have been in numerous engineering meetings which grind on and on regarding some trivial but critical design issue. Important, perhaps, in many cases. But we submerge our creativity under this overwhelming conventional but safe engineering thinking. It is staggering how many brilliant and effective products are out there which were created through creative thinking and 'thinking foolishly'. These range from products as varied as the 3M Post It note, the Kreepy Krauly pool cleaner, the iPod to the ubiquitous telephone.

Here at IDC we brainstorm foolishly at times when designing new services or products. Initially my rational engineering mind is irritated and uncomfortable. However, when creative impulses intrude, the barmy content which appeared illegal, unsafe and even dangerous, can, with a more chaotic and lateral vision begin to appear quite stunningly brilliant. The trick, when the ideas are flowing, is to get other people to comment on them and to turn them around and see whether they can be made useful and productive.

When you are engaged in another meeting examining a difficult problem; be foolish. According to *The Entrepreneur* magazine, the following framework is recommended:

- Pose an initial question to get the "show on the road"
- Identify a challenge which you want to solve
- Suspend criticism of all ideas that are presented
- Postpone evaluation whilst the ideas are being presented
- Build on others' ideas in a fast paced manner

Do not risk life and limb, but as Steve Jobs says: 'Stay hungry, stay foolish'.

Don’t spend another penny on formal training

Posted: 22 August 2006

Stop pouring your money into formal training without pausing to consider the other far more powerful options. The US Bureau of Labor Statistics (1996), indicated that people learn 70% of what they know about their jobs informally. Not through formal courses. Or training workshops.

According to Jay Cross, formal training accounts for only 20% of what people learn at work. Was it wisely spent ? In many cases, I doubt it. Our experience leads us to believe that a two day short course is great. The instructor is often good (and sometimes not so good). The transfer of learning is outstanding. Everyone understands the topic. But then no one applies the learning. And after a few weeks, it is all forgotten. So a completely wasted investment by the firm. Great course manuals. Great interaction with other professionals. But that is where the learning stops.

At the end of the day, businesses are after results. Performance. Return on investment. According to Marcia Conner (2005), ‘the most valuable learning takes place serendipitously, by random chance. Most companies, however, focus only on formal learning programs, losing valuable opportunities and outcomes. To truly understand the learning in your organisation you might want to recognise the informal learning already taking place and put in practices to cultivate and capture more of what people learn’.

What is informal learning ?

According to Jay Cross (Internet Time Group), people generally acquire the skills they use at work informally. Talking to others, watching what others do, trial-and-error and simply by osmosis, getting shown or corrected on a task they are struggling to accomplish.

The most powerful form of training is to permeate your entire company culture with further informal learning. An example. When a regular problem occurs and the bearing of a machine keeps seizing up or an alarm trips a part of the plant, identify what the problem is and then try and make the learning experience more generic so that the learning experience can be spread to other instances. Gather everyone around. All 5 technicians, the new snotty nosed graduate engineer, the ancient manager about to retire, and the reception lady and then spend 5 minutes showing them what went wrong and how to fix the problem. And then get them involved in the learning process so that they can all demonstrate they understood what happened and won’t forget it. And get them to go and teach someone else in the firm. All informally. At low cost. And yet a very powerful learning experience.

What can you do to get dramatic improvements to productivity with informal learning ?

- List all the informal training activities that are going on in your firm. Publicize them and increase them.
- Permeate your whole work culture with engineering learning – that informal learning is great and valuable. Do this from the top down.
- Build and create informal communities of practice based anywhere from the water cooler to the internet
- Improve meetings to make them learning experiences for everyone.

IDC Technologies is about training. We live and breathe it. We are passionate about it. We run many training courses throughout the world and train thousands of engineers and technicians every year and have many loyal clients. Short courses. Mostly formal courses. But in some respects formal training must be one of the greatest wastes of money for industry. Most of the results are not measured as far as return on investment and real improvements to productivity or morale. We try hard to ensure our clients do this. But we believe that informal learning has tremendous untapped benefits.

So why not try to put some more effort into your greatest resource: your people and informal learning. True engineering learning. Technology and engineering training that works. And when you use formal training, ensure that you carefully research the need and that it is applied to the job effectively.

Fearsomely outstanding engineering presentations

Posted: 29 August 2006

After running an engineering conference with 80-odd engineers, in the beautiful surrounds of Sydney harbour and its yachts, I reflected on why some of the presentations were outstanding and others dull. The presenters were of a similar calibre with identical resources. The presentations which lacked lustre used a plethora of powerpoints and words, often delivered in a monotone and all compressed into an hour – slides were thrust out to the bemused audience in machine gun succession. And inevitably there was no interaction with the audience. The reviews for these were predictable.

On the other hand, however, the best speaker was an engineer hailing from Minneapolis. He galvanised the audience with an excellent and humorous opening quote, he showed passion for his subject and then after presenting two slides, efficiently broke the 80 strong audience into small groups of five. Each group was given two short 4 minute assignments to illustrate the points made. Each group had to write up its findings on flip charts during which time the presenter circulated, assisting the groups as they prepared their findings. The results were then displayed around the room.

The interaction was fearsome, the delegates, without exception, were talking vigorously with each other about the topic at hand. The prize of a bottle of good wine for the best group was also helpful in achieving a carnival atmosphere. There was the hum of real learning going on. The participants were following the 'constructivist' approach of learning - constructing their own knowledge and understanding of the topic.

People walking into the room at the end of the proceedings would have been surprised – the presenter was delivering the last part of his presentation, surrounded by the audience, from the middle of the room - using a remote microphone and controlling the slides remotely. And the room was festooned with at least 40 large sheets of paper summarizing each group's findings. The reviews afterwards were outstanding.

In summary - a few suggestions for your next presentation:

- Interact with your audience from beginning to end
- "Sell" the topic to the audience – why it will be important to them
- Show everyone that you have passion for your subject
- Challenge the delegates, with every slide you use, to come up with their own comments and understanding
- Give the delegates tasks to enable them to construct their own learning - perhaps in the form of small groups
- Make the delegates interact with each other

Engineering innocence

Posted: 31 August 2006

Last night, we enjoyed a great evening with our two kids playing in a school musical evening. One in a choir (much to his chagrin) and the other playing the violin. What struck me about these very young adults is their incredible ability to absorb knowledge and skills. Also their openness to new concepts. As we have all heard before - like sponges. Over the past week, I have delighted in teaching my boy (9yo) the essentials of differential calculus. I believe when presenting in an interesting, interactive and effective way it is very easy to transfer across even the most complex concepts. My mind wandered to the application to us as engineers and technical professionals. The trick I believe is, that our current knowledge is always being superseded and we have to open our mind to new knowledge and let it simply stream in.

Now to teach my boy, the essentials of integral calculus.....

Feedback

It is very true that the young have no fear of trying things new ... I wonder that as we age we try to hang on to things that are important to us (people, places, activities...), and a fear of change creeps in. This reluctance to accept change may in turn affect our ability (or willingness) to learn new things.

Intellectually; most people have the capacity to learn anything they put their minds to... so in my opinion it comes down the attitude of the individual.

Thanks for the thoughts

Larry Browning

Is there anything left for us to do ?

Posted: 7 September 2006

I am currently travelling with a roadshow, presenting short information sessions in various mining towns in the Australian outback. It has been quite fascinating to learn what is happening in these rural towns, particularly with the massive growth in China in mind.

What was especially striking, here in outback Australia, is the enormous demand for minerals and the incredible engineering skills shortage that has arisen as a result.

There is no doubt that the boom in mining and demand for product from the steel furnaces is driven by China's soaring growth. This is worrying - does it leave us anything to do as engineers in traditionally manufacturing-based countries? After all, most of the manufacturing and processing of our minerals has fled to countries such as China.

Do we want to end up with all our engineering skills hollowed out?

One of our clients from Shanghai, in China, made an interesting comment. She said that every morning she looks out from her offices across the river to see barges creeping up the river, laden with materials. One skyscraper is being built every day in China.

Here are a few other facts about China - from Rohit Talwar (The Association of Professional Futurists):

- There is about 10% a year growth - a situation that has been sustained for the last 20 years
- There are plans to spend $17.4 billion constructing airports in the next 5 years
- The number of aircraft will increase from 863 today, to 1580 by 2010 and 4000 by 2020
- China is now the world's largest manufacturer of personal computers
- In 2001, US manufactured exports were more than double China's, but now, in the first-half of 2006, China passed the US, with $404 billion, compared to $367 billion for the US
- By 2020 the Chinese middle class is forecast to double to over 40% of the 1.3 billion population - 520 million people.
- In 2006 there will be 4 million graduates - including over 800,000 in engineering.

What can we do ?

We must realize that we are in a global economy. Everyone is impacted. Not only your car manufacturing plant. Even your local fish and chips shop will be affected, with potatoes

not necessarily being sourced locally anymore, but internationally. Potatoes are flown airfreight which can potentially put the local 'veggie' farmers out of work.

We must redirect our focus to high tech type skills ('deep know-how'), which are difficult to replicate in lower cost countries. Or to look at products which cannot be made easily on a basis of mass production. Or would cost a significant amount of money to transport any distance, particularly from a lower cost source. One engineer tells me that he makes a very good income running a small foundry business for specialised engineering items (such as pulleys). The production runs are short and the know-how required is incredibly specialised. He sells his product to all sorts of interesting countries. Even China.

As one pundit remarked recently – whilst we are excited by the mining boom throughout the world at present – what we really need is an innovation boom.

Where have all our engineers and technicians gone ?

Posted: 12 September 2006

It is a well recognised truism that science, engineering and technology are critical to economic growth for a country. So it is vital that we see a continuing flow of good engineers and technicians into industry. In 2001, the British Government commissioned an important study into 'the supply of people with science, technology, engineering and mathematical skills'. The report's findings highlighted a significant fall in the number of students taking physics, mathematics, chemistry and engineering degrees in Britain.

Ian Young (vice-chancellor of Swinburne University of Technology) indicates that Australia has a similar problem. A total of 7.9 per cent of all graduates from Australian universities are in engineering, ranking Australia 24th out of 28 OECD countries. Contrast this with countries such as Korea at 27 per cent, Germany at 19 per cent and even Britain at 10 per cent. Comparatively, Australia produces few engineers and the number is declining. This will definitely pose a problem for economic development. Arguably the shortages of good technicians and tradespersonnel are even more acute than that for engineers.

The question on everyone's lips is why students aren't going into engineering either as engineers or technicians. It doesn't appear to be because of money. The Careers Council of Australia data shows that in 2003, starting salaries for engineers ranked fourth out of 23 disciplines, behind only dentistry, optometry and medicine, and the physical sciences ranked sixth. Ian Young goes onto say that his experience is that engineering and the physical sciences are perceived by students as being 'hard'. Good mathematical skills are almost essential for an understanding of science, technology and engineering. He believes the real nub of the problem lies in the early years of secondary school when students develop negative views about mathematics. Finding and retaining gifted and highly motivated mathematics teachers is an international problem. What we need are inspirational mathematics and science teachers of the calibre of Robin Williams in *Dead Poet's Society*.

MIT President Susan Hockfield noted that we need to address the 'challenge of interest'. 'Kids and Americans today fail to be inspired by engineering, by science, and by mathematics', she said, noting that only 17 percent of US bachelors' degrees are in science and engineering compared to 68 percent in Singapore. She also stressed that to move engineering forward we must 'recruit aggressively' women and minorities in this country. 'Engineering can't continue to be dominated predominantly by men – by white men'. Rather controversially, but perhaps courageously, Arden Bement (head of the National Science Foundation) stated that if US industry can find engineering talent in the developing world for 20 cents on the dollar, "they're going to do so, and probably should."

A few action steps are suggested:

- The challenge for us in the western world is to "provide students who offer five times the value added to compete with the lower wage countries"
- We need to inspire our kids at school to go for science and engineering type careers with stimulating courses
- We need a Carl Sagan-quality spokesman to inspire students to become engineers and technicians

- John Marburger (Science advisor to President Bush) also noted that the 98 percent of the students who drop out of engineering cite bad teaching as the cause. We need outstanding training and instructors.

Ensuring the supply of highly skilled engineers and technicians in our countries should be the highest priority if we want to continue to see a prosperous nation in the future.

Feedback

One big problem is that of perception.

A large proportion of people in Australia don't understand what engineers actually do. They think that engineers work with their hands. This stems partly from technical people calling themselves engineers. For instance, technicians who work on aircraft are termed Licenced Aircraft Maintenance Engineers. In this country people aspire to become bankers, lawyers, doctors, etc. Personally, I believe the government needs to place much tighter controls on who can call onself an engineer. A five year degree should be a minimum.

From Mike, Australia

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I fully agree with the message and meaning of the email about dwindling numbers of engineers.

I have just completed a one year teaching course and am/was very enthusiastic about changing the way the kids are addressed. I had thought in the past about creating a book relating day to day events to engineering and have several piles of notes about this.

I am definitely an enthusiast about engineering and electronics - others in local radio clubs have found this and said so.

However I have not yet got a position teaching and am driving on my 7.5 tonne licence for a living.

As a Sheffield Chamber of Commerce person said to me about a month ago - "Engineering / Technology is not sexy in this area".

I lived in Melbourne for several years and can understand the related comment.

Mike Hewitt, UK

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A most interesting question. One to which the answers received (as read on your blog pages), seem to miss a great point - our engineers have all shifted discipline! This can be demonstrated by the inordinate number of 'Social Engineers' about the place. They are all too busy minding someone else's business to do any real work.

Take a wee walk backward to the Dr. Spock era, and you find the root cause. Our "teachers" today are nearly all from that crop, and have not one ounce of common sense themselves, so cannot possibly impart any on students.

Political correctness will bring about its own demise, because the thing that separates Man from the animals is the ability to discriminate, and he isn't allowed to anymore!

Thus endeth my rantings! Keep up the good work!

C Bloomer, Australia

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My observations are that Engineering is not highly valued as it should be in our society and that it is a difficult course to study. Hence few young people choose Engineering as their first choice.

Furthermore, in most organisations the technical ladder is much shorter than the management ladder. Therefore, for an engineer to advance his or her career (i.e. remuneration and conditions) within industry he or she will need to move into management. The result can be (not always) is the loss of a motivated creative person and the gain of an unmotivated administrator.

I hope this mind set shifts towards valuing our engineers for their true worth in the future.

David Flatman, Australia

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Several years ago I was the electronics hardware engineer in charge of a deep water communications system which was part of a safety critical component in an offshore drilling programme. This was a technically difficult exercise, not helped by the short lead time. We managed to overcome the difficulties and the programme proceeded. You will appreciate the other engineering effort required in all sorts of field to carry out a deep water drilling programme.

About the same time an Australian won the 100 metre hurdles at a world track and field meet (not the Olympics). This was news front and back of every paper in the land for two days. Whilst I do not begrudge that person's achievements, or the effort it required to get them there, at the end of the day, that person ran 100 metres and jumped over a set of sticks. If one were to look at that event, one can see there was an extraordinary amount of engineering behind that event, from building stadiums, to flying them to the event, to getting and refining the oil for the coach that took that person to the meet, even the communications infrastructure to see that person win "live". I could go on.

Dare I say it - there is something to be said of our society which spends millions of dollars promoting teams which fly around the country and whose total contribution, in the end, is to kick a ball between a couple of sticks. A friend of mine (non-engineer) remarked – 'our profession is not sexy enough'. I used to be a member of the IEAust who claimed, amongst other things, to promote engineering. I saw little evidence of this to the general public, and what I did see/hear was none too inspiring. Perhaps they should take a sporting event and show what engineering took place behind the scenes to make it happen. Something we all take for granted.

Luigi Lemi, Australia

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Thank you for this article which was well addressed.

It certainly is no surprise as I have aged into my career some 19 years now in the Electronics Field.

People today place too much emphasis on Information Technology – man this is an exhausted market. I also believe that there is a lack of true teachers that are passionate about Math and Physics.

When one speaks technology people immediately think IT.

About 2 or 3 years ago I attended the City's Long Term Development Framework Workshop which looked at all issues. SWOT analysis and that sort.

Technology was identified as a key factor and everybody agreed, but everyone except me said IT skills. I said engineering - and spelled out Electronic, Electrical, Mechanical and Civil - but hardly anyone paid attention - this frustrated me then, and still does.

In order to develop a City (like Durban in South Africa) we need to develop our youth and mould them into engineers of all sorts. But, the media blurs the mind constantly focusing on IT and some new PC, or hardware or software.

Engineering was around long before IT. Engineering brought about IT and engineering will always be around. Software programmes change constantly.

Man, I was no boffin in school but I loved electronics and technology - and knew that Math and Physics was the foundation so I pursued it through high school.

I often find myself in a battle with IT hot-shots, they don't think like engineers and never will be . . . sorry.

I think that role players like the government need to realize this and promote engineering right from primary school. Let little minds understand that you need to build that bridge, source new energy, create tangible items from scratch, see your work evolve into something that everyone can appreciate - now you're creating an Engineer.

I think we engineers need to 'engineer' young minds and hold workshops and presentations in schools, maybe even pre-school too. Allow kids to play with toys such as Lego, Meccano, etc.

Dump that PSP, PS2, XBox and PC for now and spend more time with imagination and conceptualize.

Incidently, I forwarded your article to some people I though could forward it in the right direction.

Farouk Sulaman, South Africa

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J M in Qatar calling. Read your blog on skills shortages etc about which I have a few observations. But first, that picture of you dining. Who is your hairdresser?

ONE

Your call on maths is correct. It comes across as a scary subject to many students. Schools are the worst offenders at making maths a boogy subject.
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Many maths teachers are good at maths and bad at teaching. I have met several who have not had a good day until they made a student feel like giving up. More systemically, school internal systems and state and national grading systems have culpability.

My child is just about finished year 12 in Queensland. During those horrid parent/teacher interviews - where many parents are more nervous than the students - my child's maths teacher - one of the flock described above - was quite open in suggesting that she give up on the advanced maths option because her less than stellar grades (she is like her old man who finds applied maths easier to assimilate than more esoteric stuff) were going to drag down her fellow classmate group average for the subject.

In other words, just go away so that I can look good in the statistical reports that go to bureaucracy central. To counter this distortion I have spent a lot of money on a personal tutor for two years to make sure she has a level of knowledge and skills in this subject to give her a fighting chance. My terminal observation is that schools are caught up in the elitist pursuit of statistical glory. The numbers are coming before the kids - and that's just plain wrong.

TWO

After 15+ years of engaging with vocational learners, I have come to the very pessimistic conclusion that 90% of kids leave school without a breath of an idea on how to learn. In teaching circles this missing skill set is called preparation for life-long learning. Learning as a life long pursuit has not just fallen off the radar for many students, IT WAS NEVER ON THE RADAR for them or their parents.

I have a belief that this social dysfunction is culturally informed.

There is a strong Indian population here in both non-urban and urban areas of Qatar. The non-urban children get on a bus at 0530, commute to Doha, study all day, return, do homework and help with domestic chores. With all of this they are still A+ grade students. The difference? There is a universal cultural emphasis on excellence. This is not the mealy mouthed nonsense that comes from politicians and know nothing public servants. The COMMUNITY supports these kids 100% in their personal journeys. AND they are still balanced kids.

They are certainly not after the Japanese model where they contemplate suicide to avoid the pressure. Amazing insights from my short stint here. Anyway, the office cleaner wants his soapbox back so better give it back.

Nice 'chatting' and have a good day. ...and about that haircut ....

J M in sunny downtown Qatar

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Just a thought. Maybe the real problem is discipline in schools. Not very enticing for someone who has a predominantly mathematical/scientific brain.... why would they want to be abused by schoolchildren when there is very interesting work elsewhere?

Another thought. It would be a very interesting study to survey the quality of teachers and teaching in schools with good discipline compared to schools which do not have much discipline.

John Rott, Australia

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I have a boy at university who is taking English (his mother's side) and another hoping to go next year, I have been trying to convince him of the merits of a science/engineering course (like his old man!) but he cites maths has a stumbling block. He dropped it at A level again saying the teaching was not good (basically leaving the slower ones behind and giving them no attention), I went to the school to speak to the said teacher , who had no interest in the 'slow' learners and expected them to catch up or shut up. She did say there was a maths help centre at lunch times (kids at 17 want their lunch break! Come on!) No dice, says the teacher, he needs to keep up! Result, son drops math's. How sad is that?

Gary Roper, UK

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In Malaysia we had to turn away students. Too many applicants, even females wanting to do engineering. May be Britain should apply Malaysian marketing techniques to A-level students.

Prof. Mohamad Afifi Bin Abdul Mukti, Malaysia.

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Regarding 'Where have all our engineers and technicians gone' you must also consider job opportunities. Australia ranks low in the scale of R&D expenditure and hence has fewer challenging jobs than other countries for the academic high achievers. This situation is made worse by industries and governments run by bean counters and lawyers with little understanding of technology and even less of a future vision for the role of science and engineering. I believe that more challenging and rewarding jobs in science and engineering in Australia would be the catalyst for encouraging more students into the professions. It is up to industry and government to make this happen.

Alan Haime, Australia

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Another villain is the way pupils are now taught physics - if my daughter's experience is anything to go by. She is in year 11 and would happily dump physics next year if its importance were not so seen to be so important for her future university studies She is fairly able in physics but the way it is being presented to her causes frustration. I think that there are a number of reasons:
1. a lack of facts given in the course;
2. lack of application of even simple mathematics;
3. substitution of unsystematic "hand waving" methods to solve problems when a systematic approach/analysis (without mathematics) may still be possible.

My daughter was even asked to choose between two options in answering a physics exam question when both options were wrong!

In mathematics more than in physics I have seen far too many badly-worded questions being given to my daughter. The present situation is lamentable,

DC Newton, Australia

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I actually find the conclusions draw by people who have vested interests, to be totally and obviously incorrect. For a start the starting pay ranking, what use is that ten years down the line? Fourth out of 23 that's a joke well above engineers and I am one. By possibly (three times higher) are accountants, plumbers, electricians, bricklayers and also not quite so far above a whole host of civil servants of many disciplines (surveyors, planning officers, etc.). I told my son when he left school not to go into engineering because it was so badly paid. If you as employers do not pay sensible salaries compared to many other trades youngsters will not think it worth while to consider engineering as a trade. The ball is totally in the court of the employers. No amount of coercion at school age will influence youngsters if their parents say the pay is bad and it is!!!

My son, whose work is very similar to my own but who has very little peripheral knowledge and experience in other fields that I rely on at work, after 6 years in the Civil Service at the age of thirty earns over £5,000 more than myself, about to retire at the age of 62. Our era of engineers are no longer, there won't be any follow on after we have departed, we work in a system that is Accountant driven (pay as little as you can if you can get away with it), most of us at my age are still working in the industry because we enjoy the work and or the people!! That however means that we have been exploited, but we certainly won't encourage youngsters to be treated like ourselves. If I was 10 years younger I would have been long gone we have now slipped behind Bus and Underground train drivers in the pay steaks. Who wants the stress involved in being a design engineer any longer?

Best Regards.
Allan, UK

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I have just now read your e-mail and I wish to thank you for divulging the international statistics you have gathered on this topic and your incisive assessment of the possible causes of the shortage of engineers and engineering technicians.

Obviously I concur with your stating that mathematics [then physics] is essential for becoming an engineer as in this profession it is vital to be committed to the simple fact that 'two and two is always four'.

Without grasping this basic notion, one is bound to fail as an engineer, but of course one would be well suited for alternative professions such lawyers, or politicians, or insurance assessors, or managers of the kind I have met, for whom two and two can be anything in the continuum that exists between -/+ infinity, including, occasionally, four.

I think that you may be interested in reading the following past statistics that an old colleague of mine sent me yesterday. It is surprising that the "density" of lawyers was comparatively high. I am wondering whether the low 'density' of engineers had anything to do with the fact that Kiwis have innate practical skills and proverbial ingenuity that makes them engineers at heart: wire Nr 8 culture.

From NZ Business Nov 1991, the number of accountants, engineers and lawyers per 10,000 working population:

Accountants: Aus 112, NZ 97, Canada 71, UK 54, W.Germany 54, USA 32, Sweden 25, France 10.7, Japan 1.9. S. Korea 1.4

Engineers: Sweden 315, Japan 228, France 184, W.Germany 180, USA 153, UK 114, Canada 107, Australia 108, NZ 50.
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Lawyers: USA 63, NZ 39, Australia 35, Canada 33, UK 32, Sweden 24, W.Germany 21, France 2.3, Japan 1.6, S. Korea 1.3

Giuseppe (Jo) Grilli

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Why would any man encourage his kids into engineering when some of the best qualified of them will be driving cabs once they turn 50? That has been the experience of a great many of my contemporaries. Angry at the sheer waste of talent in this stupid country run by accountants and personnel consultants who reckon twenty years' experience and a degree with the ink still dripping wet are the same thing? You bet your life I'm angry!

All the retraining that is done is a total waste of an engineer's time. What he needs to do is to go out and get himself a second degree in accounting to stay employed, be better paid and be a total drain on society instead of always having to fight idiots to get the most fundamental truths understood.

Paul Keating predicted we'd become the poor white trash of Asia, then a succession of economists who think that balancing trade simply means digging up more scarce resources have set us on the road to destruction.

You asked the rhetorical question, "Where have they gone?" simple mate, we haven't paid them enough to keep people interested in engineering as a profession. The few that have been trained have been shown the error of their ways and requalified or gone overseas. While we continue to train engineers on an academic model we deprive the best and most practical of the opportunity of entry into a profession that SHOULD start with a trade qualification not a year twelve score that won't let them do law!

Most of the folks who know me know where I stand on the destruction of engineering as a profession and the part played by parasitic lifeforms whose sole desire it would appear to me is to be the last to drop off the dying carcass of this once proud and terrific land.

We need to appreciate the talents of our young but we also need to appreciate the value of experience. Keep smiling mate, I'm not entirely bitter and twisted. I trained as an engineer, we hate to see such obvious waste!

Ross Gardiner, Australia

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As you and others correctly observe in the 'Developed World' the numbers are declining – Why?

TV in these countries are full of Soap Operas, soccer (UK) and Pop Music so with such a powerful medium controlling the minds of the young what else can you expect?

Get engineers on TV? Why not an 'X' factor type program for young aspiring engineers?? Who would write the scripts? As most TV writers are what I call 'Arty-Farty' types and and haven't a clue about technical matters, they only write about what they know about – The 'Stage' TV' and the entertainment 'Industry' in general.

This is an interesting quote (not mine by the way):
"Somewhere deep in the British Psyche
There is the firm belief that somehow Inky Fingers are superior to Oily Hands
and that the Academic is superior to the Technical."

Regards
Leighton Northover, UK

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You might be interested to know that Engineers Australia published a report on this subject last year. It made similar conclusions to the British one.

Also in regard to engineers who are non WASP. We have always had a good number of engineers with Arabic and Asian backgrounds. As for female engineers we have two working with us right now and there re quite a number throughout the organisation.

Engineers Australia used have a programme of getting engineers into schools to talk about engineering. It requires younger engineers to be involved as the kids will relate more to a younger person than an "old fogey" like me. However us old fogeys can give our support to the younger engineers perhaps in setting up experiments etc for them.

Eric Goddard, Australia
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Roadshow through the Outback

Posted: 14 September 2006

The great Australian Outback takes on new meaning when actually being there for a few days. Such a vast area in the centre of Australia with absolutely nothing ! From the 4th September to the 8th September we wandered through Roxby Downs, Whyalla, Port Augusta and Mt Gambier running a Roadshow presenting short training courses and partnering some of the industrial automation companies exhibiting products. The distances between the various centres did require some patience in travelling. Sitting on a bus for 4 hours grinding down from Roxby Downs to Whyalla did present some challenges but the ribald exchanges between everyone did liven things up. And then getting to bed at midnight on arrival and then rousing oneself at 6 the next morning to set up the stands was quite challenging.

The great thing about going to the country towns is the enthusiastic response we received from everyone. Compared to their somewhat more jaundiced city cousins. We had over 200 participants from the various towns who attended the Roadshow – an outstanding number.

A few pictures of the roadshow...

A typical scene from setting up in each city.

The IDC exhibition stand.

The hall at Roxby Downs once all the stands had been removed.

The intrepid truck transporting all our stuff through South Australia.

A side view of the typical layout of the exhibition with the training area.

Our pilot on the regional airline (REX) seeing us off the plane.

Another view of the exhibition.

The Great Move

Posted: 14 September 2006

Well; the great move to our new home up the road was (sort of) completed yesterday. To 1031 Wellington Street. Things had got untenable at our older offices with everyone sitting on top of each other or sharing desks and computers over the day. Hopelessly painful.

Thanks to young Miss Sumi MacNaughton for engineering the move with such panache. Lots of stress and sore backs but everyone jumped in with great enthusiasm.

Some pictures of the team at work grinding their way through the move.

The new premises

Chantelle packing the forty thousandth box with philosophical detachment.

The 'library' dumped in the corner of the office.

Sharne, Alli and Gayl exchanging a few ribald words...

Rosie at the edge of the precipice fielding the telephone problems with incredible verve.

Edwina contemplating the rapidly emptying old office.

A sad remainder of our old offices...nothing much left...

Fingertip Engineering Knowledge

Posted: 18 September 2006

I watch my 12 year old daughter with some bemusement when she expertly uses Google to search for information for her school projects. She is reluctant to use my favourite source of information – books from the local library. There is a massive paradigm shift that is occurring at present where people are using search engines such as Google, Yahoo and Microsoft to secure the knowledge, information and data they require by simply typing a request into a search engine. This is called fingertip knowledge.

Elliot Masie, a learning futurist, indicated his astonishment this year after presenting to a group of 200 learning professionals. He asked them a simple question: 'If tomorrow you needed to learn something new, what would be your first step?' He expected a range of typical responses including books, e-learning, classroom-based learning and asking a colleague. But more than 90% of those present indicated that they would simply do a Google search. This is a profound change.

Engineers and other technical professionals want information immediately - available at their fingertips. Most organisations do have information available, but most storage systems are hierarchical menu-based systems that require one to memorise key navigational paths or key steps. What makes search engines such as Google so incredibly powerful is their simplicity and ease of access. Whether at home, in an office or traveling through an airport, access to Google is easy. Furthermore, when searching, the engine facilitates even fairly loosely defined strings and some misspellings - there is a lot of 'forgiveness, including typos and formats' (Masie, 2006).

Fingertip knowledge is also now diversifying. Knowledge is being secured using devices such as mobile phones and PDAs.

What does all this mean for us as engineering professionals?

1. You need to learn the rules and tricks for searching to understand how you can effectively get information. For example, using quotations around key words will allow you to search for a fixed combination of terms. In Google, have a look at the advanced search facilities. These allow you to exclude words and do other nifty searches.

2. You have to learn the tips and tricks to identify good information from bad such as articles which are well written and are from reputable sources such as universities and companies with good track records.

3. Ensure that that this ability to search quickly and effectively is available to you wherever you are. For work efficiency, the use of PDAs and quick access to notebook computers, whilst on site or travelling, is becoming essential for the busy engineering professional.

4. You need to work out mechanisms to make your engineering knowledge within an organisation easily accessible by your colleagues. For example, tags containing information such as the author, the key words describing the document and perhaps an expiry date (after which the information is no longer usable) should be created. This would allow any one else in the organisation to search for the stored information using a Google type search.

In conclusion, Elliot Masie (2006) makes the point that '…we need to start to develop the ability to be very good at Fingertip Knowledge: both very good at finding resources and

also very good at the critical thinking that goes to figure out: are they true, are they relevant, are they biased or unbiased?'

