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The adventure of engineering

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ABSTRACT: The path to becoming a professional engineer requires passing through many hoops, generally identified by examinations in a number of subjects, among which there are many of a severely technical nature, obviously related to the future work situations, and some non-technical, intended to broaden the future professional's outlook on life. That is all very necessary, but in this author's opinion, based on several years of study, some decades of professional life, and twenty-plus years of teaching engineering students, there is nothing in the education process to inspire a sense of thrilling expectation when looking ahead to 30 or 40 years in the engineering profession, which can be adventurous. All the student gets is dull cramming of information, which (all being well) becomes knowledge. Two questions arise. What is missing from the education process? And what can be done to provide a sense of adventure? The paper examines these questions and presents a conclusion.

INTRODUCTION

Engineering education must, of course, by necessity of definition, be about engineering *per se*. Such a statement appears to be virtually axiomatic, but having stated it as a seeming-truth we run into several difficulties.

The first is that engineering has become so broad that it has been divided up into sub-disciplines, so that a graduating engineering student knows only one of them to any extent at all, with, perhaps, a smattering of some others.

The second is that the now-normal curriculum can be found to also contain material from other sources, such as from the humanities (so that engineers are made aware of the good things of life) and business (to make engineers understand how the world, in which they work, works). The competition between these information sources usually results in no one being as complete as it might be, all being limited by expectations of students, parents, government and others on how long a course of study should run. However, that combination sounds as if it is a good beginning, but should there be something more? It is important to consider what might be added to the education process to make engineering a more inviting profession.

Reflection on having been through several layers of education during several decades has brought to this author an understanding of a major motivating factor which led him to entering engineering (and, of course, the beginning of the relevant education process). The factor goes back to before the author's high school days, so although it is more suitable for use when promoting engineering during school visits, it should be recognised by being continued, introduced and used in early tertiary education years.

What may this motivating factor be? It is that engineering is an adventure. Furthermore, how can that be brought to the notice of the intending (but perhaps wavering) student?

How does an academic answer a question like that? Simple: use the usual academic answer by reference to the appropriate literature.

THE AUTHOR'S FOUNDATION IN ENGINEERING

Before exploring that intriguing thought, by seeking and examining the appropriate literature, we must state a basic: something, a foundation, is needed in the young person's mind, something which makes that person suitable material to become an engineer, and it is something that should show up at an early age. The evidence of that is interest in how things are put together, or how things a pulled apart, or what things are made of, or how things are made - or perhaps all of those, or some combination of them. Fifty or so years ago, that was shown by interest in building with *Meccano* or building model planes and moving on to dismantling and re-assembling push bikes (all of which featured in this author's pre-and-during-high-school life), then motor bikes (which is another story). Similar evidences of early interest in engineering (though perhaps more sophisticated) must be recognisable today.

There seems to be no certain understanding on how a person develops that mindset but some writers consider it to be related to the individual's preferred or dominant thinking mode, which is said to be related to the part of the brain used more than any other. (Or, as this author remarked some years ago, the reverse may be correct; perhaps such people have a part of the brain they prefer to use, and that establishes the thinking mode used most of the time).

Quickly reviewing this concept - the four quarters of the brain - and the different modes of thinking they provide, are:

- Upper (cerebral) left – logical, rational thought, used for complex technical and mathematical problems.
- Lower (limbic) left – organising, planning, detailing, for implementing ideas in a controlled manner.
- Lower (limbic) right – capable of utilising feelings more than facts, understanding human, interpersonal relationships.
- Upper (cerebral) right – creative and intuitive thought, good in innovative and experimental situations.

From the above, it may be reasonable to conceive that the *born* engineer prefers to use the left-brain thinking mode most of the time and that natural ability is enhanced by much of the content of the *pure engineering* subjects studied at the tertiary level. The other strands mentioned above, for example from humanities and business, require more use of the right-brain thinking mode.

