Women In Engineering: Reflections



Back in June, Wendy Owen wrote an article celebrating International Women in Engineering Day (INWED). The article was published on the SCSC website to tie in with the INWED event, which occurs on 23rd June every year. Wendy has kindly agreed to reproduce the content in this edition of the newsletter; this will help make the insights arising from her group discussion with prominent female system safety engineers available to as wide as readership as possible and ties in with Ada Lovelace Day (findingada.com) also celebrated this month.

INWED began in the UK in 2014 as a national campaign from the Women's Engineering Society (WES). Since then, it has grown enormously, receiving UNESCO patronage in 2016 and going global the following year. INWED promotes the amazing work that women engineers across the globe are doing and gives them a profile when they are still hugely under-represented. It plays a vital role in encouraging women and girls to take up engineering careers.

The Influence of WES

Since INWED started, many companies in the engineering field have developed diversity, equality & inclusion (DEI or EDI) Strategies, as we now also have in SCSC (refer to the website). We are also still actively trying to encourage more women engineers to join SCSC, and role models are important and affect recruitment. SSS'24, as far as conferences go, did very well with about a third of the audience being women – in my books, this is very high indeed so we must be doing something right! It is also certain that previous women featured in the SCSC newsletter do act or have previously acted as role models for other women in SCSC and associated professional societies, within their own organisations, and within the wider engineering community. If society has a dire need for more engineers, getting more women engineers on board and retaining them is a no-brainer.

The Pleasures and Perils of Awards

For every person who gets an award or bonus, there's often many more disappointed, disheartened or demoralised other people who didn't. So, generally, I'm not keen on awards. Having said this, last year WES did something interesting – they had one for the Top 50 engineers in "safety and security", with the next 50 getting commendations. You'd have thought SCSC and SaRS members would be easy pickings for this one, however, when the results were released, literally only a smattering of system safety engineers made the Top 100 cut. How could this have happened?!

Well, without sponsors or allies, or visibility, and people from other disciplines stealing the show, as individuals we have little chance at all of being recommended to either a) sit on an awards panel (thus influencing who receives the awards) or b) actually get an award. It was truly a lost opportunity for the system safety (and security) community. It was a one-off, the theme changes every year, so the chances of this topic coming up again during a working lifetime are probably improbable. Sometimes you only get one shot. For me, the whole episode reminded me of the Beckett quote here and that "Don't Quit" poem.

"Ever tried.
Ever failed.
No matter.
Try again,
Fail again.
Fail better."
Samuel
Beckett

Anyway, here we are, a year on, with our next INWED article.

The Advance of Technology on Transport Systems and the Realities of Recruiting

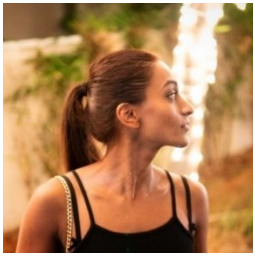
With this year's interviewees, a few common themes were noted in initial discussions; technology/software, transport systems (both civil and military) and recruitment issues. I proposed a group discussion. It included myself, Nicki Lerigo-Smith from Qinetiq www.qinetiq.com, Serrie Chapman from Women's Tech Hub www.wthub.org and Sindhura Lang from Ebeni www.ebeni.com. I had not met/spoken to any of them before. It went a bit like this…

Overview of Current Work Domains



Serrie I work in Autonomous buses on Safety. It's a relatively new field although I have been working with Safety Standards within automotive for years in semiconductors and also worked with the Safety team on the rail electrification programme. As it's so new, the standards are really playing catch up – it's a complex problem but will arrive in the not-so-distant future, and the UK is leading the way on Safety with the BSI 188x set of standards and the Autonomous Vehicle (AV) bill. We are very much involved in working on the standards and Cyber is also a major consideration as is AI usage within them. It's an exciting time and updating some of the more traditional standards to reflect the new concerns (Autonomy, AI and Cyber) is key to bringing in a more digital solution.

Sindhura I work as a Safety Engineer within Ebeni's Air Traffic Management (ATM) Business Unit and have worked on a number of ATM projects over the years, supporting ATM Equipment Manufacturers and Air Navigation Service Providers in getting new equipment/systems into operational service. I am currently working on Eurocontrol's Integrated Network Manager (iNM) Programme, supporting Eviden, a company specialising in Digital Transformation projects and working closely with Eurocontrol and Indra Safety, Quality and Security teams.



The iNM Programme is a digital transformation project with the aim of replacing Eurocontrol's core legacy systems such as Flight & Flow services and the European Aeronautical Information Service Database (EAD) with new digital architecture, hosted in a Cloud environment. Ebeni have adopted the Service Based Assurance approach developed by the SCSC Service Assurance Working Group scsc.uk/scsc-156D and have modified the approach to cater towards cloud-based services.

