

Educating new Global Engineers by Re-Cycling the old ones

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Introduction

This paper is a personal examination, and distillation of the results of 6-years' experience supervising Work-Based Learning MSc Professional Engineering programmes for company-based participants in the UK, Indonesia, Angola & Azerbaijan. These participants are seeking to attain the required academic level to become registered as UK Chartered Engineers. By undertaking this programme, at the same time as holding down their demanding jobs, the participants not only reach that required academic level, they also are able to demonstrate the required competence levels to become Chartered Engineers. All of the overseas participants work in the Oil and Gas companies - one of the world's truly 'Global Industries' that need 'Global Engineers'.

The Engineering Council pioneered the 'Engineering Gateways' scheme (Engineering Gateways - Flexible Pathways) as "another route to registration" beginning in 2007 with a 3-year pilot programme. In 2010 Aston University decided to offer the programme overseas (as well as the UK) in response to requests from BP. All of these programmes are individually tailored around each participant's job. Extensive discussions between Aston, the participant and his company help develop a series of Assignments, usually culminating in Reports for assessment, each addressing a specific themed generic academic module. This programme then effectively becomes the participant's individual and unique MSc programme.

Unlike conventional taught MSc programmes the Based Learning (WBL) approach, adopted for the Engineering Gateways scheme, is new and academically unconventional. There is usually no curriculum and few taught elements, rather, the participant is encouraged how to 'Learn', and apply Critical Reflection techniques to all delivered and assessed work.

The purpose of this paper is to show that there are other viable alternatives (to taught Master's programmes) that are challenging to the participant; supported and welcomed by the participants company; and that lead to highly professional engineers within the workplace. WBL is fast becoming that accepted alternative.

The results so far also show some fascinating 'cultural' influences that took us time to understand. The participants are all, in the main, 'mature' individuals who need to develop unique coping mechanisms to handle job pressures and self-motivation issues. Something in the order of an extra 600 hours of study is required for the programme –thus it is not for everyone. A rigorous selection process helps us identify those individuals who can cope with this challenging route to Chartered Engineer registration, through the Work-Based Learning (WBL) employed by the MSc Professional Engineering programme approach.

The successful ones are the new Global Engineers of tomorrow.

1. Background

That the world needs more highly trained Engineers is a given. Not just the 'developed' world, but increasingly the 'developing' world, which now needs to compete in an increasingly 'global' marketplace for highly skilled Engineers. The UK's traditional educational processes (full-time education to Levels 5, 6 & 7) in the HEI's and Colleges produce good young Engineers ready to enter the marketplace. These can then gain the valuable experience necessary, over the years, to attain Chartered status in their respective Professional Engineering Institutions (PEI). For the older engineers, already working at intermediate and senior levels in their companies Continuing Professional Development (CPD) and life-long learning are strongly encouraged these days. However, this together with the raising of the academic requirements for CEng (from Bachelors to Masters Level in 2004) has led to difficult situations for many engineers who are faced with the dilemma of needing 'top up' their academic qualifications to demonstrate Masters Level working if they wanted to attain CEng, at the same time as holding down a responsible position at work. Also with perhaps a family to support, and an employer who was not so keen to lose their skills and experience of their staff for a year or two while they go back to full-time learning. In 2006 The Engineering Council, aware of these issues, had the foresight to initiate a 'Pilot' Work-Based Learning (WBL) programme led by a small group of UK Universities. Kingston University London, where I was working at the time, was tasked with leading this small group. Kingston is skilled at developing WBL programmes, and had over 10 years' experience adapting WBL principles to novel situations. The idea was to test whether it was possible to devise such an Engineering MSc programme that could be undertaken at the same time as full-time employment. The result was a three-year 'Professional Engineering' programme that enrolled about 50 individuals in 2008. After joining the programme in mid-2008, I worked with a group of 10 engineers from a variety of companies and backgrounds over the subsequent years. In 2010 I joined Aston University who started their MSc PE programme with participants in the UK, together with a small cohort of six participants for BP in Angola. Today there are around 15 participants on the Angola programme. In 2011 we introduced the same programme for BP in Indonesia, and from the beginning of 2014 we have run the programme in Azerbaijan. One of the common factors for all of the current overseas MSc PE programmes is 'Oil & Gas', one of the world's truly global Industries that demands access to Global Engineers. The other common factor is 'Localisation' or 'Nationalisation' programmes - in each of these overseas Countries their Government insists that their 'local' engineers are trained up to a sufficiently high standard to eventually take over from the 'Ex-Pats' (usually British or American), who are invariably in the senior Engineering roles in the Oil and Gas companies there. The following sections identify the key findings, and cultural differences, that have emerged over the past six years leading to the successful programmes running today.