THE CONNECTION WITH ENGINEERING EDUCATION

It would be reasonable to conclude from the above that engineering education is as complete as it may be, given the constraints of the many sub-disciplines. Yet no matter how *complete* it may be in subject matter, there is nothing in that to motivate the student by filling him/her with the fire of enthusiasm for the profession as a whole.

If readers doubt that they should go back to their engineering textbooks and look for anything to excite a student. There is nothing of that nature. Engineering texts are dull; not necessarily boring, just dull: full of meaty facts, seldom with a marinated flavour in them.

How can a young person, say before high school age, become enthusiastic about engineering? How can an engineering student be brought to see the adventurous nature of engineering?

THE APPROPRIATE LITERATURE

The answer comes from what has been termed *the appropriate literature*, and as this author has concluded he was influenced by that to see engineering as a personal adventure experience, examples will now be presented as illustrations of the term.

Several decades ago, two English writers named Percy F. Westerman and John F.C. Westerman had a fair output of adventure stories. Judging by the similarity of names, styles and content they were almost certainly related; they may have been brothers, or father and son, no records have been found of their backgrounds. Few copies of their work have survived the years, and this author has picked up only one book by each of them in the last few years, after giving away a collection many years ago (and since regretting that as a near-irreplaceable loss).

Describing their output as *adventure stories* is inadequate. What they wrote were ***engineering*** *adventure stories*; all had something of an engineering nature as a vital part of the action. As examples, consider the two that have been salvaged from second-hand stock: *The War of the Wireless Waves* by Percy F. Westerman, and *The Invisible Plane* by John F.C. Westerman.

The first deals with inventing the means to broadcast electrical energy so that explosives are detonated and metallic materials become incandescent; a good story (though full of imperial jingoism of the 1930s period), and becoming somewhat conceptually (though not yet actually) possible today.

The second was based on the invention of a transparent material that we, today, would describe as a plastic, and strong enough for an aircraft's structure so that the aircraft would be virtually invisible except for the engine, the occupants and a few small items such as instruments.

Having set up those *engineering details* as essential back-ground, the authors then played out the adventure theme on the unsuspecting mind of the young person reading the stories.

A PARTICULAR ITEM IN THE LITERATURE

So much for those. The one work which will now be used to cover the author's current proposition, that engineering can and should be an adventure for all who take it up (and is for the fortunate some) is another by John F.C. Westerman, one titled *Treasure Chest Island*. With no copy available, describing the content will depend on long-term memory and perhaps the way that has adhered in the author's mind illustrates the influence these *engineering adventure stories* had on his movement into and through the engineering profession.

The plot is as follows: three young men, travelling the world as cheaply as possible, took passage on tramp cargo ship from the west coast of South America, and found themselves left on the ship when it has been abandoned by the crew during a severe storm. The ship is wrecked on a Pacific Island and before the next storm, which demolishes the ship, the three off-load a mix of equipment and cargo. This includes a car, drums of fuel, sacks of cement, the ship's radio and generator and sundry items of tools, weapons, furniture and fittings.

Over a period of several months they build a hut, set up the car to drive the generator, set up the radio equipment, find buried pirate treasure (of course, otherwise why the title?) and are finally rescued by a Navy ship (Royal, of course), which picked up their restricted range Morse signals.

Having not read this book for several decades, this author may be blinded to its deficiencies by a halo effect, making it seem in vague memory much better than it really was. However, sufficient is recalled to provide a feeling that the writer understood the engineering principles he presented and none of the events were strained beyond the elastic limit (that phrasing proves this author's engineering education).

The narrative may be taken as an illustration of how engineering is an adventure, which will now be covered under several headings.

The Adventure of Discovery

The three characters in the book find the ship has been deserted during the night or the early morning. When they wake, they

discover they are alone and must make the best of the situation. Of course, they are unable to operate the ship as the full, trained and experienced crew did, so they make do as well as they can.

This may be compared with the young person realising *I want to be an engineer*, but having no precise idea of what is involved makes the best of the unknown future that is being faced.

The Adventure of Inventory

Finding the ship grounded on the reef near an island, and reasonably stable, they took stock of what was available. The items in the cabins and quarters were visible and obvious; and the cargo was determined by seeking and finding the ship's papers.