Feedback

Re your recent newsletter on using Google to search for information :

1) In some respects I have noted that there is less good reliable technical information available for free on the internet than there was about 5 years ago. I think many organisations have realised that information which they have authored and which has a commercial value was being posted for free by various people and these organisations have now prevented this free posting.

2) In-house searching for information can be done easily using search engines that index the business file servers. Keywords and careful structuring of folder names are then less important in the search process. The free version of Google Desktop will search a single PC. The free version of Copernic which also search mapped network drives. However there are security issues to be watched when using these.

Richard Beneke

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I agree with Richard Beneke's view. Whilst I use search engine (as do my children) almost without thinking, it also seems that 'free' information is becoming harder to find. Also associated with "free information, is the idea of philanthropy. When I started using computers (this will date me, Microbee, Commodore 64, etc.), information and code were very freely available. Indeed it was a matter of pride to publish your ideas. Now, however, the idea of posting it for no financial gain, but for the pleasure of saying "I did this, and it worked", seems to be a thing of the past.

I see information availablity in the future becoming a subscription service.

Trevor Prendergast, Australia

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I think both this and last newsletter are very relevant as the world is becoming more 'Instant' oriented. I recently taught a group of young people and found it very frustrating. all they wanted was "What do I have to memorise to get the diploma? Don't try to help me understand the area of expertise. I do not want to be able to use it, I just want it done."

I agree our teachers and parents are too statistics oriented. Maybe we should spend a bit more time explaining things and how they work. AND make puzzling things out fun.

Pieter Rossouw

Have we forgotten the most important asset of our businesses ?

Posted: 25 September 2006

Once a team of accountants runs their ruler over your business, you can bet your bottom dollar that first they will be looking at the assets in terms of plant and equipment and stock in the warehouse. Second, they will then look at the intangibles such as software, trademarks and goodwill. There will be scant consideration paid to people – those 'strange entities' not on the balance sheet. Or if they are on the balance sheet, it will be in terms of liabilities such as pensions, health costs and medical costs. As for assigning a value to engineers and other technical professionals. Well…

I watch with bitter amusement (and chagrin) how the share price of a company soars when a large number of employees are sacked. Whenever new management takes over, it is always a winning formula to downsize. There are trickier (and longer term solutions) in improving value in the business such as creating new state of the art products, changing the product mix, putting money into R&D to look for new products and looking for product synergies but the winner is invariably downsizing, for that quick fix. There is no doubt that companies and management are under pressure everywhere to improve their return on assets. And with the continued pressure from lower cost countries on wages in the so called first world countries, the temptation is always to take the low road and cut staffing costs. Interestingly enough, while most managers constantly remark that people are their finest asset most often it is simply corporate hypocrisy. The CEO earns many multiples of the training budget, engineers and other technical professionals are dumped whenever there is a down turn in a particular business division.

Admittedly, there is an unforgiveable amount of wastage in any business with technical personnel slumped (my favourite word) in front of their computers performing meaningless designs, for example. But then that is the topic of a future comment.

Peter Drucker, one of the founders of modern management theory, and who died recently referred to 'knowledge workers' as being the real name for employees. He felt strongly that people should be treated as assets, not simply as costs and liabilities to be eliminated. The world's greatest investor, Warren Buffet, noted on May 6th at his company's annual meeting, that: 'I can make a whole lot more money skillfully managing intangible assets (such as people) than managing tangible assets'. He indicated he has been doing this for over 30 years and obviously the results speak for themselves. He is the second wealthiest man (although he has recently given away most of his wealth to charity). Dr Baruch Lev of New York University has also recently calculated that the overwhelming proportion of value is being created by investments in intangible assets (people and intellectual property), not by bricks and mortar type assets.

I am not suggesting for one moment that one should pussyfoot around our engineers and technicians and not measure and drive them to greater success or tolerate incompetence or disinterest. But what I am suggesting is that when these issues arise, they are often due to the defective management or culture of the firm.

But rather than human capital, as the HR people call it, I would like to refer to it as engineering capital and use this to refer to our engineers, technicians and other technical professionals in the firm. Firms are after smart, self motivated, self managing business oriented engineers and technicians professionals today.

So how does one create value in a typical firm with engineering capital ? According to Jim Pinto, Michael Golden and Michael Echols (2006) there are a few important suggestions to improve on engineering capital:

- Engineers and technical professionals are dynamic assets that appreciate in value in contrast to other assets which depreciate. Invest in them in terms of training and the interesting work that you give them to enhance their skills. Provide mentors and assistance to increase their skills.
- Encourage and recognise new ideas and creativity that come from the youngest, freshest minds in the firm.
- Ownership of technical professionals cannot be transferred so loyalty to a firm has to be earned. This is done by managing them fairly and not micromanaging. Make the work environment friendly and rewarding to increase the retention of your staff.
- Technical professionals should be treated as the highest level of asset – far more than land, cash and equipment and invested in.
- Company value can be dramatically enhanced by managing your human capital effectively. The best example is Google which is worth over a 100 billion dollars after only 8 years in operation. Built purely on human capital and eminently measurable in terms of the stock price and morale of the technical professionals working there.

Dr Michael Echols (2006) notes that looking after our people in our firm is not merely an academic exercise. Up to 2019, the total pool of workers in the 25-44 year old gap will not grow at all in the US. In fact, in many countries in Europe (and indeed Australia), the total pool of workers will decline quite dramatically. The result of this shortfall in engineering capital is a threat to the firm's very existence. But if we seize this opportunity today to build up outstanding engineering capital in our firms, we will gain an enormous competitive advantage tomorrow.

Feedback

My sentiments exactly but don't worry, just as water finds its own level, you will see that things will change, as reality starts to bite (I just hope I live long enough to see it!) as the real worth of the wealth producers emerges.

Keep the faith and keep putting your message out.

Terry, Australia

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Nice comments about management. Unfortunately, the bitter pill we have to swallow here is that, without these bumbling managerial/accounting infidels (who can't manage people) you have referred to, most engineers would be out of work. Think about it. Just for the record, I am a professional engineer myself.

From Gary Danks, Australia

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It is most uncommon that I reply to a newsletter. Yet your editorial deserves and needs to be commended. It is absolutely to the point. I have been in engineering

(T&M, Wireless) for on twenty years, 16 with HP and Agilent Technologies. I have worked around a large part of the world, particularly in training and consulting. Bar some notable exceptions (HP T&M up until the mid 1990s), my experience supports what you write. Since July 2003 I am building up a knowledge services company based on exactly what you describe: The immense need to further engineering people for the value they provide to a firm. I firmly believe that this is the time that 'developed country firms' need to wake up to that need.

My take is that those who measure assets are incapable of defining a usable quantitative measure of value for intangible assets such as knowledge, skills and abilities. As a consequence, it is not measured. And if it is not measured, it is not of value - at least in financial terms. It is left to the line managers and engineers, yet who at the same time are not provided the ability to invest in those assets. Enter Joseph Heller's *Catch 22*... Knowledge and ability are in my experience the most neglected assets of a company. It's really back to front: Knowledge, skills and abilities are most, if not the most valuable assets. It's the system that measures asset-value that is deficient.

Ralph P. Becker

Excellence in Australian engineering

Posted: 27 September 2006

I was intrigued by our logistics manager, Rosemary's, pride and joy - Cedric - a 54 year old FJ Holden designed, crafted and built in Melbourne. Beautiful engineering of a car built to last; unlike some of the rubbish loitering around on the road today.

Why our engineering education system is broken and what to do about it

Posted: 2 October 2006

We employ an eclectic mixture of experienced engineers, graduate engineers and engineering students both on permanent staff and on contract at IDC Technologies. We run many courses every day throughout the world; so I am privileged to have the opportunity to talk to the experienced old salts and the young enthusiastic engineering graduates itching to conquer the world.

But what infuriates me is the redundant content these young engineering students are being taught at college or university. They are still learning how to program an obsolete microchip, how to program in languages no longer used and arcane mathematical concepts which will never be used in industry, among other things.

We are all aware of the throw-away line about 90% of the material taught at engineering school being absolutely irrelevant to our jobs. So why do we continue to teach this stuff ? I clearly remember learning lots of interesting theory at university engineering school – from esoteric mathematics (remember Cauchy Integrals ?), to calculating the damping of the needle movement of a galvanometer. I must confess that I did sneakingly enjoy the mental gymnastics that went with the learning, but sadly, most of it was irrelevant to my later work. We are told repeatedly that the knowledge gained is not the main issue; the reason for it all is to teach us to think. Hmmmm…

The other challenge that we face is that the material we do learn at engineering school, which is useful in industry, has a very short shelf life. I remember learning BASIC programming. I was quite taken by it and applied it quite successfully, writing some interesting mining programs which generated real results. But today of course, BASIC has largely been replaced by C++ and C# programming languages.

The result of this is that we have ended up with engineering graduates who have spent at least four years at college and have virtually no skills which can be immediately applied in the workplace. Essentially they have to be (re)trained at enormous cost and frustration to the employer. I would hazard a guess that for most of them, if they had been plucked straight out of high school having graduated and given a proper engineering cadetship at the firm; they would be in considerably better ‘nick’ to function as engineers after only 2 years.

The other challenge probably is a fault of the schooling system rather than the universities and colleges is that we have many engineers who are virtually illiterate – they can’t write, read properly or indeed do a decent presentation to a group of their colleagues. As far as I am concerned this is one of the most important skills for an engineer. Technical skills wane over time but sound communication skills are difficult to pick up beyond high school.

A couple of years ago we successfully presented numerous courses at an undergraduate engineering level. Over the 4 years we received tremendous reviews and provided a great practical learning experience for the students. We brought real equipment into the engineering school and had real industry practitioners teaching real engineering. But eventually the professor of engineering had to terminate our program on instrumentation and industrial data communications – real nuts and bolts stuff. He sadly confided that this was due to a problem with university funding (they had too many lecturers). They replaced us with a course on instrumentation engineering with virtually no instruments presented by a lecturer who had never worked with

instruments in industry. I notice with grim interest that a year or so after this, this professor left the university as well.

I don't appreciate people who rant about issues (as I appear to be doing here) without proffering a constructive solution. So here is my take on the situation in terms of solutions:

1. We need to go to the high schools and promote what good engineering education is about. According to ASEE Prism (2002) Massachusetts fired the shot heard round the engineering world in 2001 when it became the first state in the USA to require engineering instruction in every grade of its public schools. It was the first time that a new discipline had been introduced into the state curriculum in 100 years.

2. We need to significantly upgrade the pay and conditions of university and college instructors so that we attract the finest but with significant industry experience. The pay and conditions have to be comparable to private industry. Academics should be actively encouraged to supplement their pay by working in industry to keep their hands in and to relieve the stress on the public purse.

Don't get me wrong, however, there are some outstanding lecturers and college teachers. They are absolutely dedicated and driven to do the best for their students and put in enormous hours with tiny rewards. They often do have superb industry experience and credibility and they turn out outstanding graduates. Despite being regularly kicked in the guts in terms of financial cut backs, I am constantly amazed by the passion and enthusiasm shown by these instructors.

The challenge we face is that there are a large number of academics who have no industry experience and are not interested or able to teach current engineering practice. They have never worked in industry and most never will. So what are they teaching our young people? The community colleges have similar challenges. Perhaps here it is at its worst as the underpayment of these employees is greatest.

3. We need to measure and market or advertise to the world, the good university and college engineering departments – those that are teaching outstanding engineering with instructors who have real passion and commitment. This recognition should result in even greater rewards. We need to ensure that the colleges and universities with poor records have assistance to raise their levels.

4. We need to drive the engineering education process to be more entrepreneurial and business oriented and to focus on the real jobs out there. Teach our young people to be business oriented and to communicate in outstanding ways. They need to be taught to be flexible in what they expect from industry when they graduate. As Mark Davis (AFR Sept. 2006) remarks – 'manufacturers need to focus on high valued added services such as research, design, product development or marketing and distribution in this country while producing the goods themselves at factories in Asia'. The days of an engineering graduate starting work for a good old manufacturing firm and staying put just ain't gonna happen. It may be manufacturing today; but it may change to design and product development tomorrow.

5. Experienced engineers from industry need to volunteer to present courses at these colleges and universities on real engineering topics. There is a desperate need to provide real engineering practice to students at university.

6. We need to grab engineering students and offer them vacation employment in meaningful and relevant occupations. Even when they are studying at college they

should be apprenticed to a firm doing part time work and enhancing their pay and accumulating real experience. Students will learn early on whether or not they have chosen the right career. Furthermore the good students will come back and work for you and be outstanding company assets.

7. We need to teach our engineering students to think and to search effectively for knowledge. They need to treat knowledge as another commodity; to locate it (via Google, for example), test it for quality and truth, apply it, and then store it so that it is easily accessible to them and their colleagues.

8. Finally, we need to teach students that learning is a life long pursuit. Skills gained today only have a short life of a few years, they then need to look for the next wave and jump onto this.

Just my ha'penny worth today !

Feedback

Interesting article, I must agree with most of your points, and found that the most Important skill I applied in the first few years of my career was just common sense - with a basic knowledge of science and the physical world.

I would like to see a good definition of what a engineer is and what skills he or she should have; I have not come across this as yet.

Ray, Australia

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A privately run course will live or die on both the quality of delivery and the result, i.e. perceived value of the material by the recipient/paying client.

How many University lecturers, or courses for that matter, are judged by these criteria?

I would compare the delivery style of people like Lee Ritchey or John Howard (EMC and High speed design), i.e. specialist Industry trainers/consultants, with that of more than one or ten lecturers at tertiary institutions where the latter gave the impression that they were doing all they could to merely tolerate the presence of students. The difference is incalculable, as are the outcomes.

Difficult theory, for theories sake, achieves little if it isn't connected to reality at some point. Reviewing a DSP subject which one of my employees was undertaking was an exercise in sadness. He was passing the gradings on the material but had little idea of how he could do anything useful with it. This indicated to me that the whole point of the course was missing. This is in direct contrast to most paid Industry education which I have undertaken, I always find a good portion of "take home tools" which I can directly apply at a later date.

Time is far too scarce to participate in programmes that are little more than a series of hoops, I require real and actual value in information provided. Basics must be taught and grasped, but they must also be connected to application. Knowledge must be both pertinent and current. To take money for delivering anything less is to perpetrate a fraud on the client.

Bravo Steve!

I have spent the last 20 years in and out of engineering education and one thing has been consistent. The subject matter has always been woefully out of date, lots of dry
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abstract maths that I rarely, if ever, actually use and little in the way of practical take-away skills.

I recently signed up for a Masters course with a regional university and was appalled when the microprocessor subject was to be based around a Motorola 6800 era chip and the bus de jour was the S100. Put a tear in my eye reminiscing about the 1970s when my hair was longer and 1K was a lot of memory but this was a 2006 University subject which was to cost a lot of money and worse consume a lot of valuable time. Masters aspirations and CPEng on hold.

I would hate to have to get and job based only on the skills acquired during the tertiary education phases.

I greatly value life-long learning, and spend a lot of time and money pursuing it with Industry specific courses, but I object most strongly to people taking my money under false pretences, and worse, wasting my time. I often ponder the vast difference in value gained from Industry training when compared to University based training, even after taking into account the fact that the university training is by necessity more generic.

There's no dirty secret, it just costs a lot of money. Reverting to ridiculously high levels of Uni fees just creates a new educated elite, little value to Australian society. Less poncing about waving vote buying tax handouts and more Government spending on the things that the taxes are supposed to pay for in the first place like health and education would be a great start. That is, unless the best our kids can hope for in the future is waiting tables for rich Overseas Industrialists.

I have mentored a BEng Elec student for the last few years and was appalled at his lack of basic communication skills, thanks to the school education system. This would be even more surprising coming from me as I don't rate my own skills in this area particularly highly to begin with...

Something most certainly needs to be done, heck even the SE Asian kids apparently don't want to come here any more due to the poor quality of the Degrees offered. Now the overseas students are coming from NW Africa. That says a bit.

Don, Australia

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I'm an engineer with more than ten years in the field, you could add to your list that young engineers tend to climb the management ladder too quickly (to their own detriment). These engineers know all the correct terminology. But lack the 'feel' for what they are talking about. Some decisions they make cost companies huge bucks (salespeople love these type of managers/engineers).

Keep up the good job!

Ben Mabelane, South Africa

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I agree with much of what you say but believe change to the engineering degree framework is more complex.

As an experienced engineer you will no doubt agree that much of our work requires the application of funadamental theory to sometimes unique circumstances. The engineering degree is designed to challenge students to apply high complexity theory to problem solving.

Producing productive engineers at graduation will require a high degree of specialisation and a narrow focus, will rob graduates of their adaptability, would make an engineering degree economically impractical, and will turn an engineering degree in to a technical college course rather than an academic qualification. There are many possible career paths in each engineering discipline including field, project, design and research engineering. Often these careers also proceed in to management roles. Perhaps it is best to allow graduates to specialise later in their careers as required of their role or ambition.

While I agree much of the learning in my degree has not been directly applied in my work, it did provide me with a broad understanding of many fundamental concepts. I hope any change to our education system incorporates due consideration to the amount of time available in primary, secondary and tertiary education and does not attempt to produce highly specialised immediately productive graduates. I suspect it should be the responsibility of specialised industries to provide and finance the training required for specialised engineers.

Regards
Owen Lofthouse

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You certainly are raising some important issues.

As one who is about to become a retired old salt (but working part time) I can spend some time responding.

The content of engineering degree course will always be a bit contentious. In my case my original qualification was an HND plus College Diploma which at the time gave me membership of the IEE and was accepted by IEAust as well. For the normal basic engineering we do I think the Diploma would have been OK. In the UK at that time HND and HNC were acceptable for people appointed as engineers. The HND course was very practically based (we had all sorts of motors and engines to test) and I would agree with you that we need more of that in the university courses. To provide these facilities at every university would be quite costly and they are now often just simulations on a computer with no hands on at all. With the rivalries been universities they all want to have there own departments and we end up with unnecessary duplication. I have often thought that we should have degrees that can be made up from a range of subjects gained from different universities in the same city which specialise in them. This would allow funds at each university to be concentrated on the area they specialise in instead of being spread over a wider range of areas. However I suppose the current economic rationalism that supports competition would say that each university should be able to do what it can in the market. The university with the better reputation would then be the one that students would try to get into.

In some of the more specialised areas of engineering it is necessary to have a good working knowledge of the theory involved i.e. in Power Engineering Load Flow/Transient Stability/State Estimation/Contingency Analysis and Selection. There are limitations when these theories are implemented in computer applications and it is essential to be aware of them to avoid making erroneous conclusions from study results. If we do not teach these theories then we are automatically limiting the graduates opportunities. Of course the graduates could take specialist post graduate studies (I subsequently did an MEngSc degree and at least one of the units was of benefit to me as my career developed) but how can they make the choice if they have no knowledge to start with.

Some years ago I was involved with a group of engineers from a committee of a
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number of the major engineering institutions in trying to tackle this problem. We brought in people from industry to talk with the staff at the university engineering departments. We met with mixed success. I do recall that one of industry reps seemed to be wanting to get fully experienced engineers out of university and your words about the cost to industry seem to echo his. If what you are saying is true then what is needed id for industry to specify what is required. This can then be assessed and the appropriate level of courses established. Perhaps we do not need more engineers but need more engineering officers! We need to look at what task we are assigning to engineers and ask ourselves if these tasks could be just as effectively be done by someone with a diploma rather than a degree. The diploma courses would include the more practical aspects of engineering (i.e. protection settings and calculations and load flow for power engineering). At the end of the day though nothing can substitute for experience gained on the job.

The other issue is that engineers transpire to move into management at some stage and the engineering stuff is not going to help much in managing people.

Eric Goddard, Australia

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Your recent posting regarding the flaws with our engineering education system is spot-on with my own views. After matriculating I was fortunate to be taken in by an engineering company as an apprentice draughtsman (1962) and spent my first year in the workshop which later proved to be invaluable with the experience gained. After my 4th year I was sent to university by this company and obtained my degree 2 years later. It was an eye opener to meet with 3rd and 4th year students to discover how little they knew in practise and how irrelevant or outdated the pumped-in information to them were.

Johan van Rooyen, South Africa

Steve Mackay's response to Johan

Good morning Johan

As far as tertiary studies for your son? Much as I detest the qualification system, unfortunately, it is only way to get some recognition for yourself. You were one of the clever ones who gained a considerable amount of practical experience before going to varsity and then really re applied yourself with greater vigour once you had finished. So you have a nice rounded background. Thanks so much for your interesting note and I hope we meet up some time.

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Some valid points - just be careful not to generalize too much. I'm grateful for all the math and physics and other courses I've had when I was a student - It gave me a broad background and a starting point when investigating a new problem. Maybe we should have done more maths at school? I don't know - a life without Shakespeare I could not think - " Friends, Romans, Countrymen - Lend me your ears". How can we else learn to communicate and to appreciate live? Man is not just a machine.

I think it is dependent on the type of industry you're working in. Working on the newest is not always what industry wants - they don't have money to waste on unproven equipment (that was the main concern of the mining firm I worked with and criteria - they are still in business and their share price is climbing).

Looking at the defence industry - here systems are build needing to last up to 20 years. Logistic requirements thus forced them to look closely at items such as second sourcing, etc. Often the case is that some of the new is also some of the first

to be off the market. Look at the trusted 2N2222 transistor.

Your comment about BASIC - totally unfounded and unfair - I use BASIC, C++, Spreadsheet, MATLAB to name a few - depending on the task at hand.

Thanks for your thought provoking mails.

Pieter Swanevelder

Woz - What an inspirational engineer

Posted: 8 October 2006

Admittedly, Steve Wozniak ('Woz' to his buddies) of Apple fame is somewhat of an eclectic engineer and definitely not everyone's cup of tea. Many engineering professionals would be decidedly twitchy to class Woz as 'one of us'. My musings today are on why Woz should be considered inspirational to us – whether you are an engineer, technician or a member of Joe Public.

This was all composed on a glorious spring day on one of Perth's finest beaches with the sun setting in a massive red ball as a great cricket game with the kids concluded. What a great way to start the week.

Most of you would have heard about Steve Wozniak of Apple fame, but here is a quick recap (thanks to Wikipedia.com). He dropped out of UCLA (but went back later to complete his engineering degree) and together with Steve Jobs sold their prized possessions (an HP calculator and a Volkswagen car) to raise $1000 to build their first prototype Apple computer in Jobs's bedroom (and later in the inevitable garage). Woz remarked on their enormous uncertainty at this point: 'We were in (Steve Jobs's) car and he said – and I can remember him saying this like it was yesterday, "Well, even if we lose our money, we'll have a company. For once in our lives, we'll have a company."'

Their computer was way ahead of its time in terms of simplicity and ease of use. Jobs and Wozniak sold their first 25 computers to a local dealer. Sales skyrocketed and in 1980, the Apple company went public. The next revision, the Apple II, had high-resolution graphics and sustained the company over the bumps with duds such as the Apple III and Lisa until the advent of the Macintosh which has done remarkably well for the company. Obviously now with the iPod, Apple is once again roaring ahead of the market with billions of dollars of sales attributed to this one product alone (admittedly, due mainly to Steve Jobs this time).

I believe Woz, this quirky human, being can act as a tremendous engineering inspiration especially to our younger set.

He:

- Is philanthropic – and pours money into education
- Is brilliantly technical with the design of the initial computers and other projects since
- Worked on engineering design whilst still a young sprog at home – well before university
- Thinks laterally ('foolishly' ?)

- Knows that the essence of good engineering design is ‘Simplicity and Usability’
- Persisted with design (and a number of failed products) before achieving success with the Macintosh
- Is a risk taker in terms of engineering design and business
- Is imaginative in terms of his design
- Focuses on people’s real needs not some techno-geeky requirements
- Is entrepreneurial - taking on many other ventures over the years

And (for what it is worth)

- Has made a helluva lot of money and has had a lot of fun; yet has strong feelings about ethics and morality. He noted in his book, ‘To us, Dylan's songs struck a moral chord. They kind of made you think about what was right and wrong in the world, and how you're going to live and be’.

He has just written an autobiography *Woz: From Computer Geek to Cult Icon: How I Invented the Personal Computer, Co-Founded Apple and Had Fun Doing It*. It is easy and enjoyable reading for everyone, including engineers and techies. A nice story. An engineering story. Worth using as an inspiration to our fellow citizens about who our leading engineers are.

Real time engineering collaboration

Posted: 22 October 2006

Last week, we had to urgently collaborate in writing a short article with two other engineers – all of us on different continents. This was the most unusual experience in writing and editing an article in real time. Inevitably, I was on the road. The lot of an engineer, eh?

The three of us needed to collaborate in writing the document so that the others could read through what I had written as I wrote it. Essentially 'looking over my shoulders'. I jumped into Google Documents which now has a free web based word processor (and spreadsheet). I gave the two other engineers sharing and editing rights and off we went. As I typed up, they chatted with me in the box to the right of the word processor and helped me with my writing. We managed to put together a shade under 1000 words in less than 45 minutes with three graphics inserted in as well. I must confess that I like to think carefully through what I am doing; so real time collaboration with other co-writers in real time doesn't fill me with much enthusiasm. But I can see it being very useful for working on something on the road when you can't rely on having your trusty notebook with you (and/or you want others to work on the document as well). For more information go to: http://docs.google.com

To get maximum value from this you need to be a google mail (gmail) user. It is a free service. But of course; nothing is really free is it ? You will be 'paying for it' via advertising on the google site or whatever.

Obviously if you have a large document (particularly with graphics), it may prove to be somewhat unwieldy to work over a slow internet connection. And of course, the formatting was inevitably lost when I hoisted some Word files in with tables. Ah – the joys of compatibility between the different vendors.

This simple example illustrates the increasing growth in web collaboration tools that are appearing on the market. From video conferencing software to sharing of files, planners (diaries) and databases no matter where you are. The stand alone word processor is becoming a thing of the past.

And as Ken Leebow, a well known author, remarks: '...whenever I have an idea or information to place in one of my books, I just go to the nearest computer and log in'.

PS As with you, I get a little tired with the increasing flow of newsletters and emails that try and sell me stuff surreptitiously within the supposedly professional message. Don't get me wrong. I do appreciate you reading my newsletters and we obviously do sell stuff; and lots of it – training and books. But we try and avoid any hard selling of products within my commentaries. We do follow up after the message with a clear list of where we are running training courses or a sale of our books, etc. But we try to ensure there is no confusion between the two. If you disagree with this; please let me know soonest. Thanks.

Giving it all away (or retirement from engineering)

Posted: 13 November 2006

'Retirement is a serious blow to one's self esteem and should be avoided', according to Peter Wilhelm (*The Financial Mail* 3 Nov 2006) and he makes some very valid points. Some of you may have contemplated retirement from engineering (as an engineer or technician) – whether this be in your thirties or sixties. Wilhelm lists a number of great reasons for retirement (and the sad reality in brackets):

- Being free of all workplace commitments and hassles (but in the non-work environment, no one cares any longer about who you worked for)
- Enjoying your favourite hobbies such as fishing (but now, because you have so much time, this becomes devalued)
- Spending more time with children and grandchildren (but besides watching the cartoon channel together there is a lot of babysitting available!)
- There will be money for luxuries (no – medical expenses and pet food will consume any spare cash)
- Travelling (definitely once in a while, but too much and the realities of travelling kick in - plane delays, cramped seating kilometres up in the air, and the yearning for familiar home haunts - to name but a few)
- Deepening your relationship with your partner (hopefully true; but instead of covering new ground your thinking becomes so attuned that you land up finishing each other's sentences)
- Nurturing friendships (well, not the working ones – they are too busy – and how do you meet new people?)
- Reading the books you always wanted to (but will you? 'Ulysses' or 'The Decline and Fall of the Roman Empire'? Probably not. To pass the time, something more lightweight, perhaps, such as JK Rowling)
- Making your intellectual legacy available to younger people (but they aren't interested in listening)

Admittedly Wilhelm seems somewhat cynical about life; but I believe the points he makes are important. The answer, therefore, is not to retire. Why even consider it? Reduce your "working" time and increase your 'leisure' time, if necessary. But most critically ensure that you do what you enjoy - and if you don't - change as soon as possible to something you are passionate about.

Remember, however, that you fought hard to gain skills in engineering and this know-how shouldn't be simply tossed away. If what you are doing in engineering is not satisfying, examine other related areas of engineering which would create enjoyment and passion for you. Don't write the whole profession off because of some bad experiences; challenging management or some horrible projects, for instance.

A number of our engineering instructors are well into their seventies. They are absolutely outstanding and do a brilliant job presenting courses. They appear to balance work and their personal time very well. We are told very quickly when their assignments are too burdensome and they often insist on taking their wives with them when they travel to more exotic spots. They also keep time aside for gardening, walking the dog and reading. These instructors are still absolutely passionate about engineering and ensure their areas of expertise are updated by extensive study and interaction with their peers.

Research has proven that Alzheimer's disease can be minimised (or eliminated) by treating the brain as yet another muscle and exercising it. Continuing to work also ensures a steady income; helps one maintain friendships and contacts; stimulates the intellect and

for the community it helps ease the deepening crisis with the overwhelming shortage of good technical professionals.

Wilhelm does say, though, that whatever your decision, remember these three qualities: humour, joie de vivre *("joy of life")* and a sense of proportion. And as Groucho Marx put it: "Outside of a dog, a book is a man's best friend; and inside a dog it's too dark to read."

Feedback

Great stuff! I could not agree more. I will be 70 next year and enjoy my engineering more than ever. I try to reduce my hours with a measure of success, depending on the demands on my time by my clients. I keep away from clients who tend to take you for granted. Keeping up with technology is usually demanding and time consuming: the brain does not retain as well as it used to. But a lot of engineering is plain common sense mixed with experience (and knowledge, of course). I enjoy your e-mailed "musings". Keep it up and thank you.

Marcel Dewerse

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Thank you for these insightful comments. They have reinforced my thinking with regards the 2nd half of the game.

Garry Clements

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I just thought I would take the liberty and privileged to comment on your take on Retired Engineers and Technicians.

Incidentally I serve on the Regional Committee and the Metal Chamber of the XXXXX. I have become a strong voice advocating the recruitment of Retired Artisans to play a role as mentors, Trainers of Apprentices. We have a valuable potential resources going to waste and if we don't harness this resource and utilise it to the maximum for the good of Industry and the country then we who are passionate about training are all going about our jobs with tunnel vision. If we do not make a firm stand and demand that the Setas and the DOL should investigate how best we can utilise this Knowledge, Experience and Expertise that is out there being wasted and a golden opportunity not taken with both hands and used for the good of Training and Education.

In the Apprentice system, Indentured apprentices are understudies to Qualified Artisans. The Artisans must mentor the apprentice and still cope with the pressures of production, not a very efficient system as it does not give the Apprentice the 100% attention of the Qualified Journeyman. Imagine if a retired craftsman was brought into the equation and all he had to do was concentrate all his energies on Training and Training only, we would most certainly lick the Dire Shortage of Artisans in the Engineering and Metal Industries. There is an abundance of Candidates with N2 to N6 Qualifications if we concentrated in recruiting these Candidates for apprenticeships and under the tutelage of Retired Craftsmen's. We will be in a position to Train them in 80 weeks instead of the 4 years it normally takes for an apprentice to Qualify in his or her chosen Trade.