2. The roles of the Supervisors

The Aston programme adopted two types of Supervisor (the Professional and the Academic) for this programme. This approach was developed from the original 'pilot' work back in 2007. With no formal curriculum or conventional teaching, the Programme has a very high reliance on the roles of the Supervisors to ensure success of the programmes. We take as the guiding document 'UK-SPEC' published by the Engineering Council (UK-SPEC 2014). To mirror the twin aims of the MSc Professional Engineering, Aston uses 'Professional Supervisors (PS)' along with Academic

Supervisors (AS) to work with participants on their programmes, each focussing on a different aspect. PS's visit the participants four times a year (Quarterly), spending around a ½ day each visit on face to face discussions, as well as regular monthly contacts by email, phone or Video-Conference. Initially, most of these discussions take place assist the participant to formulate and articulate their proposed work on the programme - the Learning Agreement. With constant iteration between the participant, the Supervisor(s) and the Company, this process can easily take 4-6 months to complete. Once the participant's programme is underway the Professional Supervisors role changes to one of developing the participant's 'Professionalism' by constantly challenging the participant and continually asking 'Why' are you suggesting that approach?.....' What's' World-Class practice here?.....'How' is this problem tackled in other Industries? Constantly getting the participant to think more strategically, and behaving more professionally.

Academic Supervisors visit the participants in their places of work at least once per year, and will also have additional interaction with them by email or phone, in order to guide (but not teach) the participant. Not all Academics are comfortable with this role, particularly working overseas. However, experience has taught us that those who make the effort to understand, and work with this new education paradigm, really enjoy the process. Participants may submit a draft submission to the AS who will make general comments about the work, before the participant submits the final version for assessment. The participant's final submitted work is then first marked by the AS, and also then 'blind' marked by the appropriate Module Owner, another academic who has a responsibility for all submitted work in that Module world-wide. Assuming they agree then the Aston Board of Study has the final validation of the mark. If not, a third marker is appointed if they cannot agree, and then the final validation by the Aston Board of Study. This process is completely transparent and only on very rare occasions is the third marker instituted.

3. Critical Reflection

One of ways we help the participants prepare for the rigours of this programme is to help them understand some basic ideas about how people learn, rather than how they are taught. The first assignment they tackle on the programme is for the participants to prepare an 'Evaluative Review' about themselves. Work packages, to be downloaded and worked on; help the participant get familiar with Learning Theory and Critical Reflection, and other tools necessary for them to undertake an Evaluative Review of their own career to date. As I said before most engineers are not often equipped with many of these softer skills, and it does take a while for the ideas to be understood and applied to them-selves. By and large it's the men that have the greatest difficulty with this. Women seem to understand be able to apply the principles more readily for some reason.

Critical reflection is widely recognised as a key component in the learning processes of individuals and is advocated in many areas of professional practice. Mezirow (1990) considers critical reflection as a precursor to transformative learning, which may lead to changes in personal understandings and potentially behaviour. Critical reflection is used in education to encourage the integration of theory and practice while enhancing participant learning and self-confidence (see Fig.4).