Somewhat similarly, the young person takes an inventory (consciously or subconsciously) of what is available. For example: knowledge already accumulated, contacts who might give advice, knowledge expected to be needed, available education establishments, and, of course, the family situation. Some of these may be valuable, while some may present constraints. If the comparison between them shows a credit balance then forward progress will obviously be easier than if a debit balance appears.

The Adventure of Invention and Adaption

Memory of how they unloaded the ship is hazy; all that is recalled is that they had to improvise lifting equipment in order to hoist items out of the hold and to transfer them onto land. The car, an old-fashioned tourer by today's standards, was deck cargo in a large packing case, and they somehow unloaded that. Parts of the ship were simply torn apart to get what they wanted and access to those wants, such as the generator and all the related electrical equipment. Many of those bits and pieces were used to make living conditions agreeable, all adapted for use by applying an inventive spirit. No doubt, many items were taken with no knowledge of whether they would be needed but because they might be useful.

The intending engineer, at the beginning of the student stage, is faced with an inventory of information currently available and how that can be used to make progress. As the learning process progresses, each new item is assessed to see how it can be used. As we move into our occupations, we meet new, previously not experienced, situations, and what was learned must be adapted to the changing work environment. Sometimes, there is nothing in stock that fits the need and we have to invent an idea, a procedure or a way of working to fit what has to be done.

The Adventure of Development

As well as can be remembered, the three young men spent a couple of years on the island, during which time they developed a range of skills by meeting the needs of the conditions they faced. Some of these were minor; one that is remembered is their solving the problem of fitting a belt drive between the car's rear axle and the generator shaft.

In a similar manner the engineering student develops skills by progressing through education and work experience. The education process does not provide everything needed in early professional life, or at any stage! As an example, this author became deeply involved in pressure vessel design, none of which was specifically covered in design subjects, and that led to the discovery of the scope of the Australian Standards, which (as far as can be recalled) were also not mentioned in design lectures.

The Adventure of Rescue

The three protagonists could have ended their days on the island, in reasonable comfort, which was limited only by the relatively primitive nature of their living conditions. The least satisfactory aspect of their life, one may surmise, would have been inadequate diet, for although the island was big enough to provide more than enough for the three in quantity there was a definite lack of variety. Fortunately for their long-term existence, they were found and taken home.

That step brings us to an aspect of employment which few experience: being rescued from a difficult situation by another, most likely a superior, but those who do go through such an event also go through a shift of character. As an example of that, there is the case of a junior engineer who fell behind planned progress in a project and faked his reports. When the senior engineer discovered what had been going on he acted promptly to get the work finished on time, then gave the junior a brief but severe lecture, reasoning that he could live with the junior who had behaved in such a silly manner (he was thinking of his own somewhat chequered past). However, the junior had to decide whether he could live with the boss he had disappointed. They stayed together and the junior's way of working improved markedly, so that within a few years he was ready to accept a high-level position with an international firm, largely due to the lesson learned from the rescue experience.

A FIRST-STAGE CONCLUSION

So there are parallels between the adventure steps in that one book and those in the life of a typical engineer. Is it possible that one book influenced this present author, by suggesting that being an engineer would not be dull and boring but would be adventurous and exciting? Perhaps. Even probably. That one alone? No. There were other books also providing influence.

FURTHER LITERATURE

Several other works of fiction were read during the same early-life period, and as an example T.C. Bridges is one writer's name that is remembered. Most of these dealt with aircraft of one type or another, even airships, and all are remembered as giving a feeling of what engineering, technology and their senior relation, science, was all about, in the context of adventure.

Then there were two comic strips, generally known by the names of the principal characters, Buck Rogers and Flash Gordon. *These* were real adventure stories for an intending engineer! (at the pre-high school age). The first of these involved dashing around the solar system, ignoring the need for the time required to cover the distances in a mathematically-agreeable manner, and ignoring many technical limitations - but so what? It gave a young person with a strong left brain a good

story to read, and introduced an adventure-idea equal to that Columbus must have had 600 years ago.

