



# Shortage of engineers

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In this paper the word engineer applies equally to scientists. An “engineer” is, or should be, a person who has a degree in engineering. The title “engineer” should indicate that the holder is able to follow a train of thought on any subject within his or her field of expertise analytically, logically, honestly and objectively to its conclusion and ideally to be able, where appropriate, to initiate, organize and manage its conversion into reality. Engineering excludes “social engineering”, the pernicious practice of making rules that are contrary to survival instincts. Invariably its results are the opposite to those expected, intended or advertised.

## 1. The need for engineers

It is more important to teach people to think objectively and constructively than to teach them anything else. Politicians and salesmen think about the next challenge and the kudos they can gain from it. Lawyers’ freedom to think and invent is limited by the law, accountants have to work within the fiscal regulations (the four-inch-thick book of rules that HMRC<sup>1</sup> pumps out every year) and the media think only about scooping news and maximizing the stress that the public crave.

Almost alone among the professionals, engineers are free to think objectively and constructively about how to change things to make them better and to apply their thinking wherever they choose. It may be in some aspect of engineering, geology, construction, medicine, organization, management or government. Wherever it is, they and their brains are needed urgently.

Too many engineers do not realize this. They are content to be told what to do. They do not see or realize their potential, and state education does not help them to do so. Curricula and exams favour big memories rather than the thinking and constructive brain. This must be changed but by whom?

This is where engineers and their professional associations need jointly to overcome the interest and dis-interest of the academic and political authorities who have designed the present education system, and change the system so that it produces the skills the country needs.

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<sup>1</sup> Her Majesty’s Revenue & Customs—the UK’s tax collection service.

Such is the poor quality and unsuitability of state education and the degree of entrenched interest in the status quo that it is difficult to change anything, but there is no alternative if we are going to survive in the medium or long term. Moreover engineers cannot expect help from anyone, it is up to them. They must accept that no one else has the wits or interest even to understand the problem, let alone solve it. Engineers have the most valuable brains in the country and no changes will be made in the education system unless they make them happen.

## 2. Where it all began and where it is now

Originally people's ability to think was as limited as that of their animal forebears. They had big memories and stores of inherited instincts to govern their lives but, if they met a problem that their instincts were not programmed to solve and that they had not solved previously, they had to solve it by trial and error.

Then, by mutation or natural selection or both, man began to be able to think and, by collating relevant facts, come to logical conclusions. He began to be able objectively to organize and plan. This was the dawn of intelligence and the emergence of the engineer. In his<sup>2</sup> challenging environments the better a person could think and plan the more likely he and his family and tribe were to be selected by their environments for survival.

By its continual selection for better survival the urge to think became a survival instinct. Those who could not think did not solve their problems or plan ahead as well as those that could, hence they did not survive as well. Eventually the non-thinkers, *Homo erectus* and *Homo neanderthalensis*, were absorbed by the thinkers or, being unsuitable for their environments, became extinct.

In those days there was a penalty for being improvident, careless or not thinking but not any more. Nowadays people do not have to think. Most people do not think. They react to circumstances according to what they perceive superficially to be their interest at the time.

Welfare states, however laudable and necessary to civilization, support those who, although perfectly able and healthy, do not think or strive. They are content to be supported by others. They are not interested in a better standard of living or giving their children a better start in life than they had. This is an increasing trend as idlers beget idlers and dishonesty becomes more fashionable.

The original "Old Socialist" definition of freedom was the freedom socially to mobilize upwards, to have equal opportunity with others and for all to be treated equally under the law. In other words, for everyone to have the freedom to think and, by thinking and making and taking opportunities, to advance in whatever direction he chose.

By unnatural philosophies, enforced by ideological régimes and social engineers, thinking is now suppressed. Even in so-called free countries, like the UK, there is much that you may not think, say or do. In their own interests the suppressors condemn thinking that has been selected for years for the better survival of our species and is built into our genes. They require people to conform to "models" and standard operating procedures (SOPs), according to their unnatural philosophies, and to think and react along prescribed and unnatural lines.

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<sup>2</sup> The mention of one sex in this paper includes all sexes unless it is obvious that it does not.

They have inverted the Old Socialist definition of freedom to mean social mobility but only downwards, and equal opportunity but you cannot take advantage of it. These distortions were introduced because many people think that upward social mobility and taking advantage of opportunity promotes class difference. Lenin said that class difference leads inevitably to oppression, so upward mobility and taking advantage of opportunity must be banned. In fact oppression is, and always has been, due solely to bad leadership and bad management and not to difference in aptitude, ability or class. The result of Lenin's nonsensical philosophy and the denial of upward mobility and opportunity have resulted in a national malaise of diffidence and mediocrity.