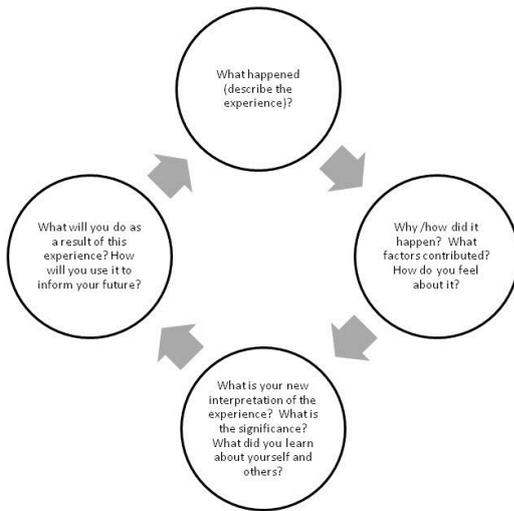


Fig.4

4. The UK Programme

From the very beginning of this programme in the UK, in 2007, we insisted that every potential participant was interviewed individually to assess their suitability. We were looking for a high degree of self-motivation, good self-management, and a clear understanding of why they wanted to enrol in this programme rather than a full-time Masters. This type of programme is not suitable for every individual - indeed we actively discouraged potential participants from joining, if they had any doubts at all. We only wanted those who were 100% sure. In those early days although we were aware that the work 'culture' would play an important part of the programme, I don't think we fully understood how difficult it could be for certain types of participant to adopt the necessary mind-set required to undertake this type of programme. The younger ones, with far less job responsibility, were still in the traditional educational mind-set of having the structure laid out for them, and being 'taught' a curriculum rather than them having to 'Learn' what they needed. The older participants, some with senior roles in their company, had more difficulty in adapting to a new work/life balance, where they had to allocate the priorities required when their MSc work and work roles conflicted for their time. In essence neither group had the necessary 'Professional' mind-set developed at the start of their programmes.

This was the spur for us to introduce the concept behind the 'Professional' Supervisors to compliment the Academic ones - more on this later. As the programme progressed it became evident that many of the participants struggled with the initial work module, designed to help them understand some basic Learning Theory; different personality types; and then applying those principles to themselves by delivering a piece of work showing an understanding of themselves and how they developed as engineers. None of these 'softer' skills had been taught during their engineering education. Even today it's rare that these valuable soft skills are taught at undergraduate level. Therefore this was the part of the programme that most of the participants struggled with - some even leaving the programme because of it. Nevertheless it was rewarding to have comments from them later, during the latter stages of their programmes, that although they disliked doing this work at the time, afterwards they began to realise its value - indeed a couple of them now use it regularly in their work. The other thing frequently noted by their companies was a real change in work attitude. Participants became more 'Professional' in their workplace whilst undertaking this programme. Many gained promotion during their MSc PE, and one individual was promoted twice. Often the work delivered (Reports) has proved highly valuable to the companies. One particular report saved the company hundreds of thousands of pounds, by redesigning work processes rather than opting for the capital investment approach that was normally undertaken. This aspect of mutual benefit to the Participants

and their companies is at the heart of this programme. Any programme of this nature will suffer from some 'drop-out'. Typically 20-25% is not unusual. The MSc PE drop-out rate was in line with these figures, however one thing that did become obvious was that if the participant completed the first year, they would then go on to complete the whole programme. Working with the UK participants allowed us to refine how we approached the programme, and made us very aware of possible pitfalls along the way. The main conclusion reached, over this time, was that balancing the day job and the extra time required by the Aston programme was difficult - too difficult for some to manage. Nevertheless, with our help, most managed to develop coping mechanisms that allowed them to do both successfully, and therefore complete the programme. To date around 25 participants from the Kingston and the Aston programmes have completed their MSc PE programmes, and many of them have already now become Chartered Engineers. These lessons stood us in very good stead when we started the programmes overseas.

5. Launching the MSc PE Programme in Angola

Starting a WBL programme in BP Angola for local Angolans was an 'interesting' and challenging experience. One thing that wasn't entirely expected was the effect of the 'culture' of the local Angolans. When establishing a new WBL programme (like the MSc PE) in an environment like Luanda, Angola's capital, the normal business expectations have to be suspended or even thrown away completely. Angola is a country not long out of a 25 year Civil war. Normal business expectations such as uninterrupted electrical power, Internet access and ease of travel were not what we expected at all - although the situation has now improved substantially over the past few years. Also, the participants in the Oil & Gas industry work in a particularly demanding environment, sometimes offshore on drilling ships, or dealing with suppliers anywhere in the world. In that industry it's a 24x7 job, where equipment break-downs must be dealt with as a **top priority** over everything else (for example 'Deepwater Horizon'). To put this into perspective in an FPSO (Floating Production and Storage Operation - See Fig.1), the normal mode of production is drilling 100+ miles offshore in very deep water (1800 Metres). It can cost upwards of \$100 million per week of lost revenues if it's out of action.