In passing I just want to Quote from a movie I once saw it was called *Zorba the Greek*, with Anthony Quinn and Alan Bates. There was this dialogue about age, and Zorba says, 'They say that Age kills the fire inside of a man, and he sees death coming, and he says open the door and give me rest, that is a pack of lies, I have enough fight in me to devour the world so I will fight'.

Yes there is hundreds of retired persons out there with the fire still burning in them, a reservoir of talent going to waste, it is about time the relevant Setas put full page adverts calling for Retired Engineers. Technicians, Artisans to come forward with their credentials so that a data Base can be created so that we have a pool where we can draw from.

DN

Tethered to your desk and smothered by your work – whilst mobile

Posted: 4 December 2006

I know I am one of the major culprits here. I have an insatiable desire to keep up with everything happening in our engineering business. I am tethered to my mobile phone and email/web to ensure I keep in touch and track disasters and relatively good news alike. These can range from a training kit destined for Baku in Azerbaijan being lost in New York, to a course receiving outstanding reviews. My wife tends to turn a benign eye to these deviant work related activities of mine until I am found pondering a work related message which has popped onto my mobile phone at 2am one morning whilst on a camping trip with our children.

There is no doubt that the mobile connected office has enormous power for the engineering professional today. I am constantly amazed by the leverage obtained by both the notebook computer and mobile phone. An industrial automation engineer chuckled as he related just such a scenario last week. He interrupted his bike ride home from work, sat down on a park bench with his computer and mobile phone and conducted a conference with two colleagues in the UK and US and a client in SE Asia, to secure a sizeable engineering contract.

I have no doubt that if you want to succeed in the engineering world today; far more effort than a 40 hour work week is required. There are just too many things to do, sometimes at odd times during the day. One needs to be available to grab these opportunities.

A recent survey (thanks for sending this to me, Kevin Baker) conducted by CareerOne, indicated that 72% of respondents were working longer hours than 5 years ago. E-mail and mobile phones had dramatically increased their workload with 72% admitting that they checked their work related emails on weekends and holidays. Baby boomers were the worst – a stunning 90% admitted to checking emails after hours.

Whilst I am delighted with the additional work related information I receive when traveling and whilst at home, there is no doubt that employees need to extricate themselves from the mobile office in the interests of their sanity and health and to draw the line in the sand to demarcate their personal lives from their work related activities. In ‘my book’, the two priorities in my life are my personal health (I try to keep fit and feel both mentally and physically on top of my game) and my personal relationships (with my wife and two children). Work comes a distant third. One needs to take a definite and regular break from the office and focus on other interests which can be considerably enjoyable – a good book; a plunge in the surf, a glass of wine with dear friends and/or a life partner or perhaps even indulging in more exotic pastimes like sculpturing. I can recall numerous occasions when a long spell swimming at the beach and focusing on the great sun setting over the sea with my family helped me unravel a particularly thorny work related problem - my subconscious busy on my behalf.

As Stephen Covey says: ‘Most people struggle with life balance simply because they haven't paid the price to decide what is really important to them’.

2007

Safety - different countries/different standards or not?

Posted: 24 January 2007

Before I launch into another one of my musings (rants?) - **My very best wishes to you all for a great 2007 both in excellent engineering and naturally in your personal life**. I had a magnificent break trawling through the rapidly dwindling African wilderness with my family, albeit on the one occasion being chased by a large amorous ostrich.

One of my readers (perhaps, more cautious than me), sent me an irritable note blaming for encouraging a culture of neglecting safety when the Montreal bridge collapsed a few months ago, when I remarked that everyone should "Be foolish more often in engineering"(http://www.idc-online.com/blogs/?m=068#B5) – really encouraging innovation. I am quite obsessed by safety and believe we should put this at the top of our priorities as engineers and technical professionals in everything we do. I know some of the following will seem to be patronising to some of you - who have far more experience with safety than I have. It is not intended to be so.

I have often thought that dealing with safety issues is a cultural thing. I remember a plane being grounded in some Aussie Outback airfield despite one of the passengers, a highflying CEO, raging about how he needed to get back for an urgent meeting in Sydney. The flight mechanic was unmoved by the threats and ravings of the CEO. It wasn't leaving until he had replaced a part which he suspected had a problem and would compromise safety. In poorer countries, this resistance to power and money, may not be as easy to accomplish and the attention to safety may not be as rigorous as it should be.

Without trying to be at all nasty, when I climb on board some of these rather suspicious sounding airlines (quaintly named "Cheap Fly Now"), I get very twitchy about the safety culture. Esp. when I discover the dark stain in the aisle is actually sticky hydraulic fluid, as I noticed late last year. On the other hand, I used to believe that the culture of safety was quite strong in the western world but have come to realize that this is not necessarily the case. The commentary (from the official investigation) on the ghastly Columbia shuttle catastrophe is quite damning: 'NASA's habit of relaxing safety standards to meet financial and time constraints set the stage for the Feb. 1 loss of the space shuttle Columbia and its seven astronauts. They warned that the agency's "broken safety culture" would lead to tragedy again unless fundamental changes are made'. And later: 'Nobody in the NASA management chain ever asked any tough questions about the justification for these feel-good fantasies.The shocking flaw was just another of the most dangerous of **safety delusions** — that in the absence of contrary indicators, it is permissible to assume that a critical system is safe, even if it hasn't been proved so by rigorous testing'. Obviously this is DEFINITELY not the case.

I dread being held responsible as a professional engineer for a breach of safety where someone gets hurt or even worse - killed. So vigilance is required at all times even when you are under enormous work pressure to deliver results to some impossible deadline.

As Alan Shepherd, a famous astronaut said*:* 'It is a very sobering feeling to be up in space and realize that one's safety factor was determined by the lowest bidder on a government contract'.

As professionals, we need to avoid this situation happening at all costs.

Invest in your people before you lose 'em

Posted: 4 February 2007

Recently I received this note from one of my colleagues. I have deleted company names for this purpose.

'Last week the XYZ company made me a fantastic offer that will provide me with the opportunity to gain tremendous experience and receive a dramatic increase in my salary. I pretty much signed on the spot and joined up. Today my current company made me a counter offer of a 38% increase. However, I have decided to move on - I gave the XYZ company my word.'

Having since discussed this with him I have learnt that he felt that his current company had invested significantly in him with training and mentoring. But had given very little positive feedback on his successes in bringing in more business for the firm and they hadn't kept his salary on a par with the market. He had had to drive the relationship with little, or at most, irregular feedback. Furthermore, he had an increasing awareness that, considering his productivity and technical skill level, he was being underpaid.

I believe if you are not being treated 'right' by your boss or firm, it is important to communicate this to the powers that be, to ensure they know how you feel. Talk to them and explain why you believe you are being undervalued and assess the reactions carefully. Similarly if you manage people you value, look after them before it is too late. In today's highly competitive job market it is quite possible to lose productive and well-regarded employees. This is even a problem in China where there is a significant skills shortage in engineering talent despite the reported 500,000 engineers graduating every year. (But this is the subject of another rant).

Conversely, if you are an employee who is a little incompetent, or you dislike your career/job or are inappropriately employed, but are determined to stay put; don't rock the boat. This could result in unnecessary attention directed your way and a potentially awkward situation.

I don't believe a contented and motivated employee is simply such as a result of an adequate salary or a pay rise every now and again. It is more complex than this. It can involve things such as; a healthy, positive office environment, an employee's sense that he/she is capable of achieving designated ends, that important experience is being gained and that productivity is noticed and applauded and sometimes financially rewarded.

People can be significantly motivated by positive feedback when they succeed. These can include, on-going and relevant training and mentoring, regular opportunities to tackle interesting engineering jobs and some travel to other sites, where possible, to network with their peers. Just to mention a few.

As Patty Hansen observed: 'You create your opportunities by asking for them'.

As an engineering professional - what are you really worth?

Posted: 20 February 2007

"The grass is always greener on the other side of the fence" can really gnaw at you. How can you make sure that you're being paid what you're really worth? Essentially your remuneration is based on the contribution you make to the business you work in. Other factors that impact on pay include: education, formal and informal training, technical experience, size of the company, responsibility level and the part of the country or world that you work in, and finally simply – supply and demand.

Education

During the dot com era, many thought a university degree was increasingly irrelevant – especially in the IT area. There is no doubt, however, that a good degree from a good college is an essential ingredient. If you gain the ability to think logically, read and write competently and are able to commit to outstanding project management skills you will have a good future in the earnings stakes. Interestingly, though, an advanced degree, such as a doctorate, may be counterproductive and scare potential employers off. A niche job often has to be found to fit this level of education and this may be difficult.

Formal and not so formal training

Most firms appreciate their staff constantly sharpening their skills by attending (relevant and good) courses – formal training. On a more informal basis, however, learning from others in the firm is extremely beneficial and can result in some profound learning. Actively seeking out new know-how from experts and applying this new found knowledge vigorously to new projects is highly regarded. All of these are you investing in yourself and making yourself more valuable.

Experience

This is often the hardest to attain, but often the most valuable. Sadly, the technical part of experience ages very quickly. I would respectfully suggest, however, that the experience you acquire in management will only mature with use and make you even more valuable. Gaining experience overall is essential for job growth. Down the track this is often the one area that will make you stand out when being offered a job.

The part of the country/world that you work in

In Australia's booming resource sector and on some of the Middle East oil and gas locations, the salaries are astronomical. This is true, but in these environments your costs are higher and your life style can be quite challenging – certainly compared with suburbia in a 'nice western' country. So weigh this up carefully. It always fascinates me when I see Indian nationals returning to India and leaving secure US jobs behind for the call of family and perhaps culture.

Business focus

Most technical professionals focus on the issues that are near and dear to them which include engineering projects and detailed technical issues. When assessing projects for your firm, however, it is important to actively ensure that it is aligned with the business in which you are involved. This is a skill which will again enhance your 'value' in your company.

And finally – supply and demand

New trends sweep the job market and engineers with skills in these areas become very valuable. When PLCs arrived on the scene in the early seventies, any engineer who could program these beasts and manage an entire engineering project was highly sought after. Now electricians can do a lot of this basic programming. During the dot com boom naturally it was the engineers with a strong Java and database skills who were in great demand. So when you have a highly sought after skill you can charge a premium. But be careful - others are quick to jump onto the band wagon and this can eventually reduce your 'value'.

How do you gauge your worth?

The inevitable source of information on this are the job boards on the internet sites or employment columns. However user groups – of which there are a burgeoning number -on the internet, can be a great source of information. If all your engineering peers are on $90 per hour; you can bet your bottom dollar (so to speak) that this is the going rate and you had better do something about it.

Furthermore, many professional magazines publish regular salary surveys and prove interesting reading. The jobs that have large variances in salary are often difficult to interpret, but are nevertheless worth some thought.

To sum up

Overall, I believe having a job is akin to surfing. You can ride a really good wave for a while, but eventually when you hit the shore you have to paddle back and look for the new wave – a wave with different characteristics and twists and turns. So keep your skills broad and deep enough to ride out the changes in the technology that will undoubtedly sweep through your firm. Furthermore watch the state of the market to ensure you understand what is required.

I remember when I left engineering school there was a massive demand for electronics engineers, but then suddenly it was software engineers; and then for those working on the internet and so forth. Some engineering jobs do, however, seem to truck along well through all sorts of economic storms – such as those engineers working in the (perhaps) less exciting power engineering area.

The advice from the US president Theodore Roosevelt on jobs is certainly an interesting one (a reflection of the Yankee can-do philosophy perhaps?):

> Whenever you are asked if you can do a job, tell 'em, 'Certainly I can!' Then get busy and find out how to do it.

Thanks and acknowledgements to Patrick von Schlag for his input here.

Where on earth has the electronics (or indeed, plain old) hobbyist gone to ?

Posted: 8 March 2007

I remember clearly, when I was in my teens, experimenting with crystal radios and being quite excited with the first crackly reception of the local AM radio station. Or connecting my first telephone up between our shed and my bedroom (and spilling battery acid everywhere -- much to my mum's chagrin). Other moments of excitement were stirring all sorts of interesting chemicals over my Bunsen burner and looking with interest at the litmus paper turning red due to some strange, acidic mixture I had extracted from seaweed. I even managed to manufacture alcohol from a primitive sugar and yeast solution I had fermented. After the taste test I remember lighting it to observe the wavering blue flame. I recall peering through my primitive microscope at some strange, miniscule, swimming creatures from the pond water. And my first construction of a hot air balloon, with its burner roaring – was a momentary success. Then later on, I constructed my first computer, programming in Assembler. Many electronic hobbyists became computer hobbyists (or hackers as they are often referred to today) as a result of playing with these electronics kits/computers. (Just consider the number of magazines that have been dedicated to these hobbyists). Even before our teens, we were all doing some woodworking, bricklaying and metal working with our little toolkits. I am sure this helped spur us on to go to college and do engineering, where our theoretical knowledge was underpinned by all this practical know-how which we had built up as kids. Whichever engineering you chose, I believe my story is very similar to yours.

Today, I reckon we are down to a tenth of the number of enthusiasts we had in the seventies and early eighties. Most of the magazines have died. Very few kids today are interested in tinkering with soldering irons and electronic kits, dabbling in chemistry or woodwork. Now, after a brief flirtation with an electronics kit, my 9yo boy plays with his Sony Playstation and on the computer and doesn't have much interest in constructing new electronics devices.

Why have things changed?

A lot of the fun has gone out of the game of building things; the integrated circuits today are tiny – difficult to solder and a computer program can accomplish a lot of what one wants to achieve.

You can buy ready-made products, manufactured offshore, very cheaply.

The demand for immediate gratification is also proving a little stumbling block for the curious and creative child today. I believe the effort required to experiment, build or create – in an effort to attain an outcome – is considered by children, more often than not, too onerous and unnecessary.

Test equipment has progressed well beyond a cheap multimeter and 10MHz scope to a minimum of a complex logic analyzer and protocol analyzer. No 4-20mA current loops any longer, but a communications circuit which you can't simply look at with a voltmeter.

Technology today is so exciting and cheap. The simulation games played on Playstation are so realistic. Even TV has some attraction with Big Brother proving to be riveting with all the salacious detail of some lost soul's personal agonies. Cell phones and computers have become so much more appealing than our electronic kits. Although, I remember with such nostalgia and know that hearing my first scratchy AM station with a crystal radio was one of those tremendous 'Eureka' moments.

What does this all mean, and what of the future?

Now, before you mechanical types sigh and say "Nothing to do with me", it does impact on all of us whether we are civil/mechanical/chemical or electrical engineers and technicians.

I don't believe we need to exclaim despairingly that all is lost and consign this to the boulevard of broken engineering dreams, but instead should jump in boots and all and seize the nettle (to mix a number of metaphors) and promote these older approaches today. 'But why bother?' I hear you saying (somewhat, shrilly though).

Experiential learning, especially when we are young, is the best method of gaining good knowledge, inspiring an interest in a subject and making one competent in it. Nothing can beat this – a concept supported by research. For example, experimenting with an electronic circuit, making it work and then trying to understand what makes it tick is invaluable for cementing our knowledge and giving us an understanding in the physical 'universe' in which we work as technical professionals.

There is no doubt, though, that engineering is far more automated today and the throw away culture is very much with us. If your flowmeter in your plant doesn't work, you generally don't hesitate to get it replaced – not necessarily repaired. Does this leave us poorer as technical professionals and as a sustainable civilization? I believe so. We should be using more of the equipment we throw out or even passing it onto others who can use it. This does require a good practical knowledge of engineering, however, as distinct from someone who works on a software program or who has merely gained this knowledge during 4 year degree.

Our kids

Our kids are moving away from the engineering and science worlds - it is simply not exciting enough and perhaps they haven't been exposed to these worlds enough to be enticed. We need to constantly think of ways to make science and technology interesting and riveting.

There is a great program on Aussie TV entitled *The New Inventors* which my 9 year old boy loves. People of all ages construct nifty, practical solutions to pressing and irritating day to day problems and submit them for scrutiny. The ideas range from effectively locking a valve out on a plant for safety reasons, to automatically cleaning your house gutters, to energy saving devices to a clever way to ensure you 'wee' straight into the toilet bowl as a boy. We need more programs like this.

The schools should also take responsibility for creating science programs which make science real and intriguing.

We need to harness these incredible computer games that are hitting the streets, to ensure they include a more powerful technology and engineering bias – what about designing your own renewable energy system, online, to save the planet (similar to SimCity) or designing a program by connecting Lego blocks which can ultimately control your garden reticulation network or home burglar alarm.

We need to encourage our kids to work with the great, physical materials surrounding us. They could build wooden bridges, construct pumps to create simple, but beautiful fountains. Electronics kits are cheap. Encourage them to troubleshoot the garden reticulation to reduce water consumption. Get them to help us to install our first solar energy panels to reduce carbon dioxide consumption, or give them the job of installing it. The Do it Yourself (DIY) industry is flourishing. You can go down to your hardware store and source the most amazing products for your garden and home at ridiculously cheap

prices. And the kits plug together with minimal wastage of time - providing immediate gratification. And a physical result – not just a computer program with concepts that are merely virtual. Fundamentally, working with real physical materials is fun.

There is tremendous (professional) simulation software for electronic circuits today and it would be great to get our kids onto this by distributing a 'lite' version for kids. It doesn't matter if they don't quite understand all of it. But experimenting with it; and seeing the relevance to the real world would make it interesting and enjoyable.

As Anatole France remarked, oh so many years ago,

The whole art of teaching is only the art of awakening the natural curiosity of young minds for the purpose of satisfying it afterwards.

Thanks to Electronic Design magazine for an article in similar vein which triggered this outburst of mine.

Where have all our engineering leaders gone ?

Posted: 2 July 2007

Dear Colleagues

After a few week's gap in my musings, for which I apologise, I am firmly back on deck again. We have been developing a new software product for video conferencing which has drained me of every waking moment, and as you know with software products, budgets and time are rather flexible unless you actively intervene and drive them the right way.

Two things today. Firstly, my comments on the dearth of leadership in engineering and secondly, some interesting survey results from a pumps conference we ran this week.

Engineering leadership

I have noticed over the years that there is a distinct lack of enthusiasm by engineers and technicians to get involved in leadership in their organisations. Perhaps this is due to the reluctance to manage other skill sets such as marketing and finance where one feels somewhat insecure, and the irritation with being sucked into the 'politics and backstabbing' that often happens in larger firms. And perhaps, somewhat contradictory skills required in being a good engineer and leader – being a good engineer involves being good at and enjoying technical "detailed things". Leadership requires a different set of skills, as a leader does not have to have detailed knowledge but needs to know where to look to get know-how. Getting people together in a team and getting the best out of them is the hallmark of a good leader. And from a purely mercenary point of view, as Jim Pinto points out: '…you can enhance your job, your results – and your pay – by acquiring some leadership skills.' As Iaccocca (the legendary and sometimes controversial Chrysler CEO) remarked, there are nine main attributes of a good leader which you must possess to be successful. You must be:

- Curious – one has to listen, absorb and try and understand this "big old complicated" world and vigorously learn on a daily basis
- Creative – try something different and innovative all the time to improve your results. The definition of insanity is doing the same thing again and again and getting the same old boring results (and failures)
- Show character – having ethics and morality to follow your convictions and to say I'm wrong when necessary
- Be courageous – taking a position even when it will 'cost you votes' in your firm or with your friends and colleagues
- Have conviction and passion – 'fire in your belly' and genuine enthusiasm and joy with what you are doing
- Be charismatic – inspire others around you to trust you with their careers and time
- Be competent – a problem solver and hard headed. If your team doesn't come back to you with their problems, they have probably lost confidence in you, or don't care. Either way, it is not a good thing.
- Have common sense – ability to think logically in the context of the real world. But as a friend of mine pointed out: 'Common Sense is not so common around here'.

And as the inimitable Tom Peters pointed out: ‘Leaders don't create followers, they create more leaders.’

My heartfelt thanks to Jim Pinto, Automationworld, and Iacocca for their assistance with this write up.

Pumps Conference

I am always humbled by the enormous number of people that come along to our conferences and how they freely and enthusiastically share their information and know-how. This week we ran a very hands-on and interactive pumps conference in Perth, Australia and the response to an impromptu snap survey of pumping applications was very interesting. To download a copy of the survey, click on:

http://idc-online.com/newsletters/snapsurvey.pdf

Essentially, it is amazing to find out how many pumps failures there are and the lack of a systematic process of condition monitoring to minimize this issue. It will be interesting to compare these results with your plant.

Feedback

I feel compelled to respond to your email. I disagree with the statement made about leaders in engineering. I have sat through way too many lectures from baby boomers talking and talking about the lack of leadership and the lack of enthusiasm and the lack of this and the lack of that. Then go up and try to talk to one of these old farts and get ignored or treated like you were born yesterday. They like to talk about the ‘leadership’ topic but unless your over 50 can't see the light that some younger people actually have talent and need opportunities. Now more than ever their is a glass ceiling in companies that is blocking out more than just women. The real problem is change. Leadership is different today than it was when baby boomers were taught their initial skills. These newer leadership skills and styles are what most current leaders have problems with, they just fail to recognise.

I will now get down from my soap box.

I would really appreciate a response.

Allan

Steve’s response:

Dear Allan

I appreciate your very well thought out response. Really well put. I guess I am one of the baby boomers you are referring to! It would be worth quantifying what exactly are the changes to the modern leadership skills required today as you eloquently suggest. I do know that with Generation Y, there is a definite change in employees' attitudes. And since 10 to 20 years ago; the master servant relationship has also disappeared from the workplace. Well, if you want to survive as a company in the Western World, at least., your leadership skills have to change.

Your sentiments are definitely another way of looking at things.

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We were having a "leadership" conversation this morning. One fellow pointed out that when the boss was someone who had come up through the ranks and had gained the respect of his "followers" then you had a leader. Before someone can be called a leader - they must have followers.

I have crossed to the management side and back. I think others would say I have some of the nine attributes you presented (doesn't really matter what I think) and yet "a distinct lack of enthusiasm" is certainly a good way to characterize my aspirations for management. However that does not mean that technical people can't provide leadership. Twenty-five years ago one of the best leaders I ever worked for introduced me to term "Non Authority Leadership". Many senior technical people are very good at NAL. We have to be if we want the projects we build to work.

Thanks for your all your "musings".

Rob Bronson

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One of the reasons there are few new engineering leaders is because there is little reward to take the risks required. Current management styles reward leaders for cutting costs and shifting costs to overseas suppliers. With a cheap global supply of engineering and manufacturing, top level leaders see innovation as sending more work to cheaper places. The risks of creating similar savings in the industrial world are not viewed as worth the risk. Why save a dollar an item at home by re-engineering when you can save two or three dollars by simply sending it abroad?

This is why the true innovation tends to come from private companies on the mid to small size- a small profit is OK for most small company leaders, they tend to do the work for the challenge. However it seems their ultimate goal is to create some value, a hit product or similar and then sell out to a large conglomerate and pocket the "rewards".

These are my opinions not those of my company.

Henry
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The (erratically) mobile engineer

Posted: 16 July 2007

As I sit in our surfside beach shack contemplating the surfers riding yet another great wave in this stunningly beautiful but remote village in the SW corner of Australia, I've had a good chance to measure up being a mobile (working) engineer for a few days. But as my teenage daughter says so succinctly - it sucks. There are unreliable mobile telephone connections and no web access here (despite being on the best plan).

I recently purchased a ghastly and expensive state-of-the-art PDA (personal data assistant - mobile phone cum email cum PC) which I peck away at and which again is a toy and a parody of my old PC. Its memory is simply inadequate. Weren't they selling Gigabyte tiny memory sticks at the same store for a few dollars? This PDA hasn't got anywhere near this capacity. It has also been totally non-intuitive and has required a few days to be bruised into submission in order to work it - me not it!

Yes, Bob, my very clever engineering friend from New England did gleefully warn me that these 'critters' are worse than some mule crossed with an ugly coyote, and cussed that they are less productive. Furthermore, the support for the PDA from one of the top retailers was abysmal - and all I wanted to do was just hook into my dear old Google account. I was instructed to search the web to find a forum on how to set up the right port numbers. Que? I am not a rocket scientist and freely admit that I am not an IT guru. But surely when you sell a consumer item, it should be plug and play (not the clichéd plug and pray).

For the past ten years I have traveled the world with a Notebook PC and dial up connection which has worked reasonably well apart from the irritation at the bulkiness of the PC and the hassle of dial up in each location - which is sometimes non-existent (remember that flea-ridden inn in England), or barred (Middle East) or so tortuously slow (an old Russian republic). So when I heard that this great PDA operates in 99 countries around the world (including Europe AND North America) I thought at long last we have arrived at the next generation - mobile engineer II. Not to be.

I feel we are still at the very early stages with the technology and you still have to follow that great principle of Caveat Emptor. Buyer Beware. I do however know with absolute certainty that the next 2 to 3 years will bring us into a smoothly connected, easily effective and mobile world. Sadly, we still have some distance to go. Ah, well. I will have to resort to my quasi mobile life style and hoik Brutus (my venerable Compaq laptop) and dialup connection around for another few years.

Yours in engineering learning

Steve

PS Thanks to those of you who respond to these newsletters - I am truly humbled and grateful and respond to everyone and put a selection up on my blog site.

In the thrall of politicians

Posted: 8 August 2007

We ran a successful (based on numbers and responses at the end, so I hope I don't sound like a used car salesman here) conference on Hazardous Areas (Classifications and Equipment) this week. Very enjoyable meeting so many of my engineering peers who were so interactive, enthusiastic and knowledgeable. An enormous exchange of information done in the papers presented, the tea breaks and over a beer or two afterwards.

But one of the common gripes was still the despairing lack of true worldwide standards in this area; as opposed to the proliferation of standards at the local level (states within a country, in many cases). And one of the themes running through the conference was the slow progress in aligning the North American standards with the "rest of the world" especially in hazardous areas. There are a myriad of standards bodies operating in hazardous areas such as the IEC, ISA, CEN, CENELEC, ANSI, NFPA, NEMA, ASME, IICA (even the US Coastguard, I understand). I was amused by one of the speakers referring to CENELEC as (Committed European Nutcases Eventually Liable to Explode Completely). There is definitely an effort to move closer together but it is very slow. One would think with the importance of the area that there would be some interest in having complete international harmonization to protect life and limb. Perhaps some of the problems have arisen by Hazardous areas being in a mixed electrical/mechanical and chemical area each governed by their own standards bodies with local country jurisdiction.

There is no dispute that this is an important area to focus on with worldwide standardisation efforts to have one agreed set of standards. One only needs to think of the disasters such as Petrobras - the world's largest oil platform with ten killed; Piper Alpha; BP Texas and the recent explosion at the chemical plant outside London....and so forth. The picture is changing slowly with one of the behemoths of the world economy China going for the international standards approach (rather than the US specific ones) and this is helping drive the case for true internationalisation of standards (not only for hazardous areas). And with such a number of engineers of enormous goodwill internationally working hard to unify our standards. But they need more support from all of us to really reach international standardisation. We are all commonly united in wanting to protect human life and make our work and home environments safer. So why on earth do we have all these competing standards and interest groups? Besides being confusing, it gives the idea to the general public that we are a disorganised crew.

Two other comments from the conference which I found interesting:

Everyone was absolutely gobsmacked with how everyone made their know-how freely available. I know some of the guys charge thousands of dollars for their advice and they were happily giving detailed advice on difficult solutions at the various breaks and during their papers. Sharing their know-how, tips and tricks built up over years of hard-won experience working in the trenches. It is always so satisfying that the ethos of the true engineering professional is to share information and expertise freely and openly so that we can design a better product and contribute to a safer world. Bear in mind that there were a number of direct competitors in terms of skills and products and they were happily talking freely. No holds barred. Great to see this happening.

The other issue was the need for the younger generation in engineering to take up the reins of leadership in driving the new standards, papers and various engineering committees. There is a definite absence of contributions from the younger guys (the generation Y). Now I know a lot of this standard development work can be considered to be a waste of

time or tedious and with very little money changing hands for your labours in sitting on these committees. But it is critical to the business of engineering that we have current standards reflecting current practice and we need the younger engineering generation involved. At the risk of sounding mercenary, you will also eventually get valuable recognition eventually by contributing here.

So please focus on unifying standards by your support for an international approach and dare to present a paper at a conference and join an engineering committee. Even in a limited capacity. You will be surprised by how much a contribution you can make and how valuable your know-how is. Let's get out of the thrall of the politicians in each country and go for a truly international engineering approach. After all, we are professionals not politicians.

Yours in engineering learning

Steve Mackay

PS In my next newsletter; I have a really interesting discussion on how to put your engineering brain into overdrive and improve it as if it is normal body muscle. Seriously - I was so impressed by really believable research here.

Put your engineering brain into overdrive – with guaranteed improvements

Posted: 13 August 2007

Whilst inevitably slumped at some ghastly airport doing my penance, I always have time for two treats: buy a good book and savour a good coffee whilst reading it. Admittedly, I do treat the airport bookshops as a sort of public library, reading avidly before buying a book. And last week, I happened to come across something very interesting in the bookshop – a book guaranteeing to improve your brain power and founded on exercises, I used to do aeons ago in Primary School – those darned little mental arithmetic exercises first thing in the (often freezing) mornings, which I used to view with some trepidation. Presumably due to my engineering background, I have always been rather sceptical about developing one's brain and mind power over matter et al. But this is all scientifically proven to work – in many cases – guaranteed results within 3 weeks. As the Franklin Institute remarks: 'Your brain is a thinking organ that learns and grows by interacting with the world through perception and action. Mental stimulation improves brain function and actually protects against cognitive decline, as does physical exercise'.

As engineering and technical professionals we rely on our brains to perform –we get paid and rewarded for our mental engineering agility and memory. And as discussed some months ago, most of us will be working in engineering or related fields well into the sunsets of our lives, admittedly at a slower pace. So we have to treat our brain as yet another muscle and keep it fit, agile and growing in knowledge. Apparently the human brain is able to continually adapt and rewire itself. Even in old age, it can grow new neurons. Severe mental decline is usually caused by disease, whereas most age-related losses in memory or motor skills simply result from inactivity and a lack of mental exercise and stimulation. In other words, use it or lose it. As my rugby-mad cousin always says critically on a particularly challenging dash to the try line: You snooze, you lose.

In the Top 10 Ways To Improve Your Mental Fitness, Mark Stiblich has some quick suggestions which you can apply now, based on two basic principles to keep your brain healthy and sharp as you age: variety and curiosity. When anything you do becomes second nature, you need to make a change. I know this often feels like having a freezing cold shower (well, it does to me); but that is the nature of the beast. If you can do the crossword puzzle in your sleep, it's time for you to move on to a new challenge in order to get the best workout for your brain. His suggestions:

1. Play Games – tease and challenge your brain esp. with logic, word skills and maths. 15 mins a day makes massive improvements and you reap the rewards when you are 85 !

2. Meditation – For relaxation and giving your brain a workout.

3. Eat for Your Brain. Healthy foods – fish oils, nuts. Minimise the Big Mac hamburgers.

4. Tell Good Stories – a great way to solidify memories and interpret events.

5. Turn Off Your Television – a given.

6. Exercise Your Body To Exercise Your Brain – more oxygen to your brain and more mental activity for you to master tricky new muscle skills such as using your computer

mouse with your other less used hand. Walking/running/swimming. Your favourite.

7. Read Something Different. Branch out from familiar topics.

8. Learn a New Skill – works multiple areas of the brain. Learning to cook and reading Shakespeare; perhaps a course in Medieval history.