Ever since the Second World War management, leadership and excellence have been sneered at. Education has been degraded and entrepreneurs and "bosses" denounced as enemies of their employees. Hard work and ambition have been discredited and politicians bribe their supporters to re-elect them. The results of these popularity ventures are bad government, bad management, inefficiency, overmanning, low living standards and a burgeoning National Debt.

It is evident that the present authorities have neither the ability nor inclination to correct these faults and it is them among others that our thinkers and drivers—our engineers—must overcome.

Small businesses are the main sources of new jobs, new ideas and prosperity. How to start up and run businesses are exceptionally important skills but schools do not teach them. They stuff children's memories, the primitive parts of their brains, with academic data, much of it boring and useless, with the sole aim of leveraging them through narrow-disciplined exams.

Those with big memories may do well in exams that merely require the recall of received information but the inventor's and engineer's brains, which work essentially from first principles and by thinking, collating relevant facts and logical deduction to arrive at a valid conclusion, may not do so well.

Their talents will not be tested or appreciated. In spite of the desperate need nationally for such brains they will be overlooked. They will be less likely to win a place at a university and, although the really high fliers among them may fly high anyway, the rest will be ignored.

The same applies to selection for medical courses. A person may be fiercely interested in doctoring or surgery and solving people's physical or mental problems but this is considered to be irrelevant. The entrance exams to medical degree courses are academic and, if the candidate cannot achieve high enough grades in subjects that may have nothing to do with his vocation, he cannot follow it. The country may be begging for doctors and surgeons but, as with engineers, however dedicated he may be to his vocation, if the candidate cannot recall the academic aspects well enough to pass the entrance exams the shortages will persist.

You may wonder how those in command cannot see how their system works against the country's interest, but this is looking at the problem from the wrong end. Pragmatically you must accept that they cannot see the problem or solution and consider what that tells you about them. Either they have not the wits to see the problem or the solution or they do not want to. So you have to tell them and, if they still take no effective action, you must bully them until they do.

There is something terribly wrong with a comparatively rich country like the UK if its education system is twenty-fourth in world ratings, it cannot train enough doctors, surgeons, engineers or scientists for its needs, and it has to import masses of people from other countries to make up the shortage.

Where has this situation come from and how can one change it? It is government policy that ministers should lay down the overall strategic direction and that people who are experts in a particular field should execute the detail. The ministers are responsible for what the experts decide. What a vague and contradictory confusion! What does it mean? It is typical polit-speak—a recipe for muddle.

How can the minister of education be responsible for executing the detail if he has left this to the “experts”? Who are the experts in this case? Academics? What interest or expertise do the academics who “execute the detail” have in the skills that the country needs? To judge by results, none whatever. What remedial measures has the responsible minister introduced? To judge by results, none whatever. How can he introduce anything when he has effectively passed his responsibility and executive power to others, admitting that he is unqualified to exercise them?

He can only lay down “overall strategic direction”, whatever that means, and pray that the experts he trusts so naïvely to discharge his responsibility will not let him down. He obviously knows nothing about them or their interests or he would know that they will act according to their interests, not his, and the result will not be the one that he or the country wants or needs.

One would have thought that the needs of the country and its industry were of paramount “overall strategic importance” and that they should be addressed by the minister, rather than being left to an academic quango, but even that would be no guarantee of the desired results.

Probably the most useless subject for 95% of the population is pure mathematics. This is maths for maths’ sake. It is the study of mathematical conundrums and hypotheses with no practical application. It is the most effective cure for insomnia known to mankind. Yet in the early 1980s the education minister, an academic, decreed that only pure maths were to be taught in schools at secondary level, instead of applied maths.

Children came home from different schools saying they never knew what they were doing in maths. Their teachers said they were good at maths but they did not even know the relationship between percentages, fractions and decimals. The teachers could not explain to the class what they were doing in practical terms because what they were doing had no practical application.

You may doubt that this was true. Most people are unaware of this disastrous policy, they do not understand the difference between pure and applied maths or the damage that has been done by teaching pure maths instead of applied maths.

In the mid-1980s a parent suggested to five maths teachers in five different schools, state and private, in different counties, that if they started their maths lessons with a practical problem it would be easier for them to teach the maths and easier for the class to learn. All the teachers replied, “It is not our job to teach the children how to use the maths.” This was obviously a mantra from some manual on PC<sup>3</sup> procedures intended to kill off the engineering and scientific prowess of the UK. That may be overdramatizing the problem but that is what the policy has achieved.