AND THEN WHAT FOLLOWED?

Somewhere about the same time as reading the Westermans' books and the others cited, this author stumbled over a magazine that contained a short story about exploration on Venus. That was a time when Venus was believed to be a hot, steamy, tropical world, since disproved, but the assumed conditions led to a good story. More magazines were discovered, most from the USA, which, curiously, in the 1950s and 1960s showed a rather jingoistic presentation of America as a world leader similar to that shown by English writing of the 1930s. But who cared? Certainly not the developing engineer.

Books followed, with authors multiplying in this field of writing, with the output of Verne, Wells, Asimov, Anderson, Binder, Dickson, Clarke, Heinlein, Blish, Pohl, Bova, Campbell, del Rey, Harrison, Hamilton, de Camp, Leinster, Williamson, Niven, Smith, Silverberg, just naming a few, with many others becoming well known. A complete *who's who* runs into pages.

Why was all that writing favoured by the developing engineer? The first reason, obviously, was that it all had a technology-base. The second was it was, generally, inventive. Ingeniously.

As an example, consider one short story by Farley from 1950 about a time machine, which this author has used to test the lateral thinking ability of engineering students, both undergraduate and postgraduate. The conventional *design* of a time machine is that time inside is slower than time outside, so the question put to the students was: given complete freedom of thinking about a time machine's operation, what commercial use could you make of it? The obvious answers (the stock market and the horses) came out, but no student thought of using it *in reverse*, so that time inside would be faster than time outside. When this was described to the students, the then-obvious use, spending a week studying in the machine during the night before an exam, was greeted with a why-didn't-I-think-of-that? reaction. If anything, the experiment showed the linear-thinking mode of the standard engineering mind.

The third reason was there was a reasonable amount of good humour, some of an ironic nature, paralleled often by a twisted way of looking at something familiar.

This was seen, for example, in another tale, by Tenn (a pseudonym for Philip Klass), titled *Time in Advance*. The principle suggested in this was allowing would-be criminals to register their intention, accept sentence (seven years transportation for murder, intended to leave no survivors), then having served the time they could return and commit the crime. The central character wanted to murder his wife or the man who took her away from him, was sentenced to the seven years transportation (one wonders whether that American writer knew Australia's criminal history). However, when he did succeed in returning, he was given a ticket allowing him to *murder one person*. But his experience had worked out his desire, so he smashed a plate glass shop window and handed the *murder* ticket to the police who rushed up to take him in for damage.

The fourth reason was much of society, including politics, was mixed into the writing, some using today, or the past, as a model, some building on concepts that might occur in the future to produce other social systems. One recently read contained a delightfully-worded parody of the sort of paper written for a journal such as this; the style was so recognisable there was no difficulty in realising what the writers intended.

But, returning to the first reason, it was all technology-based. Bringing in the second reason, it made the technology and the engineering in the stories exciting and adventurous. It was a genre of written work well capable of attracting one intending to be a professional engineer.

THE DEFINING TITLE OF THE GENRE

It is time to give the output of all those writers above its commonly accepted title.

It is indeed curious that an inspiring form of literature (if dyed-in-the-wool literary *aficionados* will allow the word *literature* to be used for a popular form of writing that still lingers outside what is generally termed *mainstream literature*) has been given the title *science fiction*. That name goes back to 1926, generally credited to Hugo Gernsback, although Ash credits it to a Swedish magazine, *Hugin*, in 1916 [1]. Clute and Nicholls unhesitatingly refer back to Gernsback, who used the term *scientifiction* in 1926, but that had faded out by the 1940s by which time the two-word title *science fiction* was in general use, often abbreviated simply to *sf* [2].

Perhaps this competition has been solved in the minds of most who read it by the way that the USA has dominated the field, which they surely have since about 1930.