9. Make Simple Changes – change your route to work, use your opposite hand to control the mouse, Avoid routines.

10. Train Your Brain – follow the basic principles of memory, visualization and reasoning. There are heaps of resources on the Net or in books on this topic.

I believe implicitly this all now and am doing it (admittedly slowly and with some difficulty).

And as George A. Dorsey says: 'The more you use your brain, the more brain you will have to use'.

Trust your guts and not always your engineering brain

Posted: 29 August 2007

Dear Colleague

Three things today:

Engineering training survey. Thanks very much for the incredible response here. Within short order I have had over 1600 completed surveys – I will make the results available to everyone in the next two weeks. Some very interesting and useful comments have emerged – I am very grateful.

We have hounded you too much with emails. The powers-that-be here have decided that we are driving you to distraction by sending you too many emails so we plan to send out only one email every week with my note in it (together with our courses and books). Apologies for the previous deluge. I hope this makes it more palatable although it will make my life more challenging trying to find useful things to comment on more often. Please continue to send me ideas, feedback and suggestions. I will acknowledge them all. I will endeavour to add one technical tip at the end (mechanical / electrical / electronics / instrumentation).

Trust your guts and not always your engineering brain

Tonight, after reading my 10 year old boy his bedtime story and fending off some ribald criticism why we still couldn't get his crystal radio (from a kit) to work (some darned loose wire which I can't quite find), I ruefully surveyed the technological carnage of the past few months in our firm.

I am supposed to be the technical expert here, but ... One of my less technical colleague's (a jovial Aussie) favourite expressions is: 'Mate, I don't know sh... from rice pudding - as the engineer, you tell us what we need here'. Well, two major disasters illustrate (once again) that advances in technology do not necessarily mean better outcomes. As the so called seasoned professional (one of our instructors used this to justify a pay raise), I don't always make better decisions.

Two examples: Voice over IP (VoIP) is supposedly the name of the game - massive cost savings can be gained as your telephone calls are routed over the internet and incredible acrobatics can be performed in routing calls to wherever you are in the world. The initial cost was significant, naturally ($30k), but with a guaranteed payback within 6 to 12 months it seemed a sound investment. Once the new, beaut system from Cisco (the guys who provide the plumbing for the Internet) was installed, however, we had an almost immediate hacker attack on the telephone system (it is now linked into our computer network) which brought it down for 24 hours while our IT experts tried to work out what went wrong. And we have now found that the quality of the calls is so bad that we have to revert to the good old (expensive) telephone calls. Interestingly, effectively free, Skype, gives us far better quality than our much vaunted Cisco telephone system.

The second technology fiasco, which again shook me to my technical roots, was our computer system. For some 5 years we have depended on a cheap server which had become overloaded and slowed down a bit. We had to manually back up our data onto DVD or tape. Easy, but 30 minutes work per week. Well, the new, beaut system with redundancy (two servers - state of the art with incredible and expensive software), crashed

last night with all the mail, shortly after being installed. Even with the backup the information was lost. The IT vendor was left scratching his head saying (inevitably): This has never happened before!

I read about Steve Dell, the billionaire of Dell Computers fame, who flirted with being the technology pioneer, but paid for it financially. He rapidly backtracked and now lets others try the new technologies to prove that they work before applying them to his range of computers.

So in essence - trust your guts and don't invest in technological whizzbangery unless you are absolutely, 100% convinced that they are better and will give a great return. Avoid disappointment and save yourself a tonne of money by waiting until the herd of technophiles have rushed ahead either crashing further up the pass or eventually proving the technology a sound and better option.

I like what James Klass says about this all: Any sufficiently advanced technology is indistinguishable from a rigged demo. Unfortunately both our computer and telephone systems are now simply useless rigged demos.

My problem now is to sort out what we do to get out of this mess. Any scrap merchants out there?

Yours in engineering learning
Steve

Nuclear power: to hell? Or maybe, just maybe... heavenly bliss?

Posted: 13 September 2007

Dear Colleague

Two things today:

1. Thanks so much for your ongoing stream of comments - every week, I typically get over 20 thoughtful and interesting comments from the 80,000 odd engineers and techies throughout the world who receive this note.. Please keep them coming. I really am grateful for your interest and enthusiasm. Please forward to all your compadres. Thank you !

2. Currently grinding in a tiny turbo prop over the Great Australian Outback, made me wonder about this vast region as a waste storage area for nuclear waste. Probably much to the odd scattered sheep station owner and Aborigine's horror. But it is important to try and take a dispassionate view of nuclear power now due to the shortage of time available. There is no doubt that nuclear power lost most of its credibility some 20 years ago with the massive Chernobyl disaster pouring radiation into the atmosphere along with the Seven (or Three - I can never remember ?) Mile Island (Pennsylvania) reactor going into melt down . Since then, no one wanted to touch it and the past 20 years have seen enormous wastage of taxpayers' money with tens of billions spent on bailing out lossmaking nuclear power companies.

But in the past few years, with the challenges of climate change, interest has quickened with America having a flood of applications (20 odd) for new plants, Finland building a reactor and Britain moving to revive nuclear power. This is besides the myriad of others such as South Africa developing new plants. Even green-oriented Australia has jumped on board, with the nation's leadership (admittedly, perhaps the last hurrah for John Howard, prime minister before he is overwhelmed by the Tsunami like Labor party) saying this is the only way forward.

On the positive side, nuclear power makes sense with most of the world's oil and gas in the hands of shaky or hostile governments and most of the world's uranium in nice (an irritating choice of word, I do confess) neighbourhoods such as Australia and Canada. The past decade has seen simpler, cheaper and considerably safer designs for nuclear power plants. And lower maintenance and repair costs. Unnecessary shutdowns (apart from the Cape Town reactor which I experienced first hand last year) seem to be a thing of the past with average availability moving from 50% (1950's) to over 90% today . Gas fired power stations have exploded in popularity. Diametrically opposite to nuclear, gas power stations are cheap to build but expensive to run. And as gas provides the extra power beyond base power, high gas prices set the electricity price. So nuclear plants have become amazingly cost effective and profitable. Coal fired plants pour out pollution whereas nuclear ones have no greenhouse gases to speak of. Wind and solar offers perhaps the best - most palatable solution, but the higher capital costs make it economically tricky at this stage.

On the negative side, nuclear waste is difficult to dispose of. How can one plan for a million years storage of the stuff ? And naturally with the increasing availability of nuclear material, the doomsday scenario of some madman detonating a nuclear device is just too horrible to contemplate. Which we know all too well with the recent New York Twin Towers attack that this is a is a distinct possibility. And there are still some risks with the new nuclear plant designs, which financiers are rather twitchy about. And as engineers, we know, that there will be numerous design and operating wrinkles to work through. This is the nature of the (engineering) beast.

After being aggressively against it (naturally), faced with the horrendous prospect of massive amounts of CO2 pouring into the atmosphere, the environmental lobby has become somewhat divided on the issue of nuclear power and the latest polls indicate that public opinion is moving rapidly in favour of it. I must confess that with my poor knowledge of the topic, I am reluctant to acclaim nuclear power at this stage. Or to gain say it. Conveniently you will exclaim; another fence sitter. But I do have a quickening interest. In common with most engineers I was horrified by the buccaneering approach to engineering many of the world's nuclear sites. But now with the advent of climate change issues, dramatically improved engineering and design, poor location of oil and gas, I don't know that we have much choice.

- What should we do as engineering professionals about nuclear power ?
- First of all, research and debate the topic vigorously as much as possible to understand what the pro's and con's are
- Put on training and education initiatives in the area to highlight the issues in an objective and informed way
- Come up with an objective assessment
- Then harness the engineering leadership to drive this objective assessment forwards to the politicians to act cost effectively
- Finally, to look seriously at the opportunities for engineering in the area - it is growing fast and provides enormous opportunities for safe and clean engineering

And as *The Economist* put it: The nuclear industry needs to persuade people that it is clean, cheap and safe enough to rely on without a government crutch. If it can't, it doesn't deserve a second chance.

Yours in engineering learning

Steve

Feedback

I am a bit late in responding to the question on what to do with Nuclear Waste if it was decided to explore that avenue in this country. Although not a specialist in this area of the physics, I, however, do believe that the quantity of waste i.e. the weights and volumes are quite small compared to waste from other more common fuel sources providing the same amount of energy. Hence, I have long wondered why such small quantities of nuclear waste could not be placed onboard a large rocket (such as the Apollo type) and blasted into space aiming at our own sun to be mixed in with, as far as I know, what is one continuous Nuclear reaction 'up there'. Maybe the logistics does not allow this but it would appear to me that no harm would be done anywhere by getting rid of the waste in such a way.

SA

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I'm enjoying this discussion though I've got a small contribution to make. It's not engineering it's a philosophical contribution.

Having read through the posts, I was horrified to come to the realisation of a blind spot I have and many have in their posts. First, let me admit one thing, I am pro-nuclear - or I was until today (and I may be again - but bear with me and read through my thought processes).

The blind spot I'm talking about is simply this - we know in life that there is no true black or white – no cause that is completely right or completely wrong. This is a world of greys – we may say we are CERTAIN, we are SURE, yes it is 100% correct – but are we? My blind spot is simply this - in this world of greys, I looked at the climate change debate and said 'load of bollocks – not enough data to back it up' which is fine in and of itself except one thing, can we be 100% certain that climate change IS NOT REAL. I would argue that for all of us disbelievers, myself included as a climate change disbeliever, to consider the ramifications of being out by 1% or even 0.1% wrong in that certainty. It may be hundreds of years from now – but our decisions today will pave the way for the world to be whether it be our children's world, their children's, etc. down the line. It is OUR duty to be SURE, 100% sure that actions WE take and condone will not adversely affect the planet and future generations. We can shrug off the blame and ultimately it will be more and more difficult for any future generation to correct errors made by us and our predecessors. Collectively, we must act now and in such a way that we are 100% sure in this world where there is no certainty (paradox?). What that means is that we cannot take the risk that the climate change disbelievers (such as myself) are right – it may well be that: greenhouse gas emissions are not causing global warming or that this is a natural cycle, or one of the other manifold reasons given against climate change (I'm a natural cycle believer) – as the climate change scenario is the worst case, we MUST err on the side of caution where 'we' are humanity who are supposedly the caretakers of this planet (unless someone will stand up and prove 100% - not 99.999% that we humans are not in some way causing an unnatural change to a natural cycle).

Again, this same thought process can be applied to the nuclear debate - we must take into account not only the short term effects and benefits but the long term. We must do that with what we know now. Can we safely generate nuclear power – 100% safely, I don't know – it is not my area of expertise. Can we be 100% certain we can safely dispose of nuclear byproducts – 100% not 99.999%. If we can't positively answer that with a categorical YES - the answer to nuclear power is no. The same goes for coal and gas and oil ... etc. It is OUR responsibility collectively and individually to study and apply this thought process. It is simple to ask ourselves the questions (at least for those so technically inclined) 'is this what I am doing now likely to – does it even have the smallest chance to - cause environmental damage, have catastrophic failure, etc.?'

I know, that whenever I have designed something or changed a process or some such. I have been guilty of taking the best route when the best route is governed by metrics such as cost, inherent safety, least environmental damage, aesthetics, corporate policies, etc. (name a metric you may use in design). It is human to compromise – but we MUST understand that there are some things we just cannot afford to compromise upon and most metrics we use in designing something involve some form of compromise!

Perhaps 'greenpower' is the answer and it will cost us individually more. But I realise now that I myself do not have the answers to say – 100% that there is another safe alternative for the future. This is not a compromise I should make. However, being human and concerned with now - I cannot categorically say that when I go home today that I will simply call my power company and say 'switch me to green power'. The dollar is a mighty temptation - am I able to take the less travelled road and sacrifice that when I know others will not and therefore save more NOW on their

power bill. I will try, but I'm only human. I'm not a Greenie, but perhaps I can become environmentally and socially conscious without becoming a Greenie or otherwise politicise a rational debate.

A bit of philosophy never hurt anyone (too much though can brand you something you may not want to be though). Well, work has paid me a penny for those thoughts, so now back to grinding that axe... (excuse the metaphors and cliches).

TF

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There are thousands of mines (coal, copper, etc.) worldwide that are continually being closed down for whatever reasons (geological, political, etc.). Why create big holes for landfill, when we already have these holes to fill? Just as the gas can still be drawn off when coal mines are closed, we could still draw off the methane gas created by the rubbish placed in these vacant tunnels and shafts. The miners could be retained to do this work, helping safeguard their jobs from closure.

CW

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Here in the UK we hear loads of politicians telling us to reduce our 'carbon footprint' and generate less CO_2, but many scientists tend to say 'manmade' CO_2 is not the main contribution to global warming. I suspect that politicians are using CO_2 as an excuse to collect more taxes!

Obviously gas and oil will run out so it makes a lot of sense to consider the alternatives. I like the idea of using the sun's energy. This would reduce the sun's heating effect and reduce global warming at the same time.

Alister

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After reading your thinly disguised support for the Nuclear Industry and your comment of 'the shortage of time available' perhaps you could better concern yourself about the very real potential danger to life on this planet for millennium to come through the use and misuse of Nuclear Energy. I'm not sure if you have a family but if you do perhaps you may like to explain to them why you supported an Industry and a technology that has already caused so much pain and suffering, perhaps you might be able to convince them that its all about global warming but more likely you will be left with the real reason, short term money making for a select few who will be long gone before other reap what they sow.

ML

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The US Navy has had no nuclear trouble whatsoever with its nuclear powered submarines since the USS Nautilus http://www.ussnautilus.org/history.html first sailed the sea in 1955. Seems to me, as you say, what it takes to avoid Three Mile Islands (TMI) is damned good engineering. We did it before we got cocksure and sloppy and we can do it again.

If we put the lead back in solder. If on the other hand, we stick our heads in the sand and continue to ignore the facts - that the no-lead EU RoHS law is a very bad law that needs to be recalled ... then forget building new nuclear plants as they will fail. One failure at a US nuclear plant has already been traced to tin-whisker growth

(which lead in tin-lead solder prevents). Getting the lead out of solder and out of tin-coatings has a negative impact on the reliability of electronics: solderability is usually degraded, the mechanical properties of the solder are degraded, and non-lead-containing tin tends to grow short-inducing whiskers. We already know about some disasters in which re-work using a different and incompatible solder has destroyed boards. (At least, the destruction was 'prompt' and not delayed enough to see these boards deployed – in this case, anyway.)

Our world depends on the proper functioning of electronics, and so this is a world-wide problem. We already see eliminations of lead as causing failures in newly-produced electronics, and we can be sure we will see many more failures as the older equipment ages out of service and is replaced by this new lead-free stuff.

Lives will surely be lost as a result, and probably already have been. But our systems are not set up to track this.

Deaths are tracked at individual levels, but medical doctors assigning causes are not trained to report: 'Cause of death was the failure of electronics, which in turn failed because the lead-free replacements did not work.'

Epidemic-tracking centers are set up to work with known diseases, and not deaths or injuries caused by equipment failing as a result of lead-free substitutes.

Companies using the lead-free replacements are not (as far as I know) reporting any injuries or deaths caused by the failures of their equipment, caused by lead-free substitutions. I suppose they are more likely to settle any cases that are brought to their attention 'out of court', which is to say, 'out of the public's attention.'

Consider the failure of Galaxy IV, that silenced 35 million communication devices for about a day. Some of these devices were used by medical doctors. Can we suppose that there were NO cases of patient suffering (or worse) as a result of the loss of contact between patient and doctor? But who would track this? And make the findings publically available?

And companies that suffer as their products fail as a result of use of leaded-tin substitutes are not tracked either. While the company remains in business, it is typically reluctant to advertise that it is suffering from such problems. If the company dies, then so too does the reason. No one tracks this cause. No one can say, 'We lost 57 companies this year, as a result of failures due to the ill-performance of the leaded-tin substitutes.'

So we have a world-wide situation that is 'under a basket', 'out of the light', and likely to remain that way!

One of the strong drivers for RoHS has been that people DO count the number of folks harmed by lead in their environment. But we do not count the number harmed by removing lead from electronics. So the situation is unbalanced.

Thus, one way to go forward in achieving a better balance in RoHS actions, is to add 'problems to people caused by failures of equipment caused by lead-free substitutes' to the problems noted by epidemic-tracking centers.

Ditto for companies.

NASA says this is so and that's good enough for me:
http://nepp.nasa.gov/whisker/background/index.htm

Also see http://www.edn.com/article/CA6477864.html as well as
http://www.rohsusa.com/

BL

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Just a couple of thoughts on NP. It is very expensive to implement and the lead times are long. One of the reasons no new nukes have been built is that most western governments pulled subsidies. To my knowledge no one has built a nuke without subsidies in a deregulated energy market. The low carbon footprint is achievable if you use NP in the refining. The French do this but then they have a state run monopoly and an intermixed NP fuel and armaments cycle so they are cheating a bit. Remote area long term storage may not be the smartest option a carefully planned attack on a remote site has much more chance of success than one on a more accessible site. At the former it may be very easy to overwhelm security and neutralise any rapid response units. Also given the very long time spans involved what is a geologically safe area. Most of the western region of the eastern states with its extensive aquifer formations is definitely out. The Sydney sandstone systems with their low permeability and high geological stability are in. Political expediency will virtually dictate that the former is selected. Reprocessing waste to extract Plutonium and re use this should definitely be an option as this reduces the military/terrorist value of the waste. Transport and refining risks are non trivial matters in this scenario. The Thorium cycle should be actively pursued by Australia. It has the advantage that the chain reaction needs external excitation to keep going i.e. it is not self sustaining and the waste products have relatively short 1/2 lives and low military/terrorist value. Simply increasing the level of Uranium trading has its own risks. We are currently planning to sell uranium to Russia. Putin has categorically stated that they will not use our stuff in weapons. Russia has an adequate stockpile of their own uranium for the latter. This scenario is not unique and as the assurance is by an ex KGB operative it makes me about as comfortable as swimming in one of those guaranteed shark free marinas at the Gold Coast on an overcast day. On the basis of past historical record and experience we can trust India (a non nuclear pact signatory) much more than either Russia or China. NP has had bad press in the past its resurrection as THE solution is as simplistic as the atoms for peace projects in the 1970s where we were assured the power would be too cheap to measure. Renewables are also not the whole answer but must be included as possible the most significant part of a system. their advantages are: Cheaper in capital cost than NP and with much shorter lead times hence the large number of wind projects in the pipeline world wide. We do not know how best to integrate them into the current power system paradigm. We need to find out very fast and there are no significant funds for this research that I know of. The Australian power systems of the near future will most likely need to include wind, solar (in all its forms including hot water as mandatory), hot rock (e.g. my firm XXX have lots of experience in geothermal a kissing cousin of hot rock) some hydro some thermal and perhaps a little bit of state subsidised NP. We are very good at renewables and can become world leaders in this field. It is worth the effort and government support instead of the government disincentives that seem to be there just to ensure the profitability of the mining industry

No problem. My reference to XXX as having experience with geothermal was not intended as an add but simply to highlight the fact that there is expertise in areas that many regard as esoteric. Incidentally I have been living in an off grid solar powered house in the bush on and off for the last 6 years and its a breeze no different from the city one except that I don’t get a power bill.

Just a thought on uranium reactor safety i.e. safety for a self sustaining reaction. I have been to several IEA meetings where the pros and cons of NP were tossed about and reactor safety always come up. The general cry from the NP/heaven side is our reactors have an excellent safety record. This is true. Their response to the Chernobyl accident is ‘our reactors are much safer than the Russian ones and they did not have a biological shield’. The discussion generally stop there. I suspect that there are a few elephants in the room i.e. both the Russian graphite modulated reactors and the Canadian CANDO types have been built without biological shield. Both use low
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grade fuel i.e. the embedded energy in the refining cycle is also low. Their cores are large and as a result the energy densities are low. This makes them inherently damage proof and poor candidates for the "China Syndrome" when an out of control core melts its way through the biological shield and into the water table with very very nasty results. The boiling water reactors have cores that are smaller more energy dense and good candidates for the "China Syndrome". The Chernobyl reactor was subject to massive abuse by its operators. I doubt if a boiling water reactor would survive this sort of treatment. The Three Mile Island reactor came very close to meltdown after a much milder incident. It is interesting to ponder on the fact that Chernobyl occurred when Russia was undergoing immense social change (Perestroika and Glasnost) and the usual restraints were coming off. What I am trying to say the safety of complex systems is dependant on their social environment as well as all the clever engineering. Something to ponder before plunging head long into installing these system all over the globe.

AH

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In a recent discussion, a friend of mine (a Geologist) has expressed his concern at the current global climate change fad. He pointed out that their is evidence to suggest that the level of CO2 has been significantly higher than it is today centuries ago, and that the current increase may just be a part of a natural cycle. However, he has also pointed out that those who choose to dispute the claims of the climate change movement are often met with a cold response. Perhaps we should stop and take a breath, then examine the past objectively before we proceed with the nuclear option.

DF

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Regarding the US vs Japan – imagine fighting a foe who does not care for dying himself. Every single battle is fought until every single enemy soldier is physically dead – no surrenders, very dangerous to take prisoners, even if badly wounded (much like Muslim extremes?). Yes, I agree with you that other alternatives was not necessarily better. But it does – like 9/11 - show that serious cracks in the US psyche is just under the surface – only fear is needed to expose this. A president like George Bush is probably proof enough of this, anyway. Hi Stephen, Thanks for sharing your opinions with us. I grew up in a household where – can you believe it! – solar power was a special interest and a serious issue. My dad, my older brother and I were forever devising new solar powered devices, my brother I still do. I must admit, I have never found it feasible to even try to earn all my income from this interest (I am a Mech/Aeronautical Engineer by qualification). But it does look as if there is some shifts in the market now. The cost of solar power versus fossil fuels has never taken into consideration the cost of the power source. When the last barrel of oil is sold, it will fetch a certain price. The asset value of the oil (which is then all gone) will only be obvious then. If we recalculate then, we will see that solar and wind power is not expensive, and should have been phased in over a much longer term in effect stretching the fossil fuel asset, preventing a few wars, etc, etc. With Nuclear power: one should also take into consideration the cost of closing down a nuclear plant – how about providing us with a figure on that? My knowledge of history (which is incredibly limited!) reminds me that the US is the only group of people that has ever used nuclear devices on other people. Still they have the most say about who is qualified and responsible enough to have access to nuclear power. No matter how bad they paint the ‘heathens’ who does things like 9/11, the truth is that the ‘baddies’ still has to do something as inconceivably bad as Hiroshima and Nagasaki. Nuclear doomsday might be prevented by : i) Every country has nuclear material and/or nuclear weapons and the outcome of a nuclear war is perfectly clear and simple or ii)

Nobody has nuclear material and/or weapons. Decision Time!! Thanks again for sharing your views.

DS

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Hi there, I hope you are well. I must commend you on your interesting discussion. I am currently working in the Nuclear industry, currently based at XXXXX and am doing my Post Graduate Diploma in Nuclear Engineering. I am extremely passionate about this industry but however notice that not many individuals are pro-nuclear. I believe that there is not much information readily available and training and education initiatives in the area to highlight the issues will be most advantageous. After all almost everything in this world is unsafe but the world is made a much safer place through knowledge, education and mitigation, right? Have a great day.

SM

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There is quite some history behind the SA nuclear endeavours (e.g. the Pelinduna reactor of the 1960s which was dropped and the Safari reactor which was imported from the USA and is still running). What does not make sense to me is to have a reactor with a useful life of 15 years (which may be extended by de-rating and with modifications) but has a cool-off period of 40 years before it can even be touched to decommission, and then has a 300 year actively-managed disposal period. The calibration pads at Pelindaba were not even 15 years old when squatters were stealing the fence, etc. I do not believe this is a technology for us at this point in history. We are like primordial cave-men burning our hands again and again. Stick to using reactors for manufacturing nuclides, etc., but to run power stations where the people do not understand or even monitor the basics of the reaction is crazy! (power plants usually only monitor heat / temperature, not neutron flux, etc. which relates to the actual reaction.) We can chat more on the use of helium, etc. too - but that would take a few hours. Thanks for your newsletters and your excellent courses.

AC

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May I add my bit to the Nuclear Power outcry. I watched the DVD of Al Gore (*An Inconvenient Truth*) recently, if you have not watched it, do yourself a favor and do.... This was quite a wake up call to me....People of the world have their eyes so focused on the Chernobyl of the past, that the fail to see the crisis on the doorstep of tomorrow...

Well, the facts are, If we as engineers do not stop emissions of CO_2,our planet will be a boiling furnace, unsuitable for life as we know it, very soon anyway. All we have to do to achieve this, is to keep the status quo. The newer and safer Nuclear technology greatly reduces the probability of a nuclear disaster. In my opinion, the nuclear risk is vastly smaller compared to the Greenhouse one, so what are we waiting for... Like you said, there is lots of space in the desert areas of our planet for storage of nuclear waste. For the sake of us and our children, we should shut down those CO_2 producing plants and replace them with Nuclear stations and Pebble Bed Modular Reactors. These relatively small PBMR plants can be put right next to the consumers, even reducing the need for expensive and rather un-sightly Transmission Lines. Another thing I was thinking of, to actually reverse the cycle of CO2 emission is as follows: The principle of CO_2 being released into the atmosphere is simple; Carbon stored over ages in the form of fossil fuels (coal, gas and oil) are extracted from under the ground and burned for energy. More CO_2 is released that what is stored again, so the balance is tipping dangerously high now. I am sure that there must be some kind of
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plant material that can grow in poor quality water, even sea water and sewerage water. Well, if we can cultivate huge amounts of such plant matter, so doing extracting Carbon from the air and other organic waste sources and simply pump that into empty/used up mines, we can create a reserve for future coal/oil and at the same time suck some CO_2 out of the air and bury it under ground (where it belongs). Well, that was just a thought

From TvdW

What on earth do you expect the world to do with your rubbish ?

Posted: 19 September 2007

Dear Colleague

Three things today.

1. Nuclear Power

I had an overwhelming response to *Nuclear Power: To hell? Or maybe, just maybe...Heavenly Bliss?* Thanks very much. Some very interesting comments and some rather acid comments about my professed love for nuclear waste and the nuclear apocalypse. To a (wo)man, all the comments were biased toward an unerring focus on safety and looking after our wonderful environment. I tried to be neutral though and don't have an axe to grind either way.

Thank you, one and all.

2. What on earth do you expect the world to do with your rubbish

As I shoved our overloaded rubbish bin up the pathway for its once weekly dispatch to the dump, I felt a surge of guilt. For the umpteenth time, admittedly. Looking down our street and seeing the rows of bins neatly parked with military precision waiting for the garbos to take them away reinforced my guilt. Is recycling worth the effort? Does it have any relevance to me as an engineer? Where is all the waste going? Apparently some of it is going into some gigantic tip in China? I clearly remember as a child hearing the phrase: 'Where there's muck, there's brass' (normally said in a broad Yorkshire accent). Unfortunately this is not always true and our consumer society drives frenzied growth and with it more rubbish. There are no wide spread financial incentives for all of us to cut back on waste. So most of the stuff is buried. And we are fast running out of space. And there is the additional hazard of toxic waste leaching into our water table. The other option, burning or incinerating (which I initially thought was an ingenious idea), sadly has other risks. Cancer producing dioxins are a possible product. So the final practical option is recycling.

The numbers are daunting. Since 1960, the amount of municipal waste being collected in America has tripled reaching (not, that this means much to all us numbed by these stats) 245m tonnes in 2005. In Europe, it is now 577 kg per person per annum. America recycles 10% of its municipal waste against Austria and Netherlands which are at a wonderful 60%. Is recycling worth it on environmental grounds ? According to credible research at the Technical University of Denmark, it is definitely better for the environment. It conserves natural resources, reduces the amount of waste burnt or stuffed into dumps, and conserves energy. Recycling aluminium can reduce energy consumption by as much as 95% (against extracting it from raw ore). Steel is at a pleasant 60% saving.

Originally, kerbside collection programmes required separate collection of paper, glass and cans. But now it is single stream. I was naturally suspicious when I saw this happening, thinking that the authorities had given up and everything was being dumped again. But new technologies can sort without human intervention and it is more convenient for consumers. And it works.

And onto China. There are concerns about shipping recyclables to China – now the largest importer of rubbish (well, recyclable rubbish) in the world. Does this all end up in landfills ? Van Beukering, a specialist economist in the area says: 'as soon as somebody is paying for the material, you can bet it will be recycled'. So this is apparently not such a problem.

It is being re-used. Admittedly, still significant problem with poor migrants being exposed to toxic waste in China.

Finally, products have to be designed by us as engineers so that they can be recycled. A complete rethink of industrial processes. For example, sustainable packaging is not only good for the environment but cuts down your costs significantly. Wal-mart believes that in cutting the amount of packaging it uses by 5% will save as much as $3.4 billion and reduce CO_2 by more than half a million tonnes.

In conclusion, as engineers I challenge you to:

- Work out ways to minimise the junk we produce - recycling and re-using as much as possible
- Design products so that they can be recycled - this requires a rethink of our current design processes
- Boycott products which are poisonous and non-recyclable
- Design new technologies to process the garbage and make money from it
- Use the waste tips to generate energy
- Convince our peers to recycle, design for more sustainability and use less
- And be prepared to pay slightly more to stick to our principles of looking after our environment and ultimately ourselves

There is no doubt that recycling protects the environment by cutting down on energy, raw materials and pollution. But where we as engineers come in - we need to recycle better. As The Economist remarked: ‘Waste is really a design flaw’. And that is where we as engineers are both culpable and have a key role in fixing.

My gratitude to *The Economist* and the Waste and Resources Action Programme (WRAP) for assistance here in this article.

3. When you retire, please don't

Every week we get notices from our wonderful clients of retirement and going fishing. If you are retiring and are mildly interested in doing some part time engineering instructing ranging from 2 days per year to a lot more, drop me a line at:

tech@idc-online.com

and we will send you an information pack on instructing at IDC.

We have some outstanding engineers and techies in their seventies and eighties, who whilst working at their own pace, deliver outstanding training and are an enormous credit to the profession. And get great fulfillment in passing on their know-how. Naturally, we believe we compensate you well for your efforts. But that is for you to judge.

Yours in engineering learning

Steve Mackay

One of education's greatest confidence tricks - lectures

Posted: 26 September 2007

Two thoughts for the day.

1. Engineering blog comments.
2. One of education's greatest confidence tricks - lectures

1. Engineering blog comments

The comments continue to pour in. Thanks very much. I have placed them all up on my blog site at:

http://www.idc-online.com/blogs/?country=Australia

I am grateful for your comments. Thank you for giving up your time to read them.

2. One of education's greatest confidence tricks - lectures

Last week I was put through yet another mind-numbing engineering lecture with numerous powerpoints bouncing around together with all sorts of multimedia wizardry. It proved to be 60 minutes of tedium where I learnt nothing and wished I were elsewhere. And yet we put ourselves through this time and time again. The first two minutes were maximum absorption for me (although devoted to some wise-crack to open the presentation on a humorous note); and then the remaining 58 minutes were a dull blur of information. I clearly recall the droning lectures at university on hot afternoons. The despairing lecturers would grind their way through the allotted times. Most of them probably knew that there was no learning occurring but didn't know what else to do. And we have been doing this since Sophocles lectured his Greek students on the beaches of the Mediterranean, 3000 years ago or thereabouts.