My youngest daughter, up for a degree in design and manufacturing engineering and having an A grade in ‘A’-level pure maths had to teach herself and pass ‘A’-level applied maths in her first term before she was capable of tackling the course work.

Natural mathematicians, those to whom a purely mathematical concept with no practical application is interesting enough to engage their brains, may find pure maths entertaining.

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<sup>3</sup> Politically correct.

They are valuable people and should have the best teaching and encouragement but, to the other 95%, pure maths is a waste of time and fit only to discourage them from ever learning any maths.

There are now two generations of children who do not know how to use the pure maths that they have been taught and it is doubtful whether they remember any of it. Naturally they have been reluctant to pursue engineering or scientific subjects at degree level, for which applied maths is essential. They do not have the tools to do the job so they are not going to do it. Academia and government have not only failed to see the solution but failed even to see the problem. The end result has been a massive influx of people from more sensible countries that have been teaching applied maths to fill the shortage in engineering, scientific and medical disciplines.

The minister who introduced pure maths was more interested in the perpetuation of his academic species than in the needs of his country. He destroyed the scientific and engineering base of the country and it has never recovered. Whoever they are, people will pursue their net interest to the exclusion of all other considerations. You can trust no living thing to do otherwise.

Present state education does not look to the future nor cater for the country's needs. Little is done to develop the intelligent part of the brain, the engineering part that solves problems by collating relevant facts and coming to logical conclusions. Nothing at all is done to address the lack of good leadership and proper management in government, government departments, nationalized industries or anywhere else.

It is no good accepting the status quo and waiting for others to put things right. They will not. The standard of education will continue its downward trend until a large number of interested and intelligent people kick up such a fuss that government is obliged finally to put the needs of the country before the interests of the people who are failing to meet them.

### **3. What is to be done**

*First the problem then the answer*, that is the way to teach and learn. Lessons and lectures on all subjects should be taught by problems. For instance, teaching history backwards fills the student's brain with problems and identifies the critical path. Why did that happen? Why was she there? Why did he do that? The brain has to find or deduce or at least to think about the answer and will be more likely to remember it. Teaching history forwards fills the memory with data without identifying the critical path or the relative importance of the pieces of the story or exercising the brain. This is an inefficient way to teach and learn but that is how it is taught and that is the reason why, for most people, history is unmemorable.

Education should concentrate on exercising the learner's ability to investigate, discover, analyse, select, collate and deduce and, in that way, to solve problems and come to valid conclusions. The learner's brain must be able to understand the problem and, perhaps with help, to solve it but the most important factor is that *the brain must be engaged*, it must be interested in the problem and in solving it.

If the brain is not engaged and interested it will not work, it will not solve the problem and both teacher and learner will be wasting their time.

Wheel a Harley-Davidson into a classroom. Instantly you have engaged every brain in the room. Just think of the number of separate mathematical and engineering subjects that you can teach with that bike and how interesting your lessons could be.

Unfortunately this exciting, multidisciplinary method of teaching cannot happen. It would not suit the present narrow-disciplined qualifications of school staff. The chemistry teacher may have an MA in chemistry but he could not be expected to combine the physics, applied maths, aerodynamics, metallurgy and mechanics involved in that machine and none of the teachers of these individual subjects could explain how they interact. So it's boring old single-subject stuff with everyone struggling to keep awake until the bell goes and still knowing nothing much that is useful or relevant to real life.

Grouping related subjects together makes them come alive. But how do you maintain the interest of the student in real life subjects, such as Harley-Davidsons, when there is no-one who can exploit that interest and teach together the related subjects involved? How do you combine history with its related subjects of geography, politics, anthropology and religion to make history logical, reasonable and therefore memorable, or applied maths and its related scientific and engineering subjects, or European and classical languages, when teachers are confined to single disciplines? An engineer's education needs to be wide so why should not his teacher's competence be equally wide?

To teach up to GCSE<sup>4</sup> standard, the averagely intelligent teacher of a group of related subjects needs to be interested and reasonably competent in those subjects but not necessarily an expert in any of them. Indeed it is often said that experts seldom make good teachers because they cannot see the difficulties that pupils have in understanding or remembering. A teacher's most important skills at secondary level are in leadership, management and teaching.