Fig.1 Floating Production & Storage Operation

(Copyright BP)

The participants here on the MSc PE programme are all junior/intermediate level engineers who have to balance this hazardous work environment with a busy home life, together with an intensive WBL programme. Even when they are on-shore in the engineering office, they probably have a two-hour commute each way to work and back, in traffic and roads that makes most congested cities in the rest

of the world look tame by comparison. Luanda was designed and laid out around 260 years ago by the Portuguese, for about 250,000 inhabitants - today Luanda's population is around 4 million people – most of which have to drive their own cars as Public transport is either non-existent or highly dangerous. With all of this in mind, the challenge was to 'motivate' and 'support' that first batch of participants on the programme, by working with them to develop their individual unique MSc programmes. For the Aston MSc PE programme, participants have to deliver a series of Assignment Reports (usually about 8 over the 3-4 years of the programme) based around their jobs. Each of these Assignments is selected to demonstrate and fulfil the required generic 'Module' Learning Outcomes, set out in the Aston MSc programme Module Descriptors for each theme e.g. Emerging Technologies, Project Management or Engineering Analysis. Having successfully worked with the participants to define their programme of work, and set them going on their assignments we sat back and waited.....and waited....and waited. The plan was, and still is, that Aston Supervisors visit them in their work environment 4 times a year, and then spend at least ½ day with each participant; exactly as we do with all of the UK participants. We had overlooked some vital differences between the Angolan 'culture' and what we were used to. Angolans are, in the main, a very happy and relaxed people who will agree to do what you ask.....as long as you are there to keep reminding them. We quickly discovered that when you leave the room you have effectively 'left their Universe'. So, unless you keep going back to remind them, they will usually prefer to do something else (listen to their music, party and other more appealing things instead). We had to therefore institute some changes on both sides. We established a 'Mentoring' system with the help of the BP senior management, where senior BP Engineers, neither on the programme nor their line manager, agreed to mentor the individuals and encourage them to keep to deadlines and submit work regularly. We also instituted a monthly contact system for the Aston Supervisors, where they have to make a contact with their participants by email, phone or Skype. Once these two actions bedded in there was a marked improvement in participant performance. This progress has been made, and is accelerating with each new group added to the cohort. Despite a few drop-outs we now have a stable cohort of 15 individuals moving through the programme, with a pretty even mix of males and females. The first of these should graduate sometime this year.

6. Experiences in Indonesia

The Aston MSc PE for BP Indonesia, in Jakarta, began a year later than the Angola programme in 2011. So we had the benefit of that first year's learning curve from Angola to assist us. Several of the Engineers were mainly based in Jakarta, but more often their 'workplace' was 2000 Km away in Tangguh, West Papua, on the edge of the jungle. This made for some interesting visits by our Supervisors, who have to ascertain the 'normal' working conditions for the participants - for many of the Engineers these are excellent facilities (See Fig. 2). Fortunately, more often when we were in Jakarta, we were able to Video Conference with any participants currently in Tangguh rather than in Jakarta.

The 'learning' culture in Indonesia was very different from that in Angola. In Indonesia participants being educated are NOT supposed to question anything from their teachers. This, combined with a deep seated aversion to admit failure (rather along the same lines as 'Face' for the Chinese) or to admit a lack of understanding, made it extraordinarily difficult to ascertain the actual understanding and subsequently the progress by the participant. It was only when 'draft' written work began to be submitted that the full extent of the issues became apparent. Extensive discussion with the participants eventually persuaded them to adopt a more pragmatic approach to what we were asking of them. One of the fundamental tenants of the MSc PE is to encourage the participants to continually question the Status Quo by asking WHY.... This does not conform to their education module at all.