So why on earth do we continue with this charade of lectures? Because it is not only a long-standing traditional method, but easy and fairly stress free - it does not require an imagination and needs few resources. There is no equipment to malfunction and the students are less unpredictable and curious as they dwell in the twilight zone of tedium. Furthermore, it is easy to wheel out replicas of this potentially beneficial content again and again despite much of it most assuredly not teaching anyone anything. In essence, I believe lecturing, in the classical sense, shows complete contempt for its audience.

So what should we do about it?

First of all, accept that classic lecturing is a waste - for both the provider and the recipient. No one listens beyond the first few minutes unless, as a teacher, you.....

1. Chat to your audience, as equals, in short bursts of pertinent information – literally a minute in duration. Intersperse these blasts of content with other related activities. DO NOT lecture to them in the usual master-servant manner or with the ‘sage-on-the-stage’ mentality

2. Make it very interactive - get everyone involved - voluntarily if possible; but if not - simply talk to them all as individuals and ensure it is a learning experience which everyone takes part in and learns from - including you the instructor

3. Use exercises where everyone is involved and from which they can learn - for 90% of the presentation. This may entail for example; small groups brainstorming ideas which they then feed back to the larger group or by simply providing exercises to individuals to work through after which feedback is gathered and shared with the whole group.

4. Get them to teach parts of your presentation as well - the best way to learn is to teach the subject

5. PRACTISE your presentation beforehand so that it is interesting and action packed with the whiz bang techniques listed above

Remember of course, that instructing is not a one-way street - it goes both ways. You can actually learn more from your class than they from you. For the simple reason, that they represent vastly more knowledge than you - on a variety of different topics - simply because there are more of them than you.

As my delightful sister-in-law remarked on Sunday morning on the beach, (whilst we were showing her 1 year old daughter how to build her first sandcastle using hands-on instructing with real equipment – sand – and chatting one to one): 'All know-how has to be doled out in micro bursts of a few minutes'. Every minute you have with your unwilling and bored (unless you are Madonna or equivalent) audience is precious. Treat them like gold and do not abuse your audience by betraying their trust in you.

A few other techniques:

- Something I learnt in another life in the Army, 30 years ago....when you are lecturing; do not do it to the whiteboard - but face the audience and explain the diagrams behind you.
- Stories and anecdotes to illustrate the key points are really valuable and again perk up interest.
- And if you can introduce an emotional roller coaster, when presenting, you will increase the interest factor. Difficult when talking about Ohm's Law or
- Transformer protection, but you can do this by changing the topic to a story. Walk around the classroom, sit down at the back with your participants while you are talking to them

I guarantee that if you apply these rules; you will make your firm thousands of dollars a year due to know-how getting transferred really efficiently. And the next boring lecture you listen to – gently tell the unfortunate instructor how he can make it a whiz bang presentation with accolades heaped on him from a grateful AND smarter audience.

And when you follow the suggestions above, you will truly do as acclaimed US poet, Walt Whitman remarked:

'Behold I do not give lectures or a little charity, When I give I give myself'.

Yours in engineering learning

Steve Mackay

Making up for the problem solving toolbox defect in our formal engineering education

Posted: 3 October 2007

Dear Colleagues

Some of us get hugely remunerated for solving problems – an airline pilot for solving a problem which involves 45 seconds in his entire career as he wrestles a plane safely to ground, or Red Adair putting out oil fires, or the astronauts bringing Apollo 13 back. At the end of the day, as engineers, I believe problems are our stock-in-trade.

For some reason, we are taught that engineering is all about design and coming up with a nice construction – there is very little mention or discussion based on problems, until they occur. Think of your course at college – most of it is set in a pure world of building things and designing software where few problems exist. This is a huge oversight in teaching engineering. Students should be absolutely sure that a mammoth number of practical problems will confront them, as engineers, on a daily basis. If we don't have problems, we don't have a job. Interestingly, our most popular short courses (for engineers or technicians) are the troubleshooting and problem solving ones.

Fred Nickols (*Solution Engineering: Ten Tips for Beefing up your Problem solving Toolbox*) gives some really excellent (although perhaps rather dry) tips on a great sequence for problem solving which I have modified to my childlike way of thinking:

1. Focus on the desired solved state

Most of the time we contemplate the problem with horror and ignore what we want to achieve. With this mind set we focus on the problem and then move from problem state to problem state. Instead, visualise clearly what you see as the final solution and focus on this unerringly through the entire process.

2. Be clear about ALL your objectives.

To clarify this it is worth asking:

What are we trying to achieve/preserve/avoid/eliminate ?

3. Expand your definition of the problem

The acclaimed "define the problem" is the most poorly understood and executed step in the process. And as you solve the problem, this definition changes. Do the following:

Locate the problem/Isolate it/Describe it precisely/Define it

4. Bounce around like Sherlock to solve a problem

The information you need is not in one structured pile, but in a heap of little bits scattered far and wide; both written down and in many people's heads. And changing. Be Sherlock Holmes – the brilliant detective; find it all and bring it together.

5. Picture it

We are engineers after all and tend to be visual thinkers. Diagrams and schematics should be used as much as possible.

6. Don't always fret about the cause

Causes can sometimes be fixed and should be investigated. But don't waste valuable time and effort looking into a cause where it is not going to help you solve the problem.

7. Avoid disconnects

We go through this every day. Top management gives instructions on fixing a perceived problem. By the time it gets down to the electrician on the shop floor, the problem has disappeared and he is merely doing a useless job for which the reason no longer exists.

8. Know your own vision

We all have built in biases and approaches to doing things. Sometimes good and sometimes not so good. It is best to be ruthless about what they are and understand the overlap between our personal and the rational objective world out there when assessing the problem. Stand back and watch yourself solve a problem and try to understand your biases for next time. Use your strengths, but guard against your weaknesses.

9.Create your own system

You know your skills and expertise the best. Develop your own system.

10. Sharpen your knife

Keep refining your knowledge and expertise and sharpening your problem solving abilities.

I believe in what the famous mathematician and scientist, Rene Descartes observed:

'Each problem that I solved became a rule which served afterwards to solve other problems'.

Yours in Engineering Learning

Steve

PS: Ranging from the plumbing to the design of an exotic process plant, we get confronted with problems on a daily basis. Five minutes ago, on this wonderfully blue-skied morning, it was a perfectly designed network system, but missing one cable to link a critical computer.

How many of us are guilty of negligent engineering and potential disasters?

Posted: 10 October 2007

Dear Colleagues

I am just ruefully contemplating a damaged door frame in our newly renovated training facilities. Great design and building; but one of the new doors was secured to its door frame with a few small and ineffectual nails. Within the first couple of weeks of use it came adrift ruining the entire installation and creating a safety hazard. Nice one.

The Code of Hammurabi stated 5000 years ago, that 'If a builder builds a house and the house collapses and causes the death of the owner, that builder shall be put to death'. Penalties are perhaps less harsh today; but consequences of negligence can be far more deadly. Simply put: An engineered system fails when it stops working. And failure is often due to negligence in the design and construction. My mind wanders back to some of the disasters that litter the engineering landscape:

- Challenger Space shuttle explodes killing 7 crew. Due to failure of the O-ring leading to the explosion of liquid fuel tanks.
- Bhopal. Piping systems failure leading to toxic vapour linked to the killing of thousands
- Piper Alpha. An offshore platform explodes, killing numerous personnel
- Chernobyl. A nuclear cloud is released over Europe
- Therac-25, a cancer irradiation device. Due to a software bug patients are killed by the doses of radiation.

The primary causes of engineering disasters (according to SUNY at Stony Brook) are due to (entirely or in part):

- Human factors (incl. both ethical failure and accidents)
- Design flaws (resulting often from unethical practices)
- Materials failures
- Extreme conditions or environments

A recent study pointed out that in 800 structural failures, engineers were at fault with the top four reasons being:

- Insufficient knowledge (36%)
- Underestimation of influence (16%)
- Ignorance, carelessness, negligence (14%)
- Forgetfulness, error (13%)

So, in our engineering endeavours, how do we guard against these human flaws? Some suggestions are listed here:

- Build redundancy into design with functionally isolated systems
- Make use of spares especially when components are inexpensive/fail often/can be replaced easily
- Know the details in your design, such as; corners, connections, reinforcements in your design – do not assume anything
- Find trustworthy suppliers and stick to them
- Watch out for problems of scale (and when changing from static to dynamic conditions)
- If people are critical in the operation; then run tests looking at the optimal numbers of personnel needed and the necessary skill levels of the chosen personnel
- Train and retrain personnel; test and retest them if operator error can cause problems
- Use redundant software algorithms to minimize the impact of bugs
- Take care in filtering or allowing alarms to be disabled
- Adjust documentation immediately when changes are made to the operation and design and ensure everyone is aware of the changes
- Exercise management controls for improvement of procedures and changes
- Use real independent verification – not just rubberstamping - in cross-checking work
- Take extreme care in maintenance especially .with the release of stored energy and the removal of energy inputs to a system
- Use materials well within their safety limits
- Only operate equipment within design limits
- Inspect and test to eliminate defective components
- Stick strictly to applicable codes

Hopefully, what Doug Adams says is not true about you and me:

‘He attacked everything in life with a mix of extraordinary genius and naive incompetence, and it was often difficult to tell which was which”.

Thanks to the late Rich Barrett for his thoughts.

Yours in Engineering Learning

Steve

Don't communicate with a battering ram or a twisted whisper, but with engineering panache!

Posted: 30 October 2007

Whilst trucking through Toronto this week (and getting sunburnt, despite it being October), I was intrigued by a recent problem between two of our offices due to the lack of proper communication. In this so-called connected world with email and mobile phones, communications between people are perhaps even worse than ever before. A successful engineering firm is based on outstanding communications – both internally and externally; to clients and suppliers – something particularly neglected by engineers as we love technical stuff. Particularly difficult for engineers working in situations where the language spoken is not their own. I always feel sorry when I meet an eminently qualified and experienced engineer from overseas who can't communicate in the local language (in my case English). His/her employment and promotional prospects are immediately jeopardised. Technical skills date fast and can be updated without too much angst. The ability to communicate, however, is extraordinarily difficult to learn as an adult and reading, writing and listening/talking will remain critical throughout your career. Some suggestions for engineers bent on improving communication skills. (Which by the by, I keep having to remind myself):

- Prepare in your mind exactly what you intend to say – it may need some mental practice. Ensure it is expressed clearly – remain focused on your intent. Anything complex will be lost.
- Ensure the person is at the same technical level as you are regarding the topic being discussed. If a 'yes' is given in response remember this may indicate a complete lack of understanding. · Guard against this 'Yes' mentality. Encourage feedback focused on the issue you are communicating (this clarifies for you that the message has been understood). Converge on a common understanding by reinforcing points and getting confirmatory feedback that you are on the same wavelength.
- Understand the culture and background of the person you are dealing with to help you guard against misunderstandings.
- Use graphics to illustrate points – as engineers this is our stock-in-trade. More so than any other profession (apart from showbiz perhaps).
- Learn from other great communicators. I marvelled at one engineer who grabbed books, pieces of paper, pens, cell phones and other props to build a model on the table in front of us to describe a new process plant construction.
- Track non-verbal cues – looking up at the ceiling or staring blankly at you may mean a loss of comms.
- Listen effectively and actively. Keep an open mind and remain flexible to the ideas of others.
- Watch out for the misinterpretation of words – especially technical words in different languages
- Do not dominate the conversation. Be an active listener. And listen to yourself too - ensure you are not just saying, 'blah blah…. Above all - be enthusiastic, positive and avoid being boring.

- Finally, email – a great medium to communicate with, but sadly abused. It is not to be used for angry messages, humour or sarcasm (unless you know the person) or patronizing instructions.

We like to send emails in these circumstances, but face to face meetings are the best. Due to financial difficulties, one of the local businesses down the road fired their 20 employees with an email - to avoid unpleasantness. The consequences for the owners of the business were worse, understandably. As support, email is great to share complex engineering information. It is a useful means of providing pre-reading material before a meeting. As a follow-up it is a handy means of confirming specific technical data or contractual arrangements. Think before you send the email – read it again carefully to ensure the message is accurate and without ambiguity either in terms of content or tone. I always visualize my emails being mailed to everyone by mistake and imagine the fall-out. Face-to-face and the phone are still the best ways of communicating. Think of email as enhancing this. Not as a replacement. Pick up the phone or where possible stretch your legs and speak to the other person.

As engineers, make Anne Lindbergh's suggestion your target: 'Good communication is as stimulating as black coffee and just as hard to sleep after'.

Thanks to John Kline (*Leaders Communicating Effectively*) of Troy State University.

Yours in engineering learning

Steve

Don’t despise engineering advice from so-called simpletons

Posted: 31 October 2007

My good friend Bob Landman, a veteran electronic design engineer of fibre optic systems, was somewhat sceptical when advice came from a ‘so-called simpleton’. He was faced with a rather intractable design issue - he needed 850nm lasers to work on a data comms project, but did not have the required 850nm photodiodes to mate with them. His wife, lacking engineering know-how, suggested the photodiodes which Bob did have on hand – 1310nm! He originally laughed this off as it didn’t make initial engineering sense (wrong spectral response).

After some initial thought and with a growing sense of frustration, however, he tried her solution. It worked perfectly with no data errors in the BERT test. A most satisfying outcome. And of course the advice was considerably cheaper than hiring a consultant. In Bob’s case, it was simply a dinner out for his wife. There was a bonus too; he’d proved the circuit worked so did not have to wait for FedEx to deliver the 850nm photodiodes – he could take the rest of the day off.

Other ways of working with complex engineering systems, according to Rutan (of SpaceShipOne fame with privately financed space flights) are:

- Work in small groups
- Choose your design team on the basis of engineering passion: ‘for the fire in their eyes, not their grades’.
- Don’t be risk averse when trying solutions - work with speculation
- Avoid government support - the rules and red tape often stifles innovation
- Use the next generation. - many of the first great airplane designers were children and teens (1908 to 1912)

Naturally, as the famous Roman orator, Cicero, pointed out; at the end of the day advice is judged by results, not intentions.

Yours in Engineering Learning

Steve

Feedback

Once I was involved with the design of a manufacturing cell for a product. One of the machines required about 1 hour to set up for the production of a different size item. The rest of the units in the production cell could be set up and verified in a few seconds and this one machine was a bottleneck. Our best engineers just could not create a suitable method to cut down the setup time. About a year after we started using this cell I showed it to a prospective Personnel Clerk on a plant tour and described the problem and he made a remark that when discussed with our engineers, triggered a thought process that ELIMINATED setup time in this machine. They had been focused on reducing setup time and did not see this opportunity to eliminate setup time.

I like to say that in any project team one needs at least one idiot who is too "dumb" to know better and voices his ignorance to trigger good idea generation.

PK

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I couldn't agree with you more and have many times encouraged others to believe this - effective communication is the key to many things, including successful projects! I work for an international company in the paper industry and, during various automation projects, have communicated with international suppliers and company resources to achieve successful outcomes. I would add the following comments which support your article;

Many barriers to efficient communication, particularly internationally, between supplier and customer or team:

- Language - you mentioned this and I agree that use and understanding of language can be a major limitation
- Cultural differences
- Time zones - why is it that we always want to contact someone just after they have left the office
- Arrogance - and misplaced pride
- Bull - usually associated with another word...
- Personal 'chemistry' between team members
- Differing personality types
- Formal level only - informal just as important

Nothing to do with technology or equipment!

Thinking must always be: There are NO stupid questions

RvdF
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Accountants are killjoys and engineers over-engineer

Posted: 7 November 2007

Dear Colleagues

1. A response from last week's blog suggested that I was denigrating women. It was unintentional and I apologise unreservedly.

2. Accountants are killjoys and engineers over-engineer

Most accountants are seen as misers and killjoys by engineers. They are seen to spoil the fun we engineers have in undertaking projects – they have an innate desire to measure and to ensure that we under spend on a project. On the other hand, accountants feel that we are obsessed with over-engineering and ignore costs. Rather than do battle we should try to optimize the strengths we each have in an effort to improve the project quality. A project must be environmentally sustainable, aesthetically pleasing, have engineering integrity and have long term financial benefit that recognises risk. The point I would make is that accountants and engineers need to combine forces, with a focus on the overall vision of the project.

As we all know, engineering is intellectually demanding and is about constructing enormously positive things such as water purification plants in third world countries, supplying electricity consistently, building our streets, bridges and hospitals, transporting us and our "things", linking us all together, providing TV and entertainment and sending people into space. But we engineers, with these visions of creating and constructing, often forget to communicate this to our peers, the powers-that-be and the accountant. At times a project may be initially unprofitable when measured in purely financial terms. But long term the profits (both tangible and intangible) are often far in excess of what we had originally envisaged. But we need to communicate this to our financial peers – the accountant – to ensure they buy into the vision and support us in our hour of need - when the chips are down and the powers-that-be want to terminate or chop back.

The construction of the Sydney Opera house is a case in point. Initially, it was marred by enormous budget overruns and fights over the architecture and engineering. The engineering was futuristic and enormously challenging, but resulted in the architect being humiliated by the powers-that-be. However, over the years, no one could have imagined the tourist attraction it would become - an Australian icon. It is an enormously valuable asset and in pure financial terms it has generated far more than could ever have been envisaged all those years ago. Beyond this the intangible benefits have been even more significant and arguably far exceed any financial benefits. If this vision had been communicated more vigorously in the beginning, perhaps things may have progressed more smoothly. Perhaps.

In short we must have a vision of the project and make the accountant part of the project and the vision. Perhaps even a philosopher on the board could help articulate the vision more clearly.

So what do we do about our next project:

- • Keep the overall vision of the project in mind - all the time
- Work on the innate humanity within your engineering soul to make the vision tangible and significant

- Establish a close relationship with the accountant
- Ensure the accountant has a clear idea of the overall vision
- Communicate to him clearly and simply regarding engineering issues; whether it be the electrics/instrumentation or structural challenges
- Understand each other's fears – we as engineers are traumatized when a structure or project fails – an enormous professional humiliation
- Understand the basics of costings and finance – terms such as NPV and risk should be second nature to you as an engineer

Obviously we are not God working on a project; but this gave me something to grin about:

God is not dead but alive and well and working on a much less ambitious project.

Yours in engineering learning

Steve

My heartfelt thanks to Kevin Delbridge, an accountant crème de la crème, who suggested the topic over a few glasses of ale.

Feedback

Hi Steve, Agreed, But it is not their fault and it is not only Engineers who suffer, ALL technical people suffer from the same disease that I summarize as follows:

In today's world the Language of Money is the key to everything. This is the "Home language" of accountants. Over the years engineers and other technical people have repeatedly proved to accountants that they are liars who ask for far more money than they actually need to do the job. When the accountants then allocate less money than asked for, the technical people proceeded to achieve the required results with this fraction. Thereby teaching accountants that the technical people ALWAYS over engineer and over design and can get the results required for less. It is only after far less then we initially estimated had been allocated to us that we become really creative. We need to be creative before asking. We are our own worst enemies in this case.

Solution: Technical people need to learn the language of Money. They need to know it better than the accountants. It is amazing how often accountants take ridiculous accounting short cuts that end up denying us money, and when you catch them out at this a few times they come to heel. Many years ago when I worked in the Corporate Rat Race I developed a simple seminar to teach technical people this language of Money. Before this seminar my organisation's typical Capex Actual Allocation to Request rate was about 60% and we always had unfulfilled Capex needs. After a few years of consistently using these disciplines the total Capex as a % of Sales dropped dramatically and we often got 100% of the Optimised Request and up to 120% of the Shoestring minimum.

Pieter Rossouw

Why nanotechnology is important to engineers

Posted: 14 November 2007

Dear Colleagues

Thanks for the inevitably bulging mail bag of responses to my previous newsletters. Some very thoughtful engineers. And as per the suggestions, I am trying to add more engineering oriented musings. Three items today:

1. Amazing collection of free engineering software

I am always amazed by the incredible collection of engineering software programs available for free; sometimes as a result of (expensive) government sponsored research or genuinely altruistic engineers out there. We have been working on getting a list together and putting it all onto CD. If you have seen any useful programs which we can add, please email me by returning this message with your list of software programs and we will add this to the list. We will make this available on a complimentary CD or for download in early December as a Festive Season gift.

2. E-learning survey and paper

I have almost completed a short but readable paper summarising the main issues from the over 2500 responses from you guys on the e-learning survey for which I am very grateful. I will definitely get this out in the next two weeks. Some very interesting results on engineering training and skills shortages throughout the world.

3. Why nanotechnology is important to engineers

I always scratch my head when I hear about nanotechnology, of which I freely admit I know very little. Something tiny and presumably irrelevant. Tiny perhaps, but definitely going to make a massive impact on our lives over the next decade. Hence worth looking into. A nanometre (nm) is one billionth of a metre. A line of ten hydrogen atoms is 1 nm; whereas a human blood cell is 2,000 to 2,500 nm long. This technology can manipulate both matter and life at their most basic levels and lead to enormous breakthroughs.

Developments in the field are accelerating with billions of dollars being spent on research in the area. It is a highly multidisciplinary field combining aspects of engineering, physics, chemistry, biology and IT; supporting my ongoing thesis of the need for all engineers to multi skill. Some pundits reckon it will have as great an impact on our lives as electricity, the car and computers combined. There have been some initial (perhaps trivial) examples of nanotechnology in terms of stain resistant clothing, superdurable bowling balls and transparent sunscreens.

One of the first notable successes in nanotechnology has been in manipulating the magnetic and electrical properties of atoms to store vast amounts of data, making iPods and other storage devices possible. Dr Fert and Dr Grunberg discovered even smaller and denser types of memory storage using spintronics (for which they received Nobel prizes) where the data is stored by manipulating the spins of electrons. Other examples of nanotechnology have been in a transparent coating of a few nanometres thick on glass cutting down on infra-red (i.e. heat) penetration and allowing more light to get through into buildings. Nanoscale particles of iron compounds can be used to clean up waste sites and break down hazardous organic compounds such as PCBs, dry cleaning fluids and neutralizing poisons such as lead and arsenic. Far more effective than larger iron-based compounds; but admittedly this is still being tested. Getting heat out of the increasingly tiny but faster computer integrated circuits is also a growing area of nanotechnology research and application.

Typical benefits of nanotechnology include: atomically engineered food and crops, clean water supplies, smart foods, cheap energy generation and savings, improved design and production of pharmaceuticals, greater information storage and interactive smart appliances. On the other hand, many feel that it will widen the rich-poor gap, provide very toxic chemicals and break down the barriers between life and non-life with destructive consequences for humanity.

As with all new technologies, you can ignore nanotechnology and hope it will go away but eventually I believe there will be the inevitable Tsunami like effect on your life and business.

How can you take advantage of these marvellous (and possibly dangerous) technologies in a positive way?

- Open your mind and read as much as possible on nanotechnology
- Talk to your colleagues about it
- Look for applications in your field – you will be amazed how many applications are opening up on a daily basis
- See how this can transform your business
- Understand and argue about the ethics/morality of some of the applications (e.g. DNA manipulation) – we need to avoid this becoming another dirty field of science
- Look for opportunities to gain skills in these technologies where possible to provide support to others

Hopefully the tiny particles that constitute work in nanotechnology are not identified in the following way, as Dave Barry wryly observed:

Electricity is actually made up of extremely tiny particles called electrons, that you cannot see with the naked eye unless you have been drinking.

Yours in engineering learning

Steve

Feedback

Sure enough, these identified benefits cannot be over-emphasized.

But we must not also exonerate the environmental impact of industrialization.

I'll suggest that as we further improve our knowledgebase in nanotechnology, further research should also be looked into in the area of environmental and human impact assessment of this aspect of science.

For a few weeks now, in the shower, i have been looking up at a daddy-long-legs spider which is minding a corner of the ceiling. We co-exist, it munches on smaller critters that I don't like, and it doesn't hurt me. I guess its brain would measure around 0.5mm, or 500,000nm. I marvel at how such a complex pattern of activities is managed in such a small volume: hunting, web building and maintenance, body systems management, its (un)social interaction with a couple of other spiders enviously watching it in its prized corner position. We have such a long way to go

before we can build a computer that smart and that small as the spider's brain. If we continue to not blow ourselves back to the stone age, I think nanotechnology will take us there. Back in 1900 it was impossible for anyone to predict where electricity would take us, the science behind most of the technology we use today was just being realised by the now revered scientists of those times. While these discoveries were going on which would so totally transform the whole of humanity, everyone just went about, making other plans without thinking about the enormity of the changes ahead of them. I think we are at that same stage with nanotechnology.

TC

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Your piece on nanotechnology is thought-provoking for anyone tempted to think that the development of technology has matured or stabilised. To think that there are consumer devices based on the spin of the electron, an almost abstract notion, is enthralling.

Much of the writing on nanotechnology centres on possible medical use in delivering drugs to the point of need. There is a concern that some of these particles might prove relatively unmanageable if released in the atmosphere - how would inhalation of nanofibres affect the lungs, for instance. I gather these aspects are being investigated.

You mention their possible use as catalysts: a major promise of nanomaterials will be their strength and temperature, etc. resistance. Is it possible that such a technology might arrive just in time to meet the as-yet impossible requirements for materials that would contain a nuclear fusion process?

Unfortunately it is more than likely that the larger allocation of development funding will go as usual to military applications.

Regards

PD

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Many thanks for the interesting article on nanotechnology. Most recently we started working with HYSITRON a US company manufacturing Nanomechanical Test Instruments to determine material properties such as hardness and modulus by indenting an extremely hard probe tip of a known geometry into a specimen while continuously measuring the force and the displacement of the indentation. The resulting curve can then be analyzed to determine these properties. The application is suitable for metals, semiconductors, polymers, biomaterials, and ceramics. I thought your readers may be interested in this aspect of nanotechnology.

Wolfgang Frank

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I also have a memory of an aircraft simulator getting into trouble as: 1) when a plane banks the electronic compass no longer points correctly due to change in curve of flux lines. 2) Pilot in real aircraft needed to be aware of this (essentially during a bank their system would no longer point correctly and they would be tempted to under / over do the turn. 3) As they came out of the bank they were not pointed where they expected to. 4) The simulator did not replicate this action 5) Pilots in real world got confused because of mismatch to simulator experience. NOTE: this was along time ago and could even be URBAN MYTH material.

After writing above have done a quick Google and found below. Google terms used:
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1) mems compass. 2) compass aircraft simulator error

Although not strictly nano-technology as some define it, MEMS (Micro-Electro-Mechanical Systems) are already having an impact with cheap reliable accelerometers being used in many application areas (from vehicle crash detection for air bags to GPS tilt detection to correct for the curve of magnetic field lines for the electronic compass). See: http://www.memsnet.org/mems/ or Google mems.

Regards

JR

Are we tilting at windmills with solar and wind energy?

Posted: 23 November 2007

Dear Colleagues

Two items today:

1. Over 300 shareware software programs available

Thanks for the superb responses of a few hundred programs to my request for shareware and free software. We are finalising the list and should have it out next week with a free CD or easy-to-download from the website. Much obliged.

2. Are we tilting at windmills with solar and wind energy?

I always admire engineers who practise what they preach. After my nuclear power article some weeks back and the rather violent response from the esteemed readership, I had a particularly thoughtful response from Alex H., a senior consulting engineer with one of the world's larger consulting firm. He outlined his thoughts on the preference for renewable or clean energy and noted that he has his home wired up completely for solar energy. Not a watt of electricity is purchased from the local electrical utility. As he pointed out: "Incidentally I have been living in an off-grid solar powered house in the bush on and off for the last 6 years and it's a breeze - no different from the city except that I don't get a power bill." He continued to say that renewables are not the whole answer but should be considered as the most significant part of the system. Their advantages are cheaper in capital cost (esp. compared to nuclear power) and shorter lead times to installation (hence the large number of wind projects in the pipeline worldwide). But his reservation was that we are not clear about how best to integrate them into the current power system paradigm (wind, solar, geothermal, hot rock, hydro and thermal).

The clean energy business is turning into the next big investment boom. Investment in the field has gone from $500million in 2004 to over $2 billion today. This is fuelled by high oil prices, energy security fears and global warming concerns. The economic problem is that renewable power and fuels will be more expensive than the dirtier sort for the foreseeable future; government hand outs are essential to make this workable in the short term at least, however governments tend to let tax breaks expire which often causes a hiccup in the industry (eg wind generation in the USA some years ago). If oil prices dropped below $50 a barrel, the momentum would be lost as governments again lose enthusiasm for the carbon-free technologies due to the more expensive subsidies required. At present, keeping pace with demand is the challenge – manufacturers of wind turbines have full order books for years ahead; solar firms are outpacing the supply of high-grade silicon to make their panels and investors are rushing in. Despite all this, solar power will still only provide a tiny percentage (1%) of the world's energy for the next decade, which can be dwarfed by the other pressing issues.

The point made is that despite this flush of enthusiasm for renewables, there will be many bumps along the way. It is important as engineers that we keep the rudder steady and keep persisting with bringing the prices of the renewables down and improving the technologies and staying the course. No matter what happens.

So my suggestions are:

- Keep researching new improved technologies in renewables

- Actively look at applying these technologies in our next design
- Educate others about the benefits
- Do what Alex did and set up your own domestic renewable energy system
- Do not lose faith despite the temporary obstacles – we are not tilting at windmills but doing something really important in applying these new clean energy sources in our world

Finally in the Australian elections this week, may I respectfully suggest you vote thoughtfully for the party who will manage our resources, infrastructure and environment in the most responsible and sustainable way. Do not follow Mark Twain's exhortation of: "It is by the goodness of God that in our country we have those three unspeakably precious things: freedom of speech, freedom of conscience, and the prudence never to practice either of them".

Yours in engineering learning,

Steve

Feedback

Being part of the renewable energy sector now has given me access to a lot of information I did not have before and I believe I have good news. The speed at which production capacities for all types of renewable energy generators are expanded is amazing and probably comparable to the IT industry 15 years ago.

Obviously it's all driven by market demand and funding through the worldwide capital markets and their speculations for returns.

And, like the IT industry the new energy technologies are here to stay, because they are needed to maintain our chosen lifestyle (if not human needs) in times when existing sources of energy are no longer acceptable or available. Australia has been unable to participate in the development of the IT industry and, I fear, we are about to experience the same with the development of the global renewable energy industry.

At present several countries experience surprising benefits from embracing the many available sources of renewable energy. A virtual power station in Germany, created from real life renewable power plants that are grid connected was controlled by a central demand management system to provide matching power outputs to the grid demand over several months. In a windy night last winter Denmark's wind turbines covered 100% of the nation's electricity demand and started to export their excess power to the European grid. Grid parity prices from several renewable energy generation are expected within 10 to 15 years for countries that have to import fossil fuels. Highly efficient photovoltaic cells that operate on several wavelength have already produced efficiencies > 40% in lab applications (not bad in comparison to turbines, which have a lot less innovation potential left in them). Solarthermal, geothermal and wind are already able to supply large industrial loads and all of these technologies find almost ideal operation parameters in parts of Australia.

I share the view of many that the dominant sources of energy in 2050 will be very different from today ... and the engineering profession has many good reasons to take ownership and pride in these developments.

Best regards and greetings from Townsville

Frank Dallmeyer

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A good book to read that has just been released *Renewable Energy Cannot Sustain a Consumer Society* by Ted Trainer, University of NSW, ISBN-13: 978-1-4020-5548-5

Paradigm not just integration (the existing systems are not designed for reverse, bottom up power flows [transformer tap changers have limited buck taps, fault isolation, maintenance isolation, directional relays, etc.), also storage is obvious problem/shortcoming (as is spinning reserve, system inertia and frequency control), requiring almost the entire suite of existing conventional generation for windless winter night.. I'm sure your off-grid consulting engineer example uses lead-acid storage which is not viable on a large scale for obvious reasons.