At this point it is necessary to stop and ask government and the teaching profession what they think the education system is for. Is it to provide jobs for teachers and an army of central and local government civil servants and quangos or is it to prepare the next generation for success in life after school and to meet the needs of the country? If it is the latter then the whole organization needs to be redesigned, from teacher training to the selection and instruction of students at tertiary level, so as to get the best results. If money is short it must be found outside the school gates, never inside.

It is doubtful whether even a combined assault by the scientific and engineering associations, publications, firms and interests in the country could breach the adamant hide of academia and government and initiate such change, let alone see it through, but it has to be done if we are ever again to attract, select and train the brains that the country needs.

People's inability and failure to think things through objectively, logically and analytically is one of the main causes of the world's political, religious, industrial and material problems. They believe what they are told by their leaders and the media without thinking about it, without questioning the logic or truth of it or the real reason why it was said or written down.

This is where we so desperately need the objective engineering and scientific brain, the brain that is constantly questioning, analysing and thinking of better ways to do things, to take charge, to manage more efficiently, responsibly and fearlessly, to make things happen, to cut through the humbug and bureaucracy and re-introduce into our national psyche a respect for fact, honesty, truth, responsibility, efficiency and objective thinking.

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<sup>4</sup> General Certificate of Secondary Education, formerly called 'O'-levels, the examinations for which are sat two years before 'A'-levels, the equivalent of the French Baccalauréat, the German Abitur, or the Swiss Matura.



It is all very well to say that but how do you do it?

One might find a partial solution in Germany and Canada where engineers are respected. By law, no one may call himself an engineer who does not have a degree in his discipline. They are not content with driving a drawing board and being told what to do. They take the lead in business start-ups, in leadership and management, all the way to the top.

No longer must engineers in the UK be satisfied with just being employed, ignored or underpaid. They are the people with the problem-solving brains, addicted to clear and decisive thinking. They are the people the country needs to sort out the inefficiencies in government, government departments, local government, quangos and industries. They must stand up and command respect for what they are.

On the whole politicians know little about what they are supposed to be doing or taking charge of. They are good at selling themselves and their policies but, like other salesmen, they are too egocentric to make good managers. Their real interest lies in their own advancement, popularity and re-election.

Civil servants know about the correct procedures for handling problems and paperwork in accordance with their SOPs but they are not programmed to take the lead or initiate anything of value to the country. As long as they can knock off an hour earlier than everyone else they are content to go on doing what they did yesterday and the day before and the day before that.

It is engineers who should be collating this lot, welding them into efficient and productive organizations, properly supported by the trades unions, as they are in the richest country in Europe. But first of all they need to find a change of attitude from subjective to objective. They need to find the self-respect that they deserve and establish themselves as experts in management and organization and as entrepreneurs who are not humbled by petty regulations, SOPs and humbug. They have the advantage over others in their ability to think and reason clearly and constructively. Together with industry they and their associations also have the clout to change the entire system of education to satisfy the country's needs but they will have to take the lead and make it happen.

Lenin talked a lot of nonsense about his classless Utopia, in which the state would wither away, in direct contradiction to Marx's manifesto, which advocated a superstate that owned and controlled everything. But among all this contradictory rubbish there were gems of perspicacity. Lenin said that change comes only through strife. He was right. The obverse applies too. Change causes strife. People do not realize these principles or that trades unions exploit them. They co-operate with each other to maximize strife in order to destroy industries, jobs and the economy. Since the Second World War they have destroyed swaths of industry and jobs but how much better off they could be and how much more power and status they could achieve by co-operating with management in common cause to promote their industries to world class-standard. They do that in Germany, so why not here?

The present explosion in technology, especially in nanotechnology, robotics, drone technology, communications, IT security, biotechnology and so forth, cries out for the competent problem-solving brain of the engineer. But it is not there.

The present education system has failed to provide engineers in the quality or quantity in which they are needed. One can only conclude that the present education system is unfit for purpose and unsuitable for its environment. Therefore, in accordance with the laws of natural selection, it must die and be replaced by a system that is suitable.

The politicians and academics who designed or who run the present system have been unable sufficiently to improve the design or to scrap it and design a better one, otherwise they would have done it. They too are unfit for purpose.

The right people to design what is needed and put the country back on the road to excellence would be those who by their ability to think analytically, objectively and honestly are equipped to cut through the humbug, the entrenched interests, inflexibility and idleness and engineer the radical changes in subject matter, teaching methods, exam technique and selection that are necessary in the education system to meet the needs of the country in the 21st century. How they do it is up to them but it has to be done and yesterday is the time to start.