However once this 'barrier' had been overcome, particularly by the older participants, progress was much swifter all round. The older participants are very studious and conscientious in their approach to the programme, and we quickly learnt that we could make use of the family 'hierarchy' that operates within the society there. This is where the younger members of a group look for guidance from the older ones. By using this we were able to get the more senior participants to 'mentor' the junior ones on the same programme. This again is different from Angola where the Mentors are chosen from outside the programme participants. Another aspect of the MSc programme operating in Indonesia is how they position the work required in the programme to the work required in their day-jobs - not exactly **Work / Life** balance, but rather **Work / Work** balance. The programme tries to get the participant to begin thinking (and acting) more as a Professional Engineer by 'Critical Reflection', and developing the ability to manage themselves and allocate priorities. Initially it was very apparent that the participants viewed their priority as fulfilling their day job, and therefore only getting round to their Aston activities when time permitted - which in many cases early on was never! Gradually, through discussion, mainly around how Professional Engineers need to adopt a certain mind-set in dealing with conflicting priorities, we were able to set them onto the required path.



Fig. 2 BP Jakarta Engineering Office

Not surprisingly the more mature participants adopted these tools and techniques quicker and made progress faster. This is one of the main benefits of this type of programme. We work with the participant to accelerate the skills and understanding they would normally acquire naturally over many years, in a far shorter timeframe.

7. Early Days in Azerbaijan

The Aston MSc PE programme only started in January 2014, so it's still very early days. Nevertheless, like both Angola and Indonesia the effect of culture should not be overlooked. Azerbaijan today is an interesting mix of its fundamentally Iranian heritage (there are twice as many Azerbaijani people living in Iran as there are in Azerbaijan), and its more recent ownership by Russia. It also has a very strong Turkish influence, indeed their language is part of the Turkish family. That said, it firmly believes that it is a European nation, with its membership of the European Council, its participation in the Eurovision Song Contest, and next year (June 2015) it will host the first European Olympic Games. Oil and gas has been exploited from under the Caspian Sea for over 1600 years, when it was exported by camel along the Silk Route. Its national symbol is the 'Flame', and the word

Azerbaijan literally means 'Land of Fire'. Even today oil and gas still bubbles up out of the ground, and ignites. It also developed the world's first commercial oilfield in the 17th Century. Today, Baku (Azerbaijan's capital) is a dynamic mix of astounding architecture (see Fig.3) surrounding a 5,000 year 'Old City' which is a World Heritage site. Azerbaijan celebrates a love of Poetry, Literature, Art and Music together with mathematics and science. This mix of cultures is reflected in the participants on the MSc PE programme, who are very conscientious and serious about their study. As we discovered here (as in Angola and Indonesia) women are well represented in Engineering, and on the whole seem even more ambitious than their male colleagues. Education is very important to Azerbaijan, with some of its Universities taking part in the Erasmus Mundus programme and participants studying all across the world, including 40 Universities in the UK. One of the main Technical Universities in Baku, Qafqaz, takes many of the best participants in the country and educates them on all of its Engineering degrees in English. Impressive for a country which has a population less than that on London.



Fig 3 Baku

Despite all of this we soon discovered that there are similarities with Indonesia here, in that there is reluctance to 'question' authority (including teachers), and the work-based learning principles were unknown. However they are quick learners and we expect progress to be rapid.

8. Conclusions

It's been a highly interesting and rewarding six years for all of the Supervisors on this programme, especially for the Professional Supervisors who are usually retired or semi-retired. This programme has given them the opportunity to pass on a great deal of their experience and expertise, after a lifetime of work as Professional Chartered Engineers. Academic Supervisors, who take to the programme, also get great rewards by working with participants in their workplace on projects far more relevant to the participant's jobs, than if they only taught the traditional type of Masters Programme in the University.

I've tried to review the last six years of this programme by looking at how the programme has evolved and at different 'Cultural' effects on the individuals on the programme. But perhaps the biggest single aspect for the overseas participants is language.... their language. I have developed a huge respect for the overseas participants undertaking this programme in, what for many, is their

third language. I can't even begin to understand how difficult that makes a demanding programme even more so.

Discussions with participants themselves, following the successful completion of the MSc PE Programme, lead me to conclude that they believe they all got more from the Programme than they expected to. Most have been promoted and their progression as Chartered Engineers has accelerated their progress as Professionals.

From a personal point of view it's been enormously gratifying for me to work with these types of participants, and visit them in places one normally wouldn't expect to visit. I firmly believe that the positive transformation of almost all of the participants, over the 3 or 4 years of this programme, has led to a unique group of professional engineers, well on their way to being the 'Global Engineers of Tomorrow'.

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