Anyway, enjoy your blogs – keep them coming.

JRH
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The myth of bottling your experienced techie's know-how before they leave

Posted: 28 November 2007

Dear colleagues

My engineering peers often shake their heads ruefully when remarking on the wasted results of the last knowledge management exercise they have done. Often costing millions. A complete waste of time, they exclaim. Trying to bottle knowledge or experience of one's staff or peers before they retire or leave is exceptionally difficult. Impossible and mythical, perhaps.

Formally put (by Gartner): knowledge management is about identifying, capturing, retrieving and sharing knowledge in the business. This could include databases, documents, policies and more simply in an engineering context, know-how in your techie's heads. The last one is the tricky one. Some researchers believe that the failure rate of knowledge management projects at up to 50%.

There are essentially two types of know-how that you want "to bottle": explicit and tacit. Explicit knowledge can be written down e.g. A product specification for a breadmaking machine (or indeed, a password for your demented server). As opposed to tacit knowledge which is a core part of the craft or profession and is built on learning via actual experience and action, such as learning from a guru over a period of time on how to make good quality bread. Perhaps, also tuning a process control loop, with a good feel for a plant vagaries.

We have numerous scattered pockets of expertise locked away on our sites in the heads of a few strategic engineers or techies or on grubby pieces of paper. I have seen plants being brought to their knees when a critical techie has left site (in one case, to present a course for us from a large processing plant which crashed and no one on the plant had the know-how to fix it – it turned out that a quick phone call to him, unlocked the key issue and everything was humming smoothly again). When I had finished commissioning a particularly large iron ore plant some years ago, I used to leave site with great trepidation. As there was no one to hand over to. The client believed they didn't need any expertise on-site. They changed their mind after a few crashes and had a simple documentation system created with a few well trained techies on board to maintain the plant.

Hoarding knowledge and expertise is often regarded as a "good thing" to make one valuable and to hold management to ransom, in "difficult" times. But I believe the true engineering professional shares knowledge freely with no fear and absolute confidence in one's abilities and worth.

What I would respectfully advocate (but would welcome your suggestions) is:

- Keep written procedures updated as to how "things are done" in a simple readable format ("as built")
- Put an 'apprentice' in to learn the ropes from the various experts and then practice what they have learnt
- Run short regular learning sessions on aspects of your engineering and business systems for everyone to gain and share the know-how

- Spread the knowledge around as much as possible so no one is absolutely strategic
- Make it easy to find all this information on your system. If it is not easy; it will be lost and forgotten
- Try and index the know-how in an easy to access and easy to access format
- Have rigorous backup procedures for your knowledge and databases (which work)
- Convince everyone that it improves one's worth when they have to learn new methods and ways of doing things
- Make sure you have the key person still accessible after they have gone – ie they depart with much goodwill on both sides Swap roles around as much as possible so that you have people with a general know-how on doing critical items
- Perhaps outsource tricky but rarely used functions to others outside your firm who can be called upon when needed at a cost effective hourly rate
- Lock-in experienced people who want to retire on a part time arrangement where you will fit into their requirements
- Store knowledge innovatively - video key procedures and store it on your system
- Ensure the engineering leadership buys into the importance of retaining knowledge

Whilst it is important to realize that you have to work on building up your knowledge storage systems, a remark from Benjamin Disraeli makes us feel somewhat better:

> To be conscious that you are ignorant is a great step to knowledge.

Yours in engineering learning

Steve

How to avoid engineering career killers - 11 tips

Posted: 6 December 2007

Dear colleagues

We are closer to the end of the year. Did you achieve what you set out to do on the 1st January 2007? Perhaps you never gave it too much thought with all the day-to-day stuff going on. I am composing this over a few welcome coffees in Dubai after a missed flight (we're doing a little hazardous areas roadshow in the region).

Thanks once again to all you wonderful engineers and techies out there who write to me. Your suggestions/criticisms and help is always gratefully received and acknowledged.

A few thoughts on how to avoid the sabotage of your brilliant engineering career – perhaps something to add to your 2008 New Year resolutions? Thanks to John McKee of BusinessSuccessCoach for his relevant ideas here, which I have modified for our engineering lives (from his IT geek focus).

1. Make sure you have a life plan.

This is the number one problem for most engineers and techies. A plan that includes one's career, along with personal/family and financial goals. Where do you want to be in a year? Ten years? Write it down in a few short sentences and read it every morning before you start your day. An engineer pointed out to me yesterday that he doesn't particularly worry about money; he enjoys his job and that is all that matters. This is good, but you still need to pay the bills and put something away for when you're older or sick and want the best for your family.

2. Keep your skills current.

You need to keep surfing the engineering wave. What was a key skill yesterday is not necessarily one today. Learning new skills certainly doesn't mean only attending a course; but informal learning from your peers/books/the internet/on-the-job and then practicing the new found skills. Engineers and techies are in ferocious demand today. But all booms must end, and keep in mind that lower cost countries are developing some extraordinarily skilled people who will compete. Don't hoard your knowledge but pass it on freely to others in your organisation. They will reciprocate and regard you highly.

3. Deliver real results to your organisation.

You have to deliver the goods. Unfortunately putting in extraordinary efforts (such as working long hours) is only part of the story for career success. You eventually have to demonstrate real results which will distinguish you from others when a promotion is at hand. Persistence and innovative thinking are the key attributes to excel and deliver real results.

4. Don't confuse efficiency with effectiveness.

Many people love doing everything quickly by email with no person-to-person contact and don't bother about talking to real people. You need to talk and communicate in person or on the phone with others.

5. You're not irreplaceable and unfortunately you are not unique.

No matter how much you know; there will be someone out there who is cheaper and better who can replace you. So don't be overconfident. Listen carefully to others in your company about how you are performing and view your engineering ability objectively. Often difficult to do. As it can be a painful experience. But very productive provided you approach it positively.

6. Learn carefully from the signal in the noise.

There is a lot going on around you. An incredible amount to learn. New ideas and new approaches; a lot of them are rubbish. But occasionally you will come across new approaches and new technologies which despite your worse fears, can be applied very successfully and result in remarkably positive changes in your engineering world.

7. Don't surround yourself with "yes-(wo)men".

Don't believe people who keep telling you what a wonderful job you are doing. They may be your subordinates or others who have a vested interest in keeping you happy. Look for strong critical but constructive reviews of what you are doing.

8. Give credit where it's due.

Don't take credit where it isn't due. It doesn't reflect well on you. Ensure you praise lavishly for successes achieved by others. People will respect you all the more.

9. Self-promote yourself with panache.

A fine line between being a braggart and hiding your light under a bushel by being too modest. Ensure that everyone knows (including your boss) of your successes and achievements using newsletters/case studies/improved design procedures/helpful emails etc. Without being overly immodest, obviously. If you keep ultra quiet, no one will know what a marvelous job you are doing.

10. Don't lose perspective.

Sometimes a design or problem seems intractable. No easy solution can be found. Have no shame in consulting other colleagues for assistance here and other perspectives on solving this problem.

11. Be passionate, enthusiastic and have a positive attitude.

Don't complain and be "political". Just concentrate on getting the job done with enormous chutzpah and passion. Avoid the blame game. One of the finest and most experienced industrial automation engineers (Martin G.) I know of, has often been given failed designs to fix. He goes about his task quickly and effectively with nary a negative word about the previous incumbent. I always believe that if you are passionate about what you are doing, you will always be eventually successful. If you are not passionate about what you are doing, get an exit strategy sorted out as soon as possible. This is your life.

In conclusion, I reproduce a tiny part of a poem I keep with me wherever I am:

When things go wrong as they sometimes will/When the road you're trudging seems all up hill/When the funds are low and the debts high/And you want to smile but you have to sigh/When care is pressing you down a bit/Rest if you must, but **don't you quit.**

Yours in engineering learning
Steve

Can we make engineering safety standards work?

Posted: 12 December 2007

Dear Colleagues

On my travels in southern Africa; this morning I witnessed a horrible car accident with a little kid being tossed into the air after running across a road. Later, a good client working for one of the largest companies in the world, commented that a smelter component had recently exploded and killed an operator. A couple of nights ago, whilst supping in a sea-side café we saw flares being shot off from a small boat in distress and then shortly afterwards a rescue chopper buzzing out. And a few weeks previously, in the self-same city, an engine had fallen off a Boeing 737 whilst taking off. These all have put me to thinking of safety.

Many of these safety issues, are perhaps a little outside our direct engineering province coming down to better road or boat safety practices and a good dose of commonsense, perhaps. But the smelter explosion and engine the falling off the Boeing illustrate the issues of process safety and machinery safety respectively – issues which directly impact on us engineers and techies. I am grateful to my colleague (a real control systems safety guru), Dave Macdonald, for giving me the necessary summary below on current developments in safety control systems. No matter where you are working in engineering, you will increasingly come across these safety standards discussed below. So forgive us for a quick tutorial below. I found it very useful personally. Thanks, Dave.

The first question is of course, why bother about safety standards?

The great advantage of having international engineering standards for safety is that if we all work to the same principles there will be globally available products that will do the job in the same way in any part of the world. Good standards represent best practice, and who would want to stand in court after an accident and not be able to claim that they followed best practice? So we are moving away from locally generated prescriptive standards, which are difficult to maintain and use on a global basis. After all, we are rapidly becoming a global engineering community and we all want to use the best solutions.

As the best reference source for designing and managing automatic safety systems for process and machinery hazards the standards IEC 61508 and IEC 61511 have been a resounding success. They are not just European standards; but truly global standards covering the subject of functional safety, which means an active function or response to protect against a hazardous condition. Think of safety interlocks, trips and critical alarms.

But what the hell are these IEC 61508 and 61511 standards?

IEC 61508 has been in place for nearly 10 years. It provides a broad-based set of principles and advice on how to specify and build safety control systems using electrical or programmable electronic systems such as PLCs. It has a strong emphasis on safety management through the entire safety life cycle of a product or application ranging from a pressure sensor to full sized ESD for a large oil and gas installation. Its emphasis on management methods is because human factors remain the dominant cause of failures in functional safety systems. Whilst IEC 61508 is a generic standard for any form of electronic safety controls, it has in turn led to the publication of the more specialised standards: IEC 61511 for functional safety in the process industries and, more recently, IEC 62061 for machinery safety controls. IEC 61511 has been adopted in many

industrialised countries for safety controls in their process and energy sectors and is published in the EU as EN 61511, in the USA as ANSI/ISA S84.01 (IEC 6151 Mod) and in Australia as AS 61511.

These standards ask you to define each safety function accurately and to set target safety integrity levels (SILs) in the range 1 to 4 according to the scale of risk reduction you need to make things safe. The equipment you provide must be capable of meeting the SIL-rated performance features. They will not allow you to use just any old instrument for sensing and they have stringent requirements for control equipment such that most standard industrial PLCs will not be acceptable for safety duties. If this sounds like something you have already inherited, now would be a good time to consult IEC 61511. (Try www.iec.org or www.saiglobal.com)

Where do we start with safety standards?

The first step is to decide which standard applies to your situation. IEC 61508 is predominately used for the design and development of safety equipment and hence is used mainly by manufacturers to ensure that the hardware and software they supply for safety applications are right for the job. But if you are engineering a process control project with safety involved you will need to use IEC 61511. It is laid out in the form of a safety life cycle with a series of easy to follow steps matching the stages of a typical project. Most significantly all the standards we have mentioned call for the competency of engineers and technicians working on safety systems to be appropriate to the job in hand. This means your employer should recognise your skills if you have them and get you trained if you are falling short.

We have spoken about Process safety – but what about machinery safety?

IEC 61508 has influenced a substantial revision of existing machinery safety codes resulting in two new standards: ISO 13849-1 which is now replacing the widely used EN 954-1 in the field of machinery safety interlocks, IEC 62061 which is aimed at typical manufacturing automation applications and robotics. To get started in machinery safety practices requires a grounding in the principles of risk assessment and the application of all forms of safety features. These in turn lead to the understanding of how safety devices are to be integrated into the overall control scheme for a machine.

Without wanting to sound like a Persian rug salesman, we obviously provide training and books on the above topics. As do many other very reputable organisations throughout the world. But there is a wealth of free material on the web to assist you. Despite all this above, we should never forget, as Jeff Cooper, wryly observes:

> Safety is something that happens between your ears, not something you hold in your hands.

Yours in engineering learning

Steve

2008

Welcome to another brilliant year!

Posted: 15 January 2008

I trust 2008 is kind to you. A short one today, as I have to cope with the aftermath of two weeks of lying around on the beach with family and reading copious numbers of books and magazines. And now I am catching up here in the office.

Despite the dire predictions of a recession in the USA which will spread throughout the world, the need for engineering skills has never been more urgent. Even in Asia with its huge population, there are severe skill shortages developing (according to the respected Economist). So party and enjoy yourself (after all relaxation is critical in these harried times), but also invest in yourself. This does not merely refer to formal training courses - make it a daily mantra to sharpen your skills and know-how. Stretch yourself mentally in every task and project you do and naturally your dexterity, if you engage in manual tasks as well - such as laying out the cable loom or finishing off the panel design with even more economy and panache in the layout. And encourage your kids to do engineering and science subjects at school and projects at home.

I know the hardened cynics will grunt disparagingly, but surely we get tremendous career fulfillment in doing engineering. I know I do. And we truly build a nation's wealth by engineering things.

As the old Greek sage, Epictetus, gently remarked 2000 years ago:

> Only the educated are free.

Yours in engineering learning,

Steve Mackay

Engineering and the 'long tail' distribution

Posted: 16 January 2008

Dear Colleague

Bumping over the Malacca Straits (but 40,000 ft up, well away from the sea pirates below), relaxed after a great few weeks surf and sun holiday, I was pondering about the engineering implications of the "Long Tail" coined by Chris Anderson in his recent book. A long tail is a statistical distribution plotting sales or usage against products, with a short spiky head located to the left and a long tail of the curve drifting off far to the right and being very long and low relative to its short spiky head. Tails are everywhere: from the most obvious such as Google (selling advertising) and eBay (auctioning) – both having no inventory whatsoever, to sports and engineering. In the past with products and services, we have tended to focus on winners which are located at the left or head of the distribution. We put an enormous effort into designing, manufacturing, marketing and distributing a few products in the hope that they will be very successful and carry all the unsuccessful products that are located in the tail of the distribution.

Think of hit movies, music, cars and domestic appliances. Until recently we have lived in the purely physical world; and had to expensively carry stock of everything in warehouses; promote and market intensively at enormous cost. If a product promotion failed, we would write it off and hope the hit product would carry us through. But with the advent of the web; we can now afford to promote all our products at minimal cost - including those far on the right of the long tail distribution where we would only sell a few products but now can actually make money from these products. In the old days; these low selling products would be doomed to oblivion as we couldn't market them (too expensive) and certainly couldn't stock them in a physical warehouse. And none of our customers out there could find them, as we couldn't afford to market to them.

But increasingly today, people are demanding niche products and services. They don't want to be restricted or squeezed into the so called “hit products”. We have to provide them with variety which fulfils their rather complex needs. If we didn't have the internet, we wouldn't be able to do much about this, but now we have an incredible opportunity to serve our customers better and to make money from our marginal products. And in catering to the niche market; we actually strengthen our market position of our products. For example, there is considerably less competition in selling these niche products. Obviously we have to use the internet at lowest cost as possible to market them. And having niche products and skills raises the entry barriers to other competitors.

How can we apply this concept to our day-to-day engineering work? According to Anderson:

- Offer an enormous variety of products for your customers to purchase but in a minimal cost way using the web. Minimise the physical storage of your offerings and focus on using "bits on the web rather than atoms" to offer your products and services.

- When designing, manufacturing and selling your products and services get your customers to help you. Let 'em do the work; mostly for free. Customers are often more knowledgeable about the application of your products than you are. Get them to write the application notes of how they have applied your latest instrument or lubrication oil or gadget and give them wide credit for this.

- Make the distribution of your products multidimensional to cater for your varied customers needs. Via the web/CD or from your warehouse.
- Don't force a one-size-fits-all-product on your clients. Allow them to fit it to their requirements. Obviously without making a rod for your own back with a horrendously complicated product which you have to maintain. If you are selling a new engineering design suite of products; ensure that the client only has to purchase and use what they need. And the same applies to price. Adjust the price to the market and application. Be flexible here.
- Share information about the strengths, weaknesses and uses of your new engineering widget. Present the information in a way that is idiot-proof, easily understandable to your customer and freely available.
- Allow the customer to choose as much as possible in the creation of the product. Let him assemble the product on line before purchasing it.
- Let the market drive your products as to what it requires. Give it as big a selection as possible and help it to search successfully for your niche products.
- Give away free components of your great new engineering widget or software for your users to test out. If the product is as good as you say; they will upgrade to the paying version.

Obviously it's important to automate the selection, shipping and maintenance process as much as possible to avoid being sucked into millions of customised variations of the product requiring an infinite and impossible support process from real people. A situation we have been in before which would roar up the costs and destroy any profits. And of course, it is likely that being a niche product with small sales we need to insulate against any drop off in demand with other alternative offerings being developed all the time.

The long tailed distribution applies to everything. Whether it be skills or design and sales of engineering products and services. Take your engineering skills for example. Ensure that your collection of skills appeals to a range of employers who have difficulty in finding people with these attributes, and you have a way of marketing yourself to these global clients through the you will be hired. Probably at higher rates than your peers. So when offering engineering services to customers ensure you offer an enormous rich niche solution and do it on a worldwide basis. Thus satisfying clients who were often constrained to use limited services locally they perhaps weren't quite happy with.

Another example is industrial automation. Until the advent of the web and open software, we were severely restricted in the design of our plants in terms of giving our users and operator's choice and information at far more locations. Now if we can involve our users and operators in the design of the plant and get them to take ownership; we can make an enormously more flexible offering with a far more niche product. With an emphasis on more safety than ever before.

As Anderson concludes: "The question tomorrow will not be whether more choice is better, but rather what do we really want?"

Yours in engineering learning

Steve

I must give full acknowledgement and thanks to Chris Anderson who wrote the illuminating: "The long tail". Equally applicable to engineers and techies as to music executives. The interpretations above are all mine and he shouldn't be abused for these.

Testing engineering systems: but only perfunctorily

Posted: 23 January 2008

Dear Colleagues

Last week, a new Boeing 777 crash landed at Heathrow, England when the pilot tried to increase the throttle on the engines when landing. All power was lost, and on first reports, we owe an incredible debt to the pilot for managing to avoid catastrophe by gliding in to land. Sometimes there is human error involved. But this doesn't appear to be the case here.

Perhaps I am barking mad (again). I would respectfully suggest that this illustrates an issue I have had over many years with the testing of engineering systems. Testing and testing again and again of every permutation of operating an engineering system is something that is not sufficiently emphasized under every circumstance possible. Certainly we always do testing of our systems that we design and build; but do we do enough? Far more attention needs to be given to this process. I believe often it is the client's fault in not highlighting and budgeting more for the testing phase. The development of many systems comprising a complex combination of software/firmware and delicate electronics and mechanical hardware are often over budget and time when completed. We are so delighted to have the product completed that we just don't have the time or money to test it as thoroughly we would like. For example, once you have written your wonderful Programmable Logic program how much time and resources are spent on actually testing the complete working system? Not nearly enough, I would suggest based on commissioned industrial automation systems I have observed over the years.

As Wikipedia sagely observes: A problem with software testing is that testing all combinations of inputs and preconditions is not feasible when testing anything other than a simple product. This means that the number of defects in a software product can be very large and defects that occur infrequently are difficult to find in testing. But this doesn't mean we can release it onto the marketplace without redoubling our efforts in testing it even more extensively than ever before.

Some well known controversies with testing (especially software) include:

- What constitutes responsible software testing? Many believe there are no best practices for testing. Everything should be designed around the specific product being developed.

- Manual versus automated testing. Some believe that testing in an automated way is so expensive that it should be used sparingly. Others believe there is no other way to test these days.

- Who watches the testers?

We must re-educate our clients and the overall industry in that it is critical to emphasise testing of the final system. At present, I believe this is a neglected part of the specification. How do we really know the system is going to work under all circumstances as planned? Systems today are vastly more complicated than in the past.

Without a shadow of doubt, there are numerous standards written for testing and verifying

the performance of systems. However, I don't believe we stress the application of testing sufficiently.

Food for thought, perhaps, when designing your next Boeing 777 or simple PLC control system.

Yours in engineering learning,

Steve Mackay

Power travails of Africa or Don't let your local politician walk over you

Posted: 14 February 2008

The first few weeks in Jan'08, with rolling power cuts, have been hell for industry and mining in South Africa. There is a feeling that the genie has escaped from the bottle and with it a sense of reality. And solutions to the recent developments seem elusive.

The 2010 World Cup is being held in South Africa! Confidence in the success of these games is difficult with the power shortages prevalent, with few remedies apparent.

I must confess that I was wryly amused with these problems facing our engineering cousins in South Africa as the crisis has been looming for a good few years with little forward planning evident. If I were directly exposed to it, however, I would be less than amused, downright irritated and rather twitchy about future prospects for a reliable power supply.

Possible solutions have included reducing the demand, accelerating the construction of power stations and using more renewable energy solutions. More extensive private sector provision of power has been encouraged too. Despite the obvious lack of power available in a burgeoning South Africa there also seems to be some incompetence afoot. Contractors responsible for coal delivery to the power stations have failed to adequately supply them, for example, exacerbating the problems of unplanned outages. Furthermore, the lack of engineering training seems to be an issue – not only with regards to technical training, but also in engineering management. There is an important lesson for us engineers and technicians in this whole debacle – no matter where you live in the world.

As engineers and technicians we must actively look at the issues that confront us on a daily basis and anticipate the problems and crises that will occur and make engineering opportunities of these. And then actively canvass our local (political) leadership to fix the problems with suggested realistic engineering solutions. And then using media spin to hold them responsible. Whether it be; diminishing reliability in power supplies, inadequate sewage, crumbling infrastructure, defective telecommunications facilities, polluted environment, poor quality water or neglected education facilities.

At the end of the day, we are the engineering experts and can provide the solutions. And sadly enough, if we don't do anything about it, we are ultimately responsible for the crises that result. After all, each country gets the political leadership they deserve (or elect).

A US President, John Kennedy's remark is relevant to this crisis and others in the future:

> The Chinese use two brush strokes to write the word 'crisis.' One brush stroke stands for danger; the other for opportunity. In a crisis, be aware of the danger - but recognise the opportunity.

Yours in engineering learning
Steve

Re: The diminishing coal stockpiles at the South African power generation plants. Sounds like the economist who read about Just-In-Time inventory management has struck again.

Similar problems in India with price controls on the electricity generators. The state government policy makers prohibit the state electricity generators charging the consumers the REAL PRICE of producing the electricity. Therefore they do not have the resources to improve distribution efficiency which has 40% losses.

Regards,
Kevin.

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There seems to be a number of reasons why SA finds itself in this situation. You've probably had a lot of information on the subject already. You mentioned the contractors responsible for coal delivery in your letter: hearsay is that there was no escalation clause in the 4(?) year contracts for, say, escalation of fuel costs, and that contractors can't stay afloat at the prices. It is hearsay that inexperienced managers of Generation plants had been unperturbed over the years by the reducing hills of coal on site, and that they, despite warnings from old hands, were unconcerned that the stock was not being replaced anywhere near the rate at which it was being burnt.

In addition, since the late 1990s the NER had rejected Eskom's proposed annual increases of 7% and upwards and limited them to 1% - 3%, which would have enabled them to plan for new plant that they then estimated they required by around this time. In any event, if Eskom were able to keep the even the plant they had running last year, the load shedding should never have been so severe. Lastly, as you intimated, skilled and experienced staff are scarce. For the future, it will be a real challenge for newly recruited engineers of a few years experience to get power stations "de-mothballed" and to orchestrate the construction of new plant. Once skills are lost to the likes of UK, Australia and New Zealand they are generally lost for good. A country deserves the government it has - just as I say about Zimbabwe - but actually the wrong people suffer the most.

MG

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I predicted this nine years ago. How? I worked for [a company] in South Africa. At the time there was a considerable push for affirmative action positions, such that after a lot of these applicants failing to reach the standards we'd set for the positions, management made us revise and drop the standards. That's one aspect - dropping the standards. The result of this was the employment of affirmative action 'theorists' – great on paper, but totally bewildered and lost practically in the field. Anyway, one of these chaps was a fully (overseas) qualified Engineer – but he was not quite up to it (and I bailed him out numerous times). Suffice it to say, after time he was poached by Eskom. I had had enough of my friends and family (real direct line stories – no hearsay) being attacked and shot and robbed, I decided in the interests of my small kids to flee. This newly appointed Eskom chap 'phoned me just prior to leaving, offering me a fantastic post with great perks, bonus, car - the whole nine yards. But

realising the lack of depth apparent, I declined and escaped, wondering how long this edifice would last. Now we know. Ironically, all the people were very nice, and I'd had a lot of them at home for visits. The system let them down by not pegging them at their level of competency and experience, such that very quickly they were out of their depth, and did not have the experience or background to look for help. The spiral get steeper and faster!! That's the other aspect - people in power positions with no experience. Let's hope it all sorts itself out - but I'm not holding my breath with the situation there. Something's got to give, but they won't.

Kevin.

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When South Africa creates an environment that discourages their technical people from remaining in the country is it any wonder that they decide to come to safer havens such as Australia. I am also suspicious of the hearts of the leadership of the country. I wonder where all of the money will go. Already Zimbabwe is being driven to emasculation by a corrupt leader. Will South Africa eventually go down this path or will the future statesmen and voters realise that this is not a good situation to be in and choose to become a truly democratic state.

JA, Australia

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For past two evenings we experienced a couple of hours black-out in Lusaka, Zambia as well. Yesterday morning we were without power for two hours. It is really worrying - losing the production output but the wage bill remains the same hence making us less competitive internationally. What chances do we have??? To invest into own diesel gensets and cough up monies for the fuel to run them therefore making us less competitive again?? Or to try to recover the invested capital, abandon the place and start again from scratches somewhere else??? We, the investors may be able to do it. However, considering the social responsibility over 100+ our employees, it means 500+ local Zambians - I would feel like betraying them after so many years they worked for the Company and contributed that the Company is where it is right now... WHAT IS THE RIGHT ANSWER

Our problems do face personnel that physically invest their earnings into some productive set-up all over the world - where is the boundary between loyalty, social responsibility on one side and "saving yourself or your many years earnings/ may be your pension as individual" on the other side??? It would be quite interesting to get some kind of discussion going around this theme and to read various inputs to end-up in some kind of general conclusion???

JB

Steve's response:

Thanks for your thoughtful note. I find it rather agonizing to read this as I sympathise enormously. I would suggest respectfully that with the current resources boom (in Zambia esp.) that the problems you face are fixable and can result in a profitable outcome for you. There is no doubt that as businessmen we are constantly kicked in the teeth and wonder about the salary bills that come in day and night, power or not, and the ravaging politicians currently ripping us off. The truth of the matter is that if you set up elsewhere you are exposed to greater competition and difficulties in setting up in a new country. So invest cautiously in new generating infrastructure and combine with businessmen in a similar position as far as power problems are concerned. And make the problem a profit generator. Easy to say from me. But I

believe there is some opportunity here. But best wishes and I really do appreciate your heartfelt note.

Common sense with safety is not so common around here

Posted: 25 February 2008

Dear colleagues

As an old engineering colleague of mine wryly remarked to me recently - engineering and technical graduates are often like babes in the wood when newly on-site as their practical and safety knowledge is almost non-existent. Despite an intensive 4 year (or longer) study program. My retort was that it didn't only apply to young engineers and technicians - and that "common sense is not so common around here" is often an appropriate expression on-site for even old hands. As we all know, electricity (well, energy) is extremely dangerous and can kill or maim if you are even a little careless. Fortunately most acts of carelessness result in a mild jolt (or electric shock), leaving no permanent physical reminder of the incident; but the unfortunate get life-long scars or worse.

We are compiling a list of tips from yourselves on working safely when commissioning plant or machinery from an electrical, mechanical, instrumentation and IT point of view. Please feel free to respond to this email with any safety and commissioning tips (a one liner to a complete procedure is fine) and we will circulate them to everyone in a nicely put together electronic book - over the next week or so. As we did with the software where we had a great response thanks to you, our wonderfully supportive global community of engineers and techies.

Examples of tips (do you agree with them all or not?) from different parts of the world include: (and I would love you all to contribute) are (and thanks to Vijay, our experienced senior Electrical Engineer, for many of these initial ones below):

Electrical

- Watch out when taking measurements with your Fluke - don't think you can connect directly onto the bus bar to measure voltage
- Make sure the cabinet has been clearly tagged and locked out before commencing work
- Before going for a black start for a power station make sure there will still be auxiliary power for the stand-by generator
- Make sure you have sufficient spare fuses
- Make sure you have adequate lighting at night when troubleshooting a cabinet
- When opening the electrical cabinet, make sure the door doesn't close on you inadvertently when you are taking measurements.
- If you are going to work on an electrical panel, ensure that it is disconnected from ALL electrical sources. Visible contact separation and locking against re-energisation are a minimum check. Ensure that earthing/grounding is firmly in place until your work is completed.
- Never assume that a part is dead unless it is visibly earthed.
- When you earth/ground a bus or conductor, ensure that there is no voltage using an appropriate test method. If you are using a removable earth clamp,

connect the earth clamp first to the earth bar and then lightly touch one of the other clamps (normally there are three other clamps one for each phase) on each phase conductor. If there is no spark, then go ahead and connect the clamp.

- If you have ensured that everything is disconnected and still are unsure and want to ensure that an LV bus or terminal is dead; do so by touching the part in question with the back of your fingers with the palm open and facing you. If the part is live, the shock causes the fingers to curl and the arm to move towards the body (both are involuntary reflex actions), thus breaking the contact. Touching in any other way can be fatal.

- Live working (work on parts which are normally live) is permitted in rare cases. All other work must be done after isolation and earthing only.

- Sometimes you may have to check for voltage presence or measure the voltage under live conditions. If you are testing the voltage with respect to earth, place or connect the earth side measurement lead on the earth bus first and then place the other (usually RED) lead on the live part. Many people have received inadvertent electric shocks by reversing this procedure.

- Do not use uninsulated test-leads or tools with bare shanks when working on panels where live parts can be present. There is always a possibility of accidental short circuits.

- When you finish working on any equipment, ensure that no tools or operating handles remain on the live parts. They can cause short-circuits unexpectedly and can injure or kill you or someone else when the equipment is racked in or switched on.

- If you are called upon to work on or inside equipment driven by electricity, ensure that all procedures for safe isolation of electric supply to the equipment have been completed and power cannot be turned on unless you have done your job and move away from the equipment. Insist on a lockable safety device and ensure that the key is in your possession.

- Do not take any short cuts, especially when you are the person in-charge of a crew which is carrying out the work. Before you allow the equipment to be re-energised, ensure that everyone is in a safe location away from the equipment. Do not resort to any last minute tweaking after you return a work permit.