Gernsback (in Clute and Nicholls) defined the genre as follows:

> *By* scientifiction *I mean the Jules Verne, H.G. Wells and Edgar Allen Poe type of story … a charming romance intermingled with scientific fact and prophetic vision …*

Clute and Nicholls follow that with a lengthy discussion on what the genre should be, pointing out (among others) that it is speculative and there is a difference between prescriptive definitions (what writers *ought* to do) and descriptive definitions (what writers actually *do* do). Yet essentially adhering to the *science* connection, with which this author disagrees and claims that a descriptive definition shows the genre is *technology fiction*, or, in many examples, *engineering fiction*, both of a speculative nature.

Those writers then define the term *technothriller*, a term that sounds as if it would fit *technology fiction*, but their definition is framed in a manner which agrees with one of their examples - the *James Bond* movies. It does not agree with this author's interpretation of what is normally classed as *science fiction*, in which the technology-engineering-content dominates, making it more interesting for engineers than for scientists.

Clute and Nicholls also comment on the interest that developed in the USA from the 1970s, in using science fiction in education, particularly in tertiary courses, with some texts being

produced for that purpose (eg Williamson) [3]. Interest in Australia has been much lower; there has been some at the Universities of Sydney and Adelaide, at another in Sydney, and at one in Perth, but none as strongly as in the USA.

A UTILISATION OF THE GENRE

An opportunity came in the late 1980s to utilise science fiction in a subject in a less prestigious university that the one above, not entirely for curriculum reasons but partly due to internal politics. The title of the subject was *Literature and Society*, which ran for three semesters, presenting aspects of literature and writing to engineering students (with some nursing students joining in) and using science fiction short stories and novels as examples, good and bad, of published writing. There was a definite impression that the technology-based engineering students not only enjoyed the readings and discussions but also developed more understanding of what makes good writing than if they had been reading some of the more conventional material.

A CONTRIBUTION TO THE GENRE

Every academic has a special area of knowledge and interest. In the case of this present author, it is management, particularly in engineering, or, more generally, technological organisations; a management subject for undergraduate engineers was taught for some 15 years, generally twice each year. Having been through a management masters programme at another university, this author was accustomed to the use of case studies for teaching management and so decided to use them as a teaching instrument with engineering students. Unfortunately (although, perhaps, in the long run, fortunately) none of the published case studies fitted the needs of these students.

So a series of case studies was developed to suit the need. These were set in a fictitious scenario that was deliberately designed to parallel Australia's place at the end of the world, where we are to some extent under the commercial control of larger overseas interests. The parallel scenario was set up by establishing a company in an indefinite future with factories and other interests on many worlds, with the action alternating between Head Office in London and a particular factory figuratively as far away as Sydney is from London in today's terms.

This has been detailed in several previous papers of which four are cited as examples [4-7]. A more general presentation of benefits of using fiction in engineering has also been given [8].

Was this what is termed science fiction? Perhaps. More surely, it has shown the adventure possible in engineering, particularly in management, through a mixture of genres, principally engineering and management, with goodies and baddies and a dash of romance stirred in (after all, if a narrative's about human people, then certain relationships will develop). In the last two series written, there's been a lot of Occupational Health and Safety (OH&S). Most certainly, the students enjoyed the reading and learned management from these case studies (after recovering from the initial shock of getting something easy and oft-amusing to read).

CONCLUSION

A career in professional engineering should be an adventure. Indeed, it can be, in one of many different ways, although not all the time, not every day or hour. As a caveat on that first proposition, Sturgeon's Law is quoted: 90% of everything is crud. Engineers may feel pleased if 10% of their work is adventurous. How is that defined? Adapting from a definition of science fiction (science fiction is whatever sells and is bought and read as science fiction), the adventure in engineering life is what we make of it by what we find to do, what we do, and how we go about doing it.

As far as the education of engineers is concerned, something is needed to give students an impression that adventure will be there, in the profession, and they should expect it, look for it, and enjoy it. As a way towards that, we could encourage them to read fiction that contains engineering or technological adventure - even Ian Fleming if nothing else is available.

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4th Baltic Region Seminar on Engineering Education: **Seminar Proceedings**

edited by Zenon J. Pudlowski & Hans Peter Jensen

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