Nicki I work on a legacy military aircraft system which is undergoing an update for obsolescence and addition of newly developed systems, which incorporate more COTS than bespoke developments. New and updated systems bring many challenges that were not considered for legacy systems such as cloud-based technology, cyber security considerations and AI technology. These can bring many advantages but also introduce new hazards and require considerable effort to support qualification and certification of new and modified systems.

Wendy I'm not currently working in transport, although I worked in the rail and naval sectors for many years and currently sit on a regional Women in Rail committee. I'm predominantly working on legacy plant in the nuclear sector that are many decades old, which bring their own challenges in today's world. Never forget that, one day in the future (which could be next year or decades from now), all the new technology will turn into a legacy system. Full project and system lifecycle management is as crucial now as it ever was.

Complex Systems, Advancing Technology and Challenges to Standards

Wendy The systems I'm currently working on are largely analogue in nature, and physically/geographically isolated with no/few external interfaces. But even so, from a safety case perspective, there are considerations about the advent of cyber-security, drones and AI and 'the way things are going'. Even with long-standing operational systems, you cannot ignore the potential impact.

I do think safety has been given more attention in recent years, with people talking about Safe AI for example, as well as new regulations such as the Building Safety Act, an interesting development effectively dragging the construction sector more in line with existing sectors requiring a safety case.

I believe the instantaneous and high availability of news articles about accidents also influences levels of public concern.

Nicki My team do independent software assurance of safety-critical aircraft control systems, so we are very much safety-focussed. Traditionally, aircraft suppliers are

highly safety-focused and well-versed in software good practice in line with Air Recommended Practice (ARP) 4754/4761 and open standards such as RTCA DO-178.

We tend to see a different attitude from newer suppliers of innovative developments where safety seems to be a secondary consideration and priority is afforded to programme, cost and agile development methodology, rather than evidence-based engineering and application of hazard analysis and risk reduction techniques.



Societal acceptance and reaction to accidents from the advent of new technologies tends to influence change in safety legislation and will lead to the development of enhanced safety standards and legislation. Developers need to be aware of this and ensure that they develop to meet relevant certification in order to have products that are fit for purpose and meet safety requirements at the required safety integrity level.

Serrie The different approaches from countries are interesting, some companies and countries are going for a much less safety-based approach. I believe that the UK, the BSI, ISO and CCAV (Centre for Connected and Autonomous Vehicles) are all taking a very measured approach to the issues that are arising. Safety is a primary concern and being taken very seriously with a Safety-first approach. The key issues that I am seeing with some parts of the industry is, due to the standards and legislation following the tech solutions, it's causing concern with the public with their approach to some of the unregulated areas. This may affect the industry as a whole so the usual competition between companies to be the first to achieve solutions is not necessarily a good thing, as we have seen with Cruise and Tesla as examples. It is definitely an industry that has Safety as first and foremost as a concern though so, when the legislation catches up, I believe it will ensure that the right companies with the safest approach are the more likely to succeed.

Sindhura Ebeni is a consultancy that specialises in Safety Engineering, Assessment and Assurance, so Safety is always at the heart of any project we undertake. As Nicki and Serrie have mentioned, there are companies with a much more relaxed attitude towards Safety, who often view Safety as a tick-in-a-box exercise, but I've also found that these companies tend to change their attitude a little when they realise the influence Safety has when it comes to getting approval from the Competent Authority to enter operations with a new system/service.

Conversely, with the emergence of cloud-based technologies, there is a risk of playing things a little "too safe" and over-engineering solutions due to the challenges faced when trying to assure cloud-based services. This is something that could be managed with the adoption of new assurance methodologies.

Selling Safety as a Career for Women Engineers

Wendy We know there's a general dire lack of engineers, and we know there's a dire lack of women engineers within that picture. I'm currently employed as an associate/contractor, although not through choice, and I see others in similar situations. Very unusually, and even very ironically, I currently find myself working with a fairly high proportion of other women engineers, so there is hope out there.



There's a dire lack of engineers with experience in the nuclear sector at a time when the energy sector is going through a renaissance, but many thousands were laid off in the 90s, and the sector has effectively been dormant since. The workforce tends to be a mix of early career professionals and very experienced staff/experts, but not much in-between. This is simply down to historic reasons and, in my experience, much less prevalent in other UK sectors in regards balanced demographics of workforces.

Nicki In an ideal world there would be a pool of suitably qualified and experienced candidates to draw from. In reality, there is a deficit of software safety engineers and consultants with relevant scarce skills to satisfy job demand. This can price the best candidates beyond project affordability. The way that we are dealing with this is to make significant efforts