Instrumentation and Electronics

- Make sure you don't inadvertently put the PLC into run mode

and we also need heaps of tips on mechanical and IT (for example: IT - Assume the software is not working until it has been tested)

Yours in engineering learning

Steve

A sure-fire way to electrocution and immediate sacking

Posted: 27 February 2008

Dear Colleagues

First of all, thanks for the enormous response to common sense tips on safe practice and commissioning. We have been working on putting this into booklet form and will release it in the next few days. It will include a few hundred great suggestions (and unfortunately a few very effective, but risqué, suggestions that cannot be reproduced!). One particularly interesting point has drawn horrified responses already - understandably:

> ……and still are unsure and want to ensure that an LV bus or terminal is dead; do so by touching the part in question with the back of your fingers with the palm open and facing you…… If the part is live, the shock causes the fingers to curl and the arm to move towards the body (both are involuntary reflex actions), thus breaking the contact.

Roger, one of our more experienced engineers, remarked that perhaps this would have been acceptable in many countries 30 years ago, but definitely not today. Furthermore, as one reader commented, if this were practiced in his firm the individual involved would be sacked on the spot.

This illustrates an important point. We all work in a global engineering community. If you have someone new in your country, do not assume that he/she has the same ideas of safe practice and procedures as you do. Ensure that a thorough retraining program is undertaken to ensure the necessary engineering standards and procedures are learnt. Don't assume standards are the same, ever - an American working to European standards may be quite surprised by the different standards being applied in many cases. I do not insinuate anything other than differences exist and there are often reasons for these differences; a lack of money and resources, varying access to training, historical reasons, and generally just differing engineering standards et al.

This lack of consistency can apply even when moving from firm to firm in the same town. If you are working in the petrochemical industry with hazardous areas and someone new arrives, say from a manufacturing background, ensure he/she is trained and tested for the new hazardous areas environment. Similarly, if someone moves from the LV environment to an HV one. It is often quite staggering to see the misunderstanding that exists when someone starts in a new job with completely different demands and requirements. And naturally if you go to a new country or firm and the opportunity arises to raise the quality of engineering standards, this must be grabbed. Do so with persistence and understanding. You will inevitably save lives and often money.

As the Talmud remarks about danger and safety: Never expose yourself unnecessarily to danger; a miracle may not save you...and if it does, it will be deducted from your share of luck or merit.

I look forward to releasing your great collection of common sense tips and comments shortly.

Yours in engineering learning

Steve

Why is battery technology so slow in growing up?

Posted: 13 March 2008

Dear Colleagues

1. First of all - thanks for the further stream of comments/corrections and additions to the engineering safety document. I will acknowledge everyone shortly and we will update this booklet by late next week.

2. As engineers and techies we are required on a daily basis to stretch ourselves - engineering skills/know-how/designs/installation works/costs (and judging by last week's comments – safety). But what amazes me is the one area that is critical to all of us and yet still lurches along with only small improvements - battery technology. This is despite the technology being around since the early 1800s, thanks to Volta. Essentially a battery is made up of one or more cells, each with a negative and positive electrode, kept apart by conductive electrolyte that allows ions to travel between them. Rechargeable batteries make up two-thirds of the world battery market (56 billion dollars).

The first rechargeable battery (lead-acid) was invented by Plante in 1859 and is still much used today. In the early 1900's an electric car was a common sight, but they could not compete, on range, with the noxious, petrol driven ones. Nickel Cadmium batteries arrived in the 1900's and were used where more power was required. Lead acid and nickel-cadmium cells still dominate the market today as they are more cost effective even though they can't store as much energy, per weight, as the newer technologies. Nickel-metal hydride batteries have been in the market place since 1989 and store about twice as much energy as a lead-acid battery for a given weight. Lithium-ion is composed of the lightest metal and can thus store more energy than other metals.

Modern phones and laptops are using cobalt oxide as the positive electrode, but as it is so reactive it is not suitable for hybrid or electric vehicles. Manganese can be used, but this stores less energy and has a shorter life. Instead of cobalt oxide, iron phosphate is cheaper, safer and more environmentally friendly. It is not easy to predict which lithium ion will prevail. Between now and 2015, estimates suggest that the worldwide market for hybrid-vehicle batteries will more than triple to $2.3billion.

Perhaps we need to devote more resources and thought to this critical research – as Albert Einstein remarked: "It's not that I'm so smart; it's just that I stay with problems longer". Batteries need the same attention and improvement as computer chips – the latter have doubled their performance, every two years, for decades now. Perhaps climate change and high oil prices will finally give research the incentive.

Thanks to *The Economist* for their input here.

Yours in engineering learning

Steve

Battery technology is slow to grow up in my humble opinion, because of the following sometimes competing requirements:
1. The battery casing must not leak, or at least not leak during its useful life;
2. The battery ideally is to be made with environmentally friendly materials;
3. The battery is required to be as light weight as possible;
4. The battery may be required to supply as large a current as demanded by inductive loads such as motors, and still retain a high number of charge/discharge cycles;
5. The battery must not get too hot during the charge or discharge cycle;
6. The electrolyte must have a long life and the reduction at the cathode and oxidation at the anode mediated by ion transfer with the electrolyte should cause as least damage and introduction of impurities to both the cathode and anode as possible to allow for as long a battery life as possible;
7. The electrolyte needs to have as long a life as possible - impurities as a result of the reduction and the oxidation reactions must be kept as small as possible;
8. The reduction at the cathode and oxidation at the anode must be reversible to allow re-charging of the battery;

Due to impurities present in the battery electrolyte, there is competition between the reversible and irreversible chemical reactions. The irreversible chemical reactions are due to the impurities.

Even if a battery is devised in a lab that is close to ideal, there are many challenges in manufacturing batteries in mass quantities that produce batteries with performance deratings.

As a consequence of a battery's internal chemistry, it is regarded as an energy source and not as a power source. To provide the requirements of a power source, supercapacitor technology that works with batteries has been under development for several decades, for example www.cap-xx.com

Neil Ruedlinger

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I have read your emails for several years - which have often cheered up an otherwise lacklustre day and feel it is about time I contributed something back.

I am in the renewable energy business and have often mused about why, when the sun and other renewable sources of energy are so abundant in many places around the planet, better energy storage and transmission systems have not been developed to make the energy useable where it is needed. The availability of high energy density low weight batteries and/or low loss (super-conducting?) transmission systems would mean that some of the poorest of the world's economies would benefit from selling (almost) free energy, i.e. sunlight, to those with the biggest demand for energy, i.e. the richest and as an added bonus might just save the planet along the way. I am not sure that traditional batteries will fulfil this role but there are some interesting technologies emerging. Have a look at regenerative fuel cells for example, which have the potential to provide power station sized energy storage. Realistically though, we need a quantum leap in energy storage density to make this happen.

However, there is one area where modern battery technology has made a significant (for its débutees) impact. In my youth I was a keen aero-modeller and recently in my dotage I have returned to the hobby. I was pleasantly surprised to find that the noisy,
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smelly and polluting diesel and glow plug engines I was familiar with in my youth have been superseded by much lighter, cleaner and quieter rare earth electric motors and Lithium Polymer batteries. These batteries are half the weight of their NiCad counterparts, operate at a higher voltage (3.7volts/cell) and can sustain much higher currents, e.g. 30-40A at 11.1v. Developed for the mobile phone industry, they have revolutionised radio control aircraft.

HS

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Having been involved in battery RandD for many years the short answer to your question of why batteries haven't been developed at the pace of semiconductors is that all electyrolytic energy storage systems are governed by the Gibbs equation and all have limits which are intrinsic to the chemistry they are not subject to the quantum scale laws that have progressed semiconductors..

Lithium is good (although it has its drawbacks) but there isn't that much available lithium in the world; it's a strategic material. For that matter so is lead. when I was involved in traction battery development we estimated that nearly half of the world's available lead was running around in batteries already. Re cycling lead was a huge industry long before it became a green issue.

The 'in use' lead estimate included all the ancillary stuff like led pipes and church roofs, etc. and the availability of 'lead in the ground' was from commercially economic sources. This was in the eighties; since then the definition of commercially economic might have changed but even if it has doubled the available capacity it still leaves about a third of the world's lead in use. A reference for the lithium availability can be found on http://www.evworld.com/article.cfm?storyid=1180

JM

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While your point is CERTAINLY valid, there have been significant developments in key areas relating to specific batteries i.e. VRLA AGM which have almost totally replaced Nickel Cadmium cells and are the dominant battery technology in the telecoms and military aerospace industries today. The old notion of Nickel Cadmium batteries being far more reliable than Lead-Acid cells no longer stands true as this notion was based on a comparison with flooded Lead-Acid cells as opposed to the more recent VRLA AGM cells. Also, the use of pure Lead-Tin and various other alloys (only in NorthStar and Hawker SBS products) has extended the Lead-Acid VRLA AGM battery's shelf life from 6 months to 24 months and has extended battery design life by almost 10 years! Companies such as NorthStar continue to enhance their battery technology on an ongoing basis (led by world renowned battery chemist Dr. Frank Fleming) as recently featured in various publications. For example:

"Peoria, IL - April 30, 2007 - Firefly Energy Inc. (www.fireflyenergy.com), the Peoria Illinois-based battery technology company now developing a carbon-graphite foam lead acid battery for commercial and military uses, today announced that a contract has been executed with NorthStar Battery Company, Inc. (Springfield, MO), forming a battery manufacturing partnership to enable prototype and production support of Firefly's "3D" battery technology to serve the U.S. Army. Specific terms were not disclosed.

Firefly Energy's 3D carbon-graphite foam lead acid battery, the first of several

battery technology innovations from the company's technology portfolio for lead acid batteries, will be particularly valuable in Army field combat operations because of the dramatic advantages it offers over today's current lead acid battery products. Amongst many advantages, these batteries will deliver stronger, consistent performance in temperature extremes, at lighter weight, with greater power and life in deep cycle usage, along with increased overall runtime and stronger vibration resistance."

So in conclusion, I must agree that while battery technology has perhaps not advanced at the same rate as the microchip the advancements in specific key areas have been significant and have ultimately benefitted the various industries.

Looking forward to your next musing…

DM

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Steve, I work with DC standby systems and did a project, evaluating a 5kW Fuel cell with lead acid batteries and ultra capacitors (to supply the power during fuel cell startup). For this specific application the powersource needed to supply 5kW for +/- 30s. Technically the ultra capacitors outperformed the lead acid batteries (recharge time, number of cycles, maintenance cost etc.) but due to the fact that in 2006 it was more than 100x more expensive made the lead acid battery the preferred choice. The point that I want to make is that maybe the biggest potential for storing energy might not be batteries.

Pieter van der Smit

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Thank you for addressing the battery problems we face. Here are a couple references. Not only do we need electric vehicles but batteries for alternative energy systems as the lead acid battery is the only choice most people have to set up for their energy systems

http://www.soultek.com/clean_energy/hybrid_cars/has_chevron_stalled_hybrid_and_electric_vehicles.htm
http://www.ev1.org/chevron.htm

PC

Hard-won experience makes you master of the engineering universe

Posted: 19 March 2008

Dear Colleagues

My father once provided me with a warning that proved to be very wise – although it exasperated me at the time. I was contemplating doing electrical engineering when he said: "Remember my boy, with all your theory and design skills on paper, these are all nothing until you or one of the techies or craftsmen picks up the first screwdriver or soldering iron to start implementing your design".

In engineering education, we emphasise software and computer design skills to distraction. But sadly we ignore the importance of experience and, even more, the manual skills which build up our engineering experience. We learn a lot of theory at college as engineers and techies. But how many of us need to do a Fast Fourier transform or a Laplace transform today?

Experience seems to be in short supply, particularly if you observe a young engineer at work. In many cases (like a junior officer trying to read a map on the battlefield) he/she is often forbidden from doing any manual work due to concerns that there will be an accident and someone will get hurt. Why? He/she simply doesn't have the experience.

So was all this theory worthwhile? I doubt it. But it is infinitely easier to teach than practical know-how – much of which is missing in the engineering curriculum. Admittedly theory feels far harder to gain than practical knowledge (due to the incredible mental gymnastics one has to perform), but at the end of the day practical knowledge is the key to success in engineering. I was somewhat shocked when I finished engineering school and spent many months on the shopfloor learning basic welding, fitting, turning, milling and how to wield a soldering iron, screwdriver and spanner (to the right level of torque). I did, however, gain considerable proficiency as a result and learnt about real engineering and the difference between theory and practical engineering.

There are so many valuable skills, particularly with tools, that are simply not taught in college or university. These tricks and tips are often handled with panache by craftsmen, but are not easily taught by academics and instructors or books. They can only be gained the hard way - by brutal on-the-job experience, with a very patient mentor. Many technicians, who spend their lives working closely with circuits, often develop an incredible and deep understanding of electronic processes.

As Jack Ganssle rightly points out in his Yankee brogue:

> "Experience is a critical part of the engineering education, one that's pretty much impossible to impart in the environment of a university. You really don't know much about programming until you've completely hosed a 10,000 line project, and you know little about hardware till you've designed, built, and somehow troubleshot a complex board".

I had a young graduate (great on theory) programming a PLC. He got confused between a 10W solenoid valve and the starter of a 1.5MW ball mill when writing the program. Needless to say, with this as a starting point we had a problem when commissioning the plant.

As engineers and techies, we are like the blacksmiths of old. We start off as apprentices and through experience learn all our craft. And then when we have acquired all this expertise and know-how we start passing it onto the next generation without holding back any expertise. A sacred (engineering) obligation.

We're generally paid for what we can do and I would wager a considerable chunk of this is from experience – not from what we derive from theory. So, building up our experience as quickly as possible when we start off, makes considerable sense purely from a mercenary point of view. The top engineers and techies are valued for what experience they have gained over the years.

We have to learn from experience and understand that we will make mistakes in everything we do. As long as we keep trying, we are growing as engineers. We need to ensure that all our young engineers are involved 'practically' and get their hands dirty, when they start their careers. This is to ensure they are disinfected from the excesses of theory that they gained at college or university.

After all, as Barry LePatner remarks:
"Good judgment comes from experience, and experience comes from bad judgment."

My gratitude to Bob Landman and Jack Ganssle for their valuable input here

Yours in engineering learning

Steve

Innovation in engineering using (mainly) the KISS principle

Posted: 26 March 2008

Dear Colleagues

Thank you for your vigorous and at times feisty feedback. I do try and answer each and every one of your comments. This has become a little tricky with the number of responses, but if you go to the trouble of writing, then the least I can do is to respond. So if you don't get a response within a few days; send me a reminder.

I simply delight in the KISS principle (Keep it Simple Stupid). Probably because I end up doing everything in a rather convoluted way (just ask one of my colleagues how I put up a hi-tech tent one night with the rain pouring down; much to the accelerating chagrin of my dearly-beloved shivering in the howling elements) and am always pleasurably surprised when there is a simpler, quicker approach. Steve Jobs of Apple Corporation offers some seeds of wisdom – always worth taking and ploughing into your firm's (hopefully) fertile fields when talking engineering innovation. Bear in mind that engineering innovation doesn't mean massive groundbreaking designs; but often simple improvements such as a better way to solder or weld or handle a cable loom or deal with a vexing issue of safety. Tiny improvements perhaps, but overall enormously important to a business, especially when everyone is thinking innovation and incrementally improving things.

There are four lessons for innovating in your job or firm:

1. Focus on the user not on the technology when designing the product. Simplicity and ease of use and some elegant styling are the name of the game; not super clever, whizzbang electronics which we often love to engage in as engineers. Apply the KISS principle. The very simple and easy to use Skype was distilled from complex and arcane internet telephony. I believe this is often the most important lesson.

2. Innovation must be encouraged from both within and without your firm. The trick is to align your ideas with technologies that exist outside. The phenomenally successful iPod was invented by an outside consultant for Apple Corporation and was quickly and effectively linked in with in-house technologies and talent. This is often referred to as "network innovation". Engineers must not think something invented internally is better because of its familiarity. Grab safety ideas that you read about and apply them to your firm's applications. A new technique of wiring a switchboard -that you noticed at a neighbouring firm – which saves 30% of the time can be customised to your processes with enormous success, provided it is idiotproof and easy for the users.

3. Ignore the cacophony of the market when your instinct insists otherwise. Sometimes the market guffaws with horror at some designs; but one should persist with one's instinct if there is another untapped and quiet market which you are targeting with this new product. Nintendo invented the motion-controlled video game console called the Wii which targeted non-gamers which were a far greater market. We developed a data communications course 15 years ago which was of no interest to the traditional telecomms market (as they had all "been there, done that"); but when fieldbus and Ethernet arrived in the industrial market we ended up with 150,000 attending this course.

4. Fail, but persist. When an idea fails because of a lack of interest from the market; think through the issues carefully and perhaps redesign and relaunch a modified version. The Macintosh computer originated from the ashes of the failed Lisa computer. And was ferociously successful.

Steve Jobs remarked a decade ago – before his phenomenal innovativeness turned Apple's fortunes – "Innovation has nothing to do with how many R&D dollars you have. When Apple came up with the Mac, IBM was spending at least 100 times more on R&D. It's not about money. It's about the people you have, how you're led, and how much you 'get it'". So true and inspirational.

Thanks to the inimitable Economist and Apple for their thoughts.

Yours in engineering learning
Steve

Engineering multi-skilling in your part of the universe

Posted: 2 April 2008

Dear Colleagues

1. Thanks so much for the flood of suggestions every week – some taking alternative views to mine so they are definitely worth reading. Many include really interesting suggestions which I try to place on the blog site. Please remember that thanks to the conferences we are running we are putting up a selection of good quality engineering papers as well (in addition to our white paper archive). These are accessible at www.idc-online.com.

2. I am currently on a roadshow with a rather eclectic group of engineers and technicians. I have been struck by how many technical disciplines they have progressed through during their careers. One engineer, John, started life as a metallurgist, then moved on to work as a mechanical engineer in flow measurement, but is now focusing on IT applications to process measurement using satellites to transfer the data. Recently he combined all this experience with some business skills to build up a successful business employing twenty people - providing solutions through the Asia Pacific.

I noted, some time ago, that one of the greater challenges with our engineering careers, I believe, is the rapidly changing nature of them. As we all know, much of what we did ten years ago is more or less obsolete and no longer valid practice. But we all start off with common foundations – maths/physics and often chemistry in our initial training. There is an incredible overflow between the different disciplines anyway and they can't be put into little discrete boxes. The old timer engineers were always a source of great inspiration to me with their wide range of skills ranging from electrical, mechanical and even the new-fangled electronics and computer engineering. With a 'can do' attitude to all tasks that confronted them - grab a design book and study it or ring a colleague and quiz 'em. The old timers often ended up with a novel concept which had great significance, but in the process to achieve this end had started a completely new industry (often in totally different areas to their primary disciplines).

There is so much cross pollination between the different disciplines that jumping into other areas is often extremely productive for our own discipline. What I am suggesting is that we remain open to the acquisition of knowledge from the other disciplines – not merely tolerant, but eager to learn. Nothing is more enjoyable to me, as an (electronics and automation) engineer, when commissioning a plant, than to assist with the troubleshooting of a centrifugal pump or the review of some thorny electrical distribution problem, or assisting an operator who is trying to implement a new procedure for her plant with new equipment that is perhaps not performing to spec.

The know how and skills gained from moving into these other areas is incalculable and generally very useful in future design and commissioning work. And let's face it, most of us want more remuneration and opportunities - becoming an engineering manager for example, often means heading up multidisciplinary teams – the greater the spread of experience often results in increased respect and success.

So my suggestions are:

- Never turn down the opportunity to acquire any skill from other disciplines.

- Encourage your colleagues to do the same and thus to increase the storehouse of valuable skills in your team.
- Watch for opportunities to leapfrog from your current area to a new burgeoning area of activity even if it is outside your current skill area.
- Increase your enjoyment and appreciation of engineering by widening your skill window.

Gaining a diverse set of skills is perhaps what Aldous Huxley had in mind when he remarked:

> There is only one corner of the universe you can be certain of improving, and that's your own self.

Yours in engineering learning

Steve

Invisible engineers and technicians – undervalued, disappearing and needing your support

Posted: 10 April 2008

Dear Colleagues

1. I recently accompanied a 'Roadshow' and presented the following topics; Arc Flash Protection, Industrial Data Comms in Hazardous Areas, Lightning and Surge Protection and Process Loop Tuning Fundamentals and ... you can access these presentations at: http://www.idc-online.com/newsletters/papers/IDCPresentations.zip

2. I continue to receive much correspondence every week (both bouquets and brickbats) for which I thank you all. But one which caught my eye was from Adrian Carrington who added some thoughtful comments to my blog last week on hard won experience. His contribution follows with thoughts of my own:

- The status of technical professionals is rapidly waning due to the lack of any effective, unified marketing of the profession and this includes areas of expertise handled by technicians, technologists and engineers. Joe Public hasn't a clue what an engineer does and generally doesn't care. The fact that we build the bridges, keep the electricity and water running and invent all these (sometimes) wondrous items is quite irrelevant to most. As Adrian says: "Joe public will recognise the skill of a carpenter, but fail to admire the hidden wonders of the jet engine or the mobile phone or ever imagine how it got there and how it was designed. Us underpaid, unrecognised, unloved engineers are invisible to the public who almost never see that much of the reason why their lives are so comfortable is as result of engineering." If you are a doctor, lawyer or accountant, we all know who you are and what you do.
- It follows that young people are increasingly reluctant to enter the profession - whether as engineers or technicians. Engineering is perceived to be boring and poorly rewarded with little esteem (or perhaps "sexiness") inherent in it.
- Theory taught at universities needs to have a strong practical focus. And courses need to be taught by tying the theoretical principles directly to real practical issues to provide us with a more hard-nosed commercial training. Adrian goes onto say: "I look back with regret that my formal engineering training concentrated on scientific principles and mathematics without incorporating a business angle (contract law, marketing, finance, project management) as well as some material in understanding the basic principles of all branches of engineering. More emphasis on understanding and reasoning rather than merely focusing on difficult maths would have been appreciated. Can we get a lecturer to explain the reason why a turbine blade exhibits different angles of incidence at different radii before resorting to maths. It is often the case that lecturers see the need to intellectualise everything where some basics would really help. OK the pure academic approach does have its merits in that it does help to teach you how to think and often gives a wider perspective in studying a range of quite diverse subjects, but the diversity is restrained within engineering itself which is a mistake."
- The importance of being multidisciplinary in our engineering comes through in the following comments from Adrian: "Another great annoyance I have with engineering is with the engineers themselves; once you have worked in

one industry for some time you are almost completely precluded from moving into another. Many years ago I encountered something very strange when I went for an interview. The interviewer asked me if I had used A/D converters in circuit design, which I had. He then asked me which ones I had used (there are possibly hundreds available all using the same set of principles) and expressed shock and disappointment that I hadn't used the one that he had used. This is an extreme example, but it is true to say that if you have worked for ten years in say medical equipment design you would find it most difficult to move into defence, for example. Despite bringing fresh ideas to that industry and well-honed engineering capabilities - potentially better even than those the other candidates have from the same industry. Indeed the culture is to hire someone from a part of the same industry even though the experience and skills necessary are utterly different from those gained in a different industry. i.e. the same industry may have highly disparate technologies. We should, as engineers, be looking with prudence at the potential of someone and their transferable skills rather than the; 'have you done exactly this before' mentality."

So what do we do about this?

Let's be proud of who we are and what we do in engineering - and advertise it vigorously. Take every opportunity to speak of your endeavours with pride. Be passionate about what you do as your contribution to society is commendable.

Drive our teachers and academics to teach theory related to real practice by volunteering to teach part time in universities where we can focus on practical issues.

It is an admirable practice to be multidisciplinary - treat engineering as an holistic environment. Gain skills in as many different disciplines as possible.

In conclusion, we have to eliminate this long running perception, which has been around since Shakespeare's day (quoting Hamlet):

For 'tis the sport to have the engineer
Hoist with his own petard…

We have simply accepted this oversight for too long and need to seize the moment and make today the time of the engineer.

Yours in engineering learning

Steve

Engineering conference papers for you

Posted: 16 April 2008

Dear Colleagues

In addition to the hundreds of whitepapers (growing daily) on our site freely available to you, we have also placed up a reasonable number of conference papers (from the UK, South Africa and Australia) for you to download (at no charge obviously). These range from Pumps: Maintenance, Design and Reliability, to Safety Control Systems and Industrial Wireless systems. Obviously we would appreciate it if you would acknowledge the authors (and their companies) if you refer to them in your work. We are enormously grateful to all these engineering professionals who made their expertise and knowledge freely available to their peers.

Simply go to the bottom of our web page on:

http://www.idc-online.com/cons/?country=United+Kingdom

to locate 'em.

Yours in engineering learning

Steve

Conference Papers

A selection of papers presented at past conferences.

Pumps: Maintenance, Design and Reliability - South Africa 2008

Bernard Da Cruz - "Pump Characteristics and ISO Efficiency Curves"
Cornelius Scheffer - "Pump Condition Monitoring Through Vibration Analysis"
Hugo Howse - "The Use of Thermal Spray Coatings to Reduce the Life Cycle Costs of Mine Dewatering Pumps"
James Cowling - "Condition Monitoring, Lubrication Control and Electrical Current Discharge Protection for Pump and Motor Bearings"

Safety Control Systems - UK 2007

Harvey Dearden - " Who's Afraid of IEC 61508/61511?"
Clive DeSalis - " Certification in Perspective"
Colin Easton - "The Safety Integrity Verification of Legacy Safety Instrumented Systems"
Marc Pijnenburg - "Definition of Safety Instrumented Functions"
Stewart Robinson - "Two New Standards for Machinery Safety-Related Control Systems"

Industrial Wireless and Ethernet - Sydney 2007

Graham Moss - "The Wireless Plant of the Future"
Wayne Manges - "Intelligent Wireless Technology Agility, Mobility, and Security"
Jamil Khan - "IEEE802.11- based High Capacity Wireless LANs"
Asghar Khan - "The Sydney Water West Camden Recycled Water Supply Project "
Deon Reynders - "The Nuts and Bolts of Industrial Wireless Communications"

Originally from the Wild West, we engineers now need to be attuned to style and culture

Posted: 23 April 2008

Dear Colleagues

I must confess I have always imagined engineers and technicians as the rough and tough, Wild West action types (who work out in the field in pioneering conditions), compared to our more dilettante, cultured brothers and sisters in Law, Medicine and the Arts. In a book entitled *Does the Engineer Need Culture?*, Prof. John Peck from City College, in New York remarked that engineers were "rough, tough spirits" who took "pride in cultivating construction-camp and bar-room manners rather than the deportment that would grace a drawing room". Robert Noyce, the co-inventor of the integrated circuit, who himself came from the small town of Grinnell, in Iowa, said: "In a small town, when something breaks down, you don't wait around for a new part because it's not coming. "You make it yourself." Interestingly, many of the founders of Silicon Valley came from small rural towns. In the biography; 'The Tinkerings of Robert Noyce' when referring to the moon landing of the Apollo project, the author, Tom Wolfe, says: "It was engineers from the supposedly backward and narrow-minded boondocks who provided not only the genius but also the passion and the daring that won the space race …"

There is no doubt, however, that some of my engineering colleagues, some of whom are eminently cultured, would be a little piqued at the idea that they are Wild West types. I remember being mildly surprised, when working on commissioning a power station in the middle of the outback, that the grubbiest and seemingly coarsest technician on site ended up hosting a spectacular black tie wine appreciation night. He was the part owner of a famous vineyard with a magnificent art gallery that had hit hard times and he needed to go out and ply his craft again.

And as Kelvin Kemm so aptly remarked:

> "Today, to produce iPods, or jets, or cars, or bridges, or whatever, engineers have to possess great sensitivity to style, human emotions, shape, colour and other interacting pieces of a big jigsaw puzzle. And in communicating our ideas, black and white prose doesn't suffice- we need to use panache and style in getting our rather difficult technical messages across in a simple, enjoyable and easy to understand manner."

So what we need to do in our engineering designs:

- Always remember that in most cases a human being will be taking ownership of your wonderfully designed widget
- Make the design simple using the KISS principle, but add a dash of style
- Learn from other disciplines when executing your engineering designs, such as interior design, psychology, marketing and art, even though at first they may seem to have little relevance

And perhaps we can hark back to the 'who gives a damn, Wild West', when applying style to our engineering designs. As Gore Vidal comments:

> Style is knowing who you are, what you want to say and not giving a damn.

Thanks to Dr Kelvin Kemm for the inspiration to write this article.

Yours in engineering learning

Steve

Grasp the engineering nettle in biology and medicine

Posted: 30 April 2008

Dear Colleagues

I remember my brief encounter with electronics engineering and medical technology in the late 1970s. I was given the task of adjusting a heart pacemaker, in a primitive way, through the skin of a patient, while Dr Christiaan Barnard looked on impatiently at the fumblings of yet another engineering student. At the time, we told ourselves that the patient's discomfort was minor compared with the prospect of survival. Of course, I am not going to get involved in the debate of life/quality of life and technology today. And we have come along in leaps and bounds since then. It is incredible, however, to note that increasingly engineering science is being applied to the life sciences (biology, biotechnology, genetics, etc.) and the medical world. This is becoming more obvious particularly with the massive growth in medical science due to an increasingly aging and demanding population. The opportunities to apply our engineering skills to this growing and fertile field abound.

The IEEE notes that the field of engineering in biology and medicine includes (quoting directly from their excellent magazine on the topic): biochemical engineering, biocontrols, bioinformatics, BioMEMS, biomaterials, biomechanics, biosignal processing, biotechnology, cellular and tissue engineering, clinical engineering, imaging and image processing, information technology, instrumentation, sensors and measurements, micro and nanotechnology, neural systems and engineering, physiological systems modelling, proteomics, radiology, rehabilitation engineering, robotics in surgery, and telemedicine. Furthermore, the dean of the MIT School of Engineering, Subra Suresh, noted recently that although engineering has traditionally come from intellectual foundations of physics, biology is now a key part. As a result MIT has expanded their engineering education into cancer research, biological engineering - with a focus on human health and infectious diseases (tuberculosis, avian flu, malaria). According to Jay Keasling, from the engineering school at the University of California, Berkeley, significant strides have been made toward engineering micro-organisms that produce ethanol, bulk chemicals, and drugs cheaply.

When I look around – just in my little world, I can see significant evidence of engineering being applied to biology and the life sciences; remote diagnosis of patients, improved hearing devices, laser surgery and the extraction of ore using bacteria.

The challenge, however, is that engineers lack the tools to easily and predictably reprogram biological systems (as opposed to working with a microprocessor chip). Added to this is the fact that there is a dearth of standards for biological components making for poor interchangeability and then on top of this many biological components have been patented thus restricting further development.

Now I know I am going to get pilloried for even suggesting our involvement here - visions of doomsday virus manufacture (remember WMDs?) and dehumanizing people with horrible experimental medical technologies. There is no doubt engineering ethics will be stretched to its limits when assessing some of these technologies. But the opportunities for applying our engineering skills in this fast growing area abound. Whether it involves developing new technologies or applying existing technologies to this newish area of engineering.

So what should we do:

- Open our minds to how we can apply our current engineering technologies to medicine and biology
- Investigate these fields by reading and talking to people working in these areas
- Encourage our firms or organisations to invest in R and D where newer areas in biology and medicine may be applied to engineering
- Visualise, wildly, the growth areas based on an aging population demanding increasingly sophisticated medical technologies, but with an emerging shortage of foods.
- Encourage our local colleges and universities to set up courses in engineering which incorporate the life sciences

Above all, let us ensure that engineering doesn't assist medicine and biology to develop as Napoleon viewed it, oh so many years ago:

> *[Medicine is] a collection of uncertain prescriptions the results of which, taken collectively, are more fatal than useful to mankind.*

Yours in engineering learning

Steve

Beat a gadget-strewn path to your local geek fair

Posted: 7 May 2008

Dear Colleagues

There is an apparent lack of enthusiasm in our children for building mechanical, electrical and electronic gadgets and this has become one of my pet peeves. Tinkering around with gadgets, I believe, results in the development of a passion for science and engineering from an early age. This is essentially what we, as established technicians, engineers and scientists, were doing in our workshops in the old days – admittedly often working in solitude.

But to my delight there are some incredible innovations afoot, including gadgetry and events around the world, which look to change this trend. There are technical fairs in the world today which are stunning in their scope. For example, the MakerFaire ('Build, craft, hack, play, make'), is a two day fair in California held every year in May, and has the usual gathering of geeks supplemented by backyard scientists, engineers, artists and craftspeople building fire breathing robots, giant motorised cupcakes (?), rockets and hundreds of other exhibits. A remarkable 40,000 attended the event held last year. The faire beckons you with the spiel: '..with its eclectic mix of wild and wondrous creations, blending art and science with engineering and craft'. The stands varied greatly and included intelligence and creativity; twin Tesla coil towers demonstrating manmade lighting, 3D printers making objects using sugar, a steam powered boat, shy plants, robogames with grudge robots, a fab lab, lasers and Faraday cages. One of the gadgets (a multi touch table) made for $500 is reportedly equivalent to a $9,000 product from Microsoft.

Other trends are driving this rising do-it-yourself innovation too. The most popular is the ready availability of inexpensive or free parts – from bits out of the motion control parts of your hard drive, to digital cameras, to computer monitors and digital wireless access points. You can thus perform aerial photography by combining a kite with a digital camera relaying data back wirelessly to a computer. And the Internet enables easy communication and sharing of ideas with sites such as instructables.com – a great meeting place for inventors. Finally, everything is becoming open source and interconnectable – build something and connect it easily to another device.

I firmly believe that tinkering with technology builds innovation and encourages young people to consider science and engineering seriously as careers.

So what should we do:

- Look out for and participate in your local fair promoting science and engineering gadget building
- Make one – if there isn't one - and get your local schools and universities involved
- Get your company to sponsor it - the kudos for your firm will be enormous
- Promote it as an annual event and make sure it breeds to other cities
- Get it promoted at the highest and widest level - from the premier of the state all the way down to your local school
- Add in a dash of art and culture to really liven it up

- Ensure everyone has fun, that science and engineering is enjoyable
- Try to commercialise the really great ideas

Perhaps James Klass is right about some of the demos at these fairs when he observed wryly that:

> Any sufficiently advanced technology is indistinguishable from a rigged demo.

(This plays on Arthur C Clarke's comment: Any sufficiently advanced technology is indistinguishable from magic.)

Yours in engineering learning

Steve

Collaborate in creating your next engineering product

Posted: 15 May 2008

Dear Colleagues

According to Wikinomics, many very successful products today are being created by teams of thousands of people scattered throughout the world, using their collective wisdom.

'No company today, no matter how large or how global, can innovate fast enough or big enough by itself.'

This is according to Tapscott who coined the phrase. The beauty of this approach is that it allows us to get an accurate idea of what the market is after and to let it shape the final product. The broad majority of the engineering community are positive and enthusiastic individuals with enormous experience and innovative abilities. The end game, if this expertise is harnessed correctly, is that you will gather so much more useful information that you will leapfrog over any of your competitors and create a truly world class product. Surely this can only benefit you and your product development process – the alternative; the narrower approach of a few developers in-house.

I think recently of the chief engineer of a firm who was developing a really useful software collaboration package. They burnt through $17 million over 4 years in developing a product which had no market when it was completed!

So for your next engineering design project or product, Tapscott suggests the following strategy to make your product or service really worldclass:

- Take cues from lead users. You may be horrified to find that the lead users of your product drive you in a direction that was not originally intended, but with much greater success.
- Build critical mass. Get as many players involved in your project, as quickly as possible, to achieve critical mass.
- Supply an infrastructure for collaboration. Co-operate with other players in the industry to help with open standards and administrative frameworks.
- Make sure participants get value. Ensure that those who contribute get appropriately rewarded in developing the product.
- Let the process evolve. Keep developing and don't set hard objectives for the end result. Let the process dictate (often through trial and error) where you end up.
- Hone your collaborative mind. Try and work for the common good – both for the collaborators and for your customers.

So we invite you to put this to the test..…..

I am sure (if you are like me) many of you wonder about my blogs and the likelihood of me actually practising what I preach. Well, I do try to. Here for instance – we have been working on our web-based, live training and collaboration package for over 2 years now and I am inviting you to participate in the development of this product.

If you are interested we will send you the details of the product for your commentary. And you can join in our weekly engineering forums (at your convenience) to drive the product to a state of usefulness to the engineering community.

What do you get in return for your reasonable level of input? We will give you free use of the package for 6 months or more. Inevitably there will be the doubters who think that this is a thinly veiled sales spiel. Well, this is a valid concern, but all I can say to this is that you will get free use of the software for your own projects and after that there is no obligation to do anything more. And naturally, only you can assess if it is likely to be of benefit to you and whether participation is worth your while.

To participate:
Click on http://idc-online.com/newsletters/brochures/iQuokka_Leaflet_Apr08.pdf to download details of the software and min-tech forums which are short courses of 15 minutes each. Subjects include elec. and mech. engineering, data comms, etc. Each of these will be presented live over the web, with real instructors who you can interact with. Simultaneously you will be observing part of the product in action

Email Ric, our lead developer, at ric.harrison@idc-online.com to request involvement.

Essentially we are after a product which can be of great use to engineers and technicians who want to collaborate remotely using a variety of tools. These include a whiteboard, video conferencing, remote labs for hands-on testing and training and obviously any other useful features you can think of.

If you can think of ways we can evolve this product in this direction, please let us know.

Hopefully you don't think along the same lines as John Cage:

> I can't understand why people are frightened of new ideas. I'm frightened of the old ones.

Yours in learning

Steve

Freely available know-how and our Automation and conversions guides

Posted: 22 May 2008

Dear Colleagues

I am constantly impressed by the smorgasbord of engineering know-how out on the web - freely available – although admittedly varying in quality from the utterly useless to the enormously valuable. We persistently collect whitepapers and useful materials, so if you come across anything of interest please let us know by email and we will add these to our whitepaper collection and endeavour to circulate them to everyone. We did this recently for software and were gratified by the incredible generosity of people and their contributions. Some really valuable programs were discovered.

An important aspect of our mission, we believe, is the spreading of 'know-how', as frictionlessly as possible, to the engineering community – this is another great way of achieving this.

Many of you are perhaps unaware of our recently published complimentary pocket guides (non-commercial – no advertising et al, and really useful we think) that we have freely available on our web site. Click to download them:

Engineering Formulas (90 odd pages - physical quantities, maths and engineering formulas)
http://www.idc-online.com/pdf/downloads/Formulae.zip

Automation pocket guide (170 pages – I&C drawings, process control, data comms, Hazops, safety instrumentation, hazardous areas, SCADA, instrumentation, project management and forecasts)
http://www.idc-online.com/pdf/downloads/IndustrialAutomation.zip

In conclusion, please send us details of equivalent books/guides/whitepapers which you find useful in your engineering work. We will make these available to everyone else and add them to our collection.

Just remember, however, although we are pushing the need to spread knowledge, at the end of the day, as Albert Einstein remarked so wisely:

> Imagination is more important than knowledge.

Yours in engineering learning

Steve

Engineering cloud computing

Posted: 28 May 2008

Dear Colleagues

1.We welcomed a sizeable group of people to our complimentary, inaugural mini forums last week. During the session they interacted live (see and talk), with each other and the presenter, using our recently developed iQuokka e-learning software package. Feel free to review the list of courses (they include tuning loops/EMC, HVAC, SCADA security and so on) and join. For the list go to http://idc-online.com/news/?newsItem=98, or grab the flyer at http://idc-online.com/newsletters/brochures/iQuokka_Leaflet_Apr08.pdf . We had some excellent discussions and as a result would love to expand on this. The mini forums involve short presentations (20 to 25 mins) with some great discussions at the end, at no cost to participants (apart from the time commitment).

2. I noticed with some fascination the latest buzzword emerging from the computer world and one which is certainly impacting on our engineering lives; 'Cloud Computing'. The idea is that computing is increasingly being supplied as a service over the Internet due to higher broadband speeds and more reliable software. And the irritation with constantly have to upgrade one's computer can be minimised. All one does; is run the programs we normally use on our own computers, on a more powerful central server located somewhere "in the cloud". Using this cloud computing also makes us feel, naturally, that our impact on the climate is reduced. Sadly (inevitably?), the opposite is happening. These data centres are growing rapidly and contain thousands of server computers with some facilities stretching to well over the length of an aircraft carrier or two. And unfortunately they greedily devour and belch out energy (accounting for an unbelievable 1.5% consumption of electricity in the US today). Within 12 years, their carbon footprint will be larger than for aviation. Frighteningly, this has happened in just a few short years. Ominously, the consultancy group, McKinsey, reckon that a third of the servers are running on empty or idle. Absolutely wasted energy as the administrators have lost track of what program runs on which computer ("let's pull the plug on a computer and see which client shouts loudest" is not just said in jest, but is a real indication of what goes on in these data centres - and you thought your dirty industrial plant was a problem!).

Oddly enough, computer makers seem to be keen to draw attention to the scale of the problem. Fortunately they are now talking about performance per watt in recognition of the need to measure and reduce energy consumption. The EPA feels that employing the latest technologies could reduce power consumption by half. And some new advanced technologies are being designed to minimise this impact.

A few suggestions:

- Get figures of efficiency and find out what the carbon impact is when using a computer or cloud computing.
- Actively look for ways of saving power to your computer systems (even the ones in the cloud) - cutting your bill saves the planet and your wallet

Interestingly enough, William A. Smith, born in 1908, remarked on engineering well before the climate problems became known so many years ago:

‘Engineering is the science of economy, of conserving the energy, kinetic and potential, provided and stored up by nature for the use of man. It is the business of engineering to utilize this energy to the best advantage, so that there may be the least possible waste.’

Yours in engineering learning

Steve

Your list of favourite engineering videos

Posted: 4 June 2008

Dear Colleagues

1. Last night, I watched with a curious mixture of concern, bewilderment and delight at my 10 year old son expertly bundling up an animated video he had made, and then uploading it to Youtube - the ubiquitous video site. My concern was for someone so young exposed to the questionable content in the internet video arena; my bewilderment at how quickly and easily he had mastered the process and my delight at the engineering training opportunities available to all of us. As a multimedia tool for learning, video has probably been around longer than anything else. In the past, it has been difficult to deploy, compared to text, slides and audio. But bandwidth poses fewer problems than ever before and storage has crashed in cost. There are many ways to store your videos now (e.g. Youtube), (some?) of the editing software is easier to use and (video) cameras have dropped in price. The biggest challenge is to master the basics of using the camera and lighting – and, naturally, making good instructional use of the video (this can be easily learnt and is an enormously enjoyable experience).

Over the past few weeks, we have commenced a process of amassing an enormous number of video clips for our courses. Admittedly most of those from the Net are fairly mediocre, with the exception of some gems which possess enormous power for a 2 to 3 minute presentation. A couple of these links are listed here:

An animated demo of TCP/IP and Ethernet -
http://www.youtube.com/watch?v=RbY8Hb6abbg
A huge explosion at the marshmallow factory -
http://www.youtube.com/watch?v=t8HcQ1Va6RY
Electrical accidents such as arc flash and power cable failure -
http://www.youtube.com/watch?v=WKRudUOSFE4
Programming a PLC –
http://www.youtube.com/watch?v=zvS_BuQlSXo .

It would be great if you could send us any that you feel are good. I will then compile a list of yours and ours and post these great engineering videos for everyone to access.

2. Our weekly engineering web conferencing sessions continue to gather steam with over 30 enthusiastic participants in one presentation last week. If you want to join us and make your own technical presentation (a max. of 45 minutes) please let me know and we will schedule you in. You are welcome to join just as a participant and see what it is all about.

Last week I was gratified (and perhaps rather embarrassed) to have world class experts – who know infinitely more than I do – attend my presentations on Process Control Loop tuning. Mike Brown kindly gave us some useful, practical tips on what works and what doesn't. And this week Ian Verhappen, fresh from an ISA Fieldbus meeting, gave us a brief run-down on where he felt Fieldbus and Industrial Ethernet was moving. Thanks so much to both of these veterans of the Instrumentation and Control system industry. Both, by the way, didn't hesitate when using the medium and scribbled away on the whiteboard and chatted to everyone as if they were sharing a few moments over a cup of coffee. Exhilarating to see this free exchange of information occurring.

If you are interested simply go to http://idc-online.com/news/?newsItem=98 . There are always great discussions and there is absolutely no cost to participants (apart from the time

commitment which in the grand scheme of things is in considerably shorter supply than money). Looking at the reaction from participants and the power of learning though this medium, I am sure that these live, weekly, engineering web forums will be hosting hundreds of technical professionals within the next few months.

However, with this plethora of new technology around, bear in mind, Carrie P. Snow's comment:

> Technology.....is a queer thing. It brings you great gifts with one hand, and it stabs you in the back with the other.

Yours in engineering learning

Steve

Feedback

I always enjoy reading the comments and thoughts of Steve Mackay. The video idea is good – it gives the viewer a better insight to the topic...but...it's dangerous if it's not accurate. The PLC video that was attached is a good example because the basic motor start logic shown is incorrect. This can really mess up a newcomer to the PLC world. In this case, the stop button is shown in PLC ladder code as an "examine off" contact when it really should be an "examine on". Good luck trying to start the drive that's shown in that example if it's wired to a normally closed stop button.
I've seen this a few times in the past, even in manuals and in code that somehow made it's way too far in the design process. I guess free videos need to be treated with a grain of salt just like other free info we get on the net – we often take it for granted that it's correct but we really should back up our info and conclusions with published documents and testing.

LT

What's better? Real engineering or styling and marketing?

Posted: 11 June 2008

Dear Colleagues

I am grateful to my colleague, Ian Gibson, for passing on a copy of the recent BBC Richard Dimbleby lecture, presented by the well known engineer and industrialist, James Dyson. Some of his thoughts are discussed below. As Ian dryly remarked - 'Dyson is no sucker'. Although a superb engineer, he is also a businessman with an extraordinary manufacturing business operating throughout the world and he has clarity with regards to engineering and its place in our society.

Although his comments are focused on the decline of manufacturing in the UK (where he remarked irritably that frivolous designs are often considered as important as designing an aeroplane), they have applicability to us wherever we are in the world today. To survive and prosper as engineers we need to urgently focus on creating new, more advanced products and to be continually innovative. Simply relying on 'shallow styling' and marketing is a sure-fire dead end. Service, creative industries and software products cannot replace manufacturing. His large manufacturing company almost went under with the massive increase in taxes and costs in the UK. To survive he shifted production to lower cost countries, but boosted his R&D and engineering design team in the UK. He is now prospering. He points out that whilst China has mastered low cost production they are now going hell for leather in mastering high level engineering design (which they are increasingly doing with their acquisitions of companies such as RCA televisions, Alcatel cell phones and Dornier aircraft - notable examples).

The Western world feels that engineering manufacturing is dead - and in this so called post-industrial society, service and creative industries have replaced manufacturing. This is patent nonsense. Of the world's top ten corporations, by revenue, nine 'make big, heavy things' (I like this phrase), such as turbines and cars.

He feels that there are three successful models of manufacturing in the 21st Century:

- High tech in a high cost country - such as Rolls Royce manufacturing. They have the engineering know-how, value, reliability and safety (e.g. turbines for aircraft) so can prosper.
- High tech using both the high and low cost countries - with the R&D, strategy and direction remaining in the high cost country and the manufacturing in the low cost countries - Dyson's business.
- High tech, but mainly outsourced to the low cost countries - stylish Apple outsources manufacturing and engineering, but markets its brand at home. However, as Dyson points out, if a rival makes a significant technological leap, styling and branding counts for nothing. I don't agree with Dyson on this entirely as Apple have created new technology as well and used an innovative simple design. Admittedly they do outsource their engineering and this could be problematic.

One of his remarks is note-worthy: 'As long as we continue to innovate and produce products that have better features and work better, we can compete'. When we stop doing this, we are gone.

Dyson recommends that we:

- Give engineers a free hand in engineering design
- Encourage more entrants to science and engineering
- Get financiers to pour more money into R&D invest in the future of the business (he spends 16% of revenue on R&D)
- Avoid shallow styling at the expense of good engineering
- Ensure that colleges focus on engineering design and less on industrial design
- Use our brains innovatively, persistently and creatively to design and build products which simply 'work better'
- At the end of the day, to draw on that great quote from Thomas Edison: "Invention and success are one percent inspiration, 99% perspiration". Occasionally one wins Lotto, but for consistent success we have to work hard and innovatively to get the results. Something the financial engineers on Wall Street have found to their cost over the past year.

You can get the full transcript of the lecture at
http://www.bbc.co.uk/print/pressoffice/pressreleases/stories/2004/2_december/09/dyson.shtml . Thanks to the BBC.

Yours in engineering learning
Steve

We all need an engineering mentor (or advisor, teacher, role model, friend)

Posted: 18 June 2008

Dear Colleagues

I was struck by an engineering colleague (in his early sixties) who was heartbroken last week at the death of his mentor. I can quite understand the depth of the relationship – I was a little saddened too, on reflection, as my mentor was only around for a few years – too short, by my reckoning, as I was still inadequate as a young engineer. Being a mentor, doesn't just refer to academic or college relationships, but as in my case – the tough and tumble world of industry and can range from someone with a PhD, to a CEO of a company, to an engineering manager or to a humble electrician who has wisdom.

A formal definition of a mentor – someone who takes a special interest in an individual who is intent on developing into a successful professional. This is more than an advisor, but someone who is personally involved and wants to ensure the person becomes successful. In the engineering world, I often think of mentors from the middle age guilds where apprentices were taken under the wing of the master and guided – eventually becoming successful professionals. I believe the modern mentor is simply an extension of this. Mutual trust, understanding and empathy characterise the relationship. There have been a few challenges with female-male mentoring relationships, but I believe they too can be very successful and vibrant relationships. A good mentor has a vast amount of experience and listens (and avoids pontificating on a range of subjects to a captive audience).

Why do we need them? Well in today's fast-moving world, there is a shortage of engineers with experience. There are an enormous number of young bloods bolting around with academic training and book knowledge, but perhaps inadequate experience in terms of engineering and management. They need thoughtful guidance.

Every company needs mentors if it is to grow and sustain its young recruits. The position of mentor need not be formalised, but a firm needs to cultivate them and ensure they are available to work with and mentor young aspiring engineers.

Some advice if you are becoming a mentor:

- Listen patiently
- Don't patronise
- Build strong relationships
- Don't abuse your authority (having your charges complete jobs that are your responsibility, for example)
- Nurture and grow your charges into self sufficiency
- Establish protected time together where you spend quality time examining regular issues
- Get your charges into your professional network
- Be constructive and truthful (even if it sometimes hurts)

- Ensure there is a balance between breadth and specialisation
- Be a good role model

If you don't have mentors in your firm, get them set up immediately. You will have a reservoir of outstanding, experienced engineers dying to pass on their hard won experience. And a flood of young engineers and techies desperately needing some guidance on the rather rocky road to engineering excellence. It will be well worth it with the result; staff goodwill, excellent career development and, eventually, dramatically improved productivity.

Thanks to http://www.nap.edu/html/mentor/ (National Academy of Sciences) for the initial idea and framework.

Please send us examples of your own mentors and I will publicise them in next week's newsletter.

Here is a little bit about mine: A remarkable man, 'Ali' Erasmus, who inspired me and still does. He moved easily between the boardroom and the shopfloor and had a passion for people and engineering.

And as Henry Miller pointed out about mentors and leaders: "The real leader has no need to lead - he is content to point the way". As mentors we should be actively doing this and benefitting our profession.

Yours in engineering learning

Steve

Feedback

I know it borders on preaching to the converted, but this subject is one of my great soapbox passions. I have been pontificating about mentoring in my local church and built a few program documents around it for basically the same reason you mention below. More significantly in my industry the predominance of young university graduates hitting the streets full of knowledge and qualifications, great new ideas and absolutely brilliant lateral thinking brains is staggering. Software developers and other streams sit all around me and dazzle me with their ability to view the world through young and different eyes. As a service manager I then spend vast amounts of time tearing my hair out of basic procedural and conceptual processes which seems to escape the younger set. The controls for release management, version control and all those other painful delaying strategies have been left out of their programming. The concepts around communicating with clients who pay fortunes for services are another pet hate. There is a trend in the younger set (and maybe others) to think that near enough is good enough and a client paying large sums will have no problem with that concept.

It all screams to me that they need someone to take them under their wing and gently guide them into a space where both worlds exist and do not conflict or restrain their open minded approach to all things. I would consider it a management decision to promote and encourage mentoring to all technical people to effect a good rounding result in their personnel. Thankfully I have read of a number of large organisations who have taken that approach for junior managers and that could then create a flow down effect in later years. As for now, I suspect we are still very much in a “control

management" mindset for most organisation where technical people are generally not thought of as customer facing, regardless of reality.

My 2 cents worth.

BD

Does management know how to retain engineering professionals ?

Posted: 25 June 2008

Dear Colleagues

1. I was impressed to read Gary Perman's piece (in the IEEE) on why strategies to find and retain employees – especially of engineers and technicians - do not work.
There is no doubt, despite the looming recession, that there is an enormous talent shortage in the engineering business – a tremendous and growing shortage of good engineers and technicians. With the rapid growth in technology and the need for highly specialized skills, the talent pool will steadily dry up. Already there are significant vacancies across manufacturing, pharmaceuticals, software, in the semiconductor industry and in straightforward engineering. Companies tackle the problem in a variety of ways. Many companies have outsourced everything to India and China. I am of the opinion, however, that this does not work to benefit the company in the long term unless its high tech management and R&D are retained at HQ. Other companies simply poach and pay more. This strategy often fails too as the skilled engineers here may be working for reasons other than their passion for engineering. Some companies (such as Hewlett Packard) are "growing their own" by getting involved in universities and grabbing the best engineering graduates coming out. This is a great idea, but as with other methods of avoiding critical skill shortages - not the complete solution.

The result of all this is a focus on employee retention, to ensure that the wheels of industry keep turning. There is an enormous amount of information out there surrounding this issue. Some obvious retention solutions include; salary, promoting quickly, listening to your people, personal benefits (even massages - according to a Google source), flexibility in work hours and bonuses. Despite all this, however, employees still leave. So what can we do? As a result of his research in the recruitment business, Perman asserts that none of these strategies really work. Why? He feels that the main problem involves management failing to understand how critical this issue is and as a result failing to devote time to it. Management is rarely measured on their retention rates and keeping their teams intact. Instead they tend to be driven by short term financial goals as it is these that they are held accountable for. Many mistakenly feel that the HR department has the responsibility to devise retention strategies. Unfortunately this is an inadequate strategy, as those working in HR are not directly involved in the workplace. In essence the supervisor working with the team is the key to retention. When everyone - from the CEO to the lowest supervisor - takes on board the responsibility for retaining quality engineering professionals, retention will soar. The rewards for companies that do this will be significant in terms of revenue, profits and simply for "being a better place to work".

2. Some really thoughtful pieces on experiences with engineering mentors have come through as a result on my blog last week. I will summarise these for inclusion next week.
And as Pliny the Younger remarked two millennia ago, although he wasn't thinking of recruiting and retaining engineering staff "An object in possession seldom retains the same charm that it had in pursuit".

Yours in engineering learning
Steve

Feedback

Just a quick comment on the skills shortage.

My observation is that employers all want experienced engineers but are unwilling to provide training or simply give an engineer a go.

This results in a decreasing pool of available engineers in an environment of growing demand.

Looking back over my career, I have been given several opportunities to sink or swim and have always managed to swim and learn a lot along the way.

On the whole engineers are not silly (although like everybody they may do silly things occasionally) they have already proven their ability to learn by successfully completing their degree.

Perhaps employers need to shift their focus from complaining about the skill shortages to giving engineers who may lack some experience a chance to prove themselves in a supportive environment.

DF

Fossil fuels are almost done for

Posted: 2 July 2008

Dear Colleagues

1. This past month's persistent spike in oil prices and the horrendous damage fossil fuels are currently wreaking on both our environment and pockets and in the longer term, the economy, has prompted this today. We have depended on fossil fuels for over 200 years now and any change appears impossible. The green message, which includes simply using less energy, whilst appealing, is not workable without considerable damage to our economies. Inadvertently and as a result of various crises, we have been forced, at times, to cut back on our energy use; the power crisis in South Africa and gas pipeline explosion in Western Australia, are two examples. These have both resulted in forced reductions in energy usage and have had (and continue to have) an enormous impact on the local economies – particularly in terms of the loss of income to companies and consequently to jobs.

Strategies to conserve and utilise energy efficiently have much to offer and make perfect sense. You only need look around your home at your VCR/PC and assorted appliances chewing power at some ghastly hour of the morning when everyone is in bed! The dollar tally of this wastage would be a good few hundred dollars a year (or more). I was also struck by the world's consumption of power - 15 Terawatts (presumably "everything" from cars to electricity) translating into a business of $6 trillion per year - enough to attract many 'greedy capitalists' the world over!

I believe oil supplies are still available - the current spike in oil (and gas) is driven by factors other than a geological shortage (at this stage) and when traditional oil (out of holes in the ground) runs out, there is a plethora of tar sands and liquefied coal. But there is certainly no doubt that we are entering a new phase with the energy economy.

It seems evident that there are four differences between this crisis and the earlier ones:

- Demand for energy has jumped, in part due to the growth in China and India
- Over the past 30 years, technology has actually produced some marvellous advances in wind/solar technologies and high tech batteries.
- Investors (and presumably the "chancers") have jumped on board initiating massive projects in wind, solar and other forms of renewable energy (posing other challenges to the environment, inevitably…..and a little cynically).
- We have solid scientific evidence of the damage that carbon dioxide is doing to our environment and there is an urgency to fix it. (Whether this race to alternative energy will stop the concentration of CO_2 from reaching dangerous levels is debatable. But we have no alternative but to go for it.)

So what can we do about it:

- Investigate alternative energy sources with the full knowledge that we have entered a new era with no going back
- Promote solar/wind and bio fuels at every feasible opportunity
- Encourage governments throughout the world to tax carbon usage (even though China and India will laugh at us initially)

- Encourage competition between the suppliers of alternative energy to bring prices down
- Focus on looking after our environment in our designs
  And no matter how small we think all our endeavours are in fixing the problems here, I think Socrates hit the nail on the head when he remarked:

Better to do a little well, than a great deal badly.

2. I am awaiting permission from the authors before publishing a number of really good pieces on mentoring – hopefully this week, in time for next week's newsletter. We have also identified some more really great videos that are available in a complimentary form – thanks to you all for your suggestions – I will post these in the next few days.

Yours in engineering learning

Steve

Training courses offered by IDC Technologies

Chemical Engineering	Code	Days
Practical Fundamentals of Chemical Engineering	CE	2
Handling Chemicals and Chemical Processes - Tips, Tricks and Tools	CH	2

Civil Engineering		
Designing, Specifying and Constructing with Modern Concrete	CT	2
Hazardous Waste Management and Pollution Prevention	HW	2
Structural Design for non-structural Engineers	SD	2
Best Practice in Sewage and Effluent Treatment Technologies	SE	2
Transportation Planning and Management	TN	2

Data Communications & Networking		
Setting Up, Understanding and Troubleshooting of Industrial Ethernet and Automation Networks	AN	2
Best Practice in Industrial Data Communications	BP	2
Practical Data Communications & Networking for Engineers and Technicians	DC	2
Practical DNP3, 60870.5 & Modern SCADA Communication Systems	DN	2
Practical Troubleshooting & Problem Solving of Ethernet Networks	ET	2
Practical Fieldbus, DeviceNet and Ethernet for Industry	FE	2
Practical Fieldbus and Device Networks for Engineers and Technicians	FB	1
Practical Use and Understanding of Foundation FieldBus for Engineers and Technicians	FF	1
Practical Fibre Optics for Engineers and Technicians	FO	2
Data Communications, Networking and Protocols for Industry - Back to Basics	IC	2
Practical Troubleshooting & Problem Solving of Industrial Data Communications	ID	2
Practical Troubleshooting, Design & Selection of Industrial Fibre Optic Systems for Industry	IF	2
Practical Industrial Networking for Engineers & Technicians	IN	2
Troubleshooting Industrial Ethernet & TCP/IP Networks	IT	2
Practical Troubleshooting and Problem Solving of Modbus Protocols	MB	2
Practical Radio Telemetry Systems for industry	RM	2
Practical Routers & Switches (including TCP/IP and Ethernet) for Engineers & Technicians	RS	2
Practical Routers and Switches for Engineers & Technicians	RT	2
Practical TCP/IP and Ethernet Networking for Industry	TC	2
Practical Fundamentals of Telecommunications and Wireless Communications	TE	2
Practical Radio & Telemetry Systems for Industry	TM	2
Practical TCP/IP Troubleshooting & Problem Solving for Industry	TP	3
Practical Troubleshooting of TCP/IP Networks	TT	2
Practical Fundamentals of Voice over IP (VoIP) for Engineers and Technicians	VO	2
Practical Industrial Wireless for Engineers and Technicians	WC	1
Practical Wireless, Ethernet and TCP/IP Networking	WE	2
Wireless Networking Technologies for Industry	WN	2

Electrical		
Practical Arc Flash Protection for Electrical Safety Professionals	AF	2
South African Standard SANS 10142- The Wiring of Premises	AS	2
Practical Electrical Wiring Standards - AS 3000:2007	AW	2
Practical Maintenance & Troubleshooting of Battery Power Supplies	BT	2
Practical Electrical Network Automation & Communication Systems	CA	2
Safe Operation & Maintenance of Circuit Breakers and Switchgear	CB	2
Practical HV Cable Jointing and Terminations for Engineers and Technicians	CJ	2
Critical Power Supply Options and Planning of High Availability Supplies	CV	1
Operation and Maintenance of Diesel Power Generating Plants	DG	2
Emergency Power Supplies Electrical Distribution Design, Installation and Commissioning	EA	2
Troubleshooting, Maintenance & Protection of AC Electrical Motors and Drives	ED	2
Practical Energy Efficiency, Design, Engineering and Auditing	EE	2
Practical Electrical Safety Techniques for Industry	EF	2
Practical Troubleshooting of Electrical Equipment and Control Circuits	EL	2
Practical Earthing/Grounding, Bonding, Lightning & Surge Protection	ER	2
Earthing, Shielding & Surge Protection for Electrical Equipment for Instrumentation and Control	ES	1
Practical Distribution & Substation Automation (incl. Communications) for Electrical Power Systems	EU	2
Practical Electrical Substation Safety	EV	2
Electrical Drawings and Schematics	EW	2
Grounding of Utility and Industrial Distribution Systems	GU	1
HV Circuit Breaker Operating Mechanisms - Hydraulic Systems	HH	2
HV Circuit Breaker Operating Mechanisms - Pneumatic and Compressor Systems	HP	2
High Voltage Safety Operating Procedures for Engineers and Technicians	HV	1
Practical Electrical Wiring Standards - National Rules for Electrical Installations - ET 101:2006	IW	2
Lightning, Surge Protection and Earthing of Electrical & Electronic Systems in Industrial Networks	LZ	2
Practical Motor Protection, Control and Maintenance Technologies	MP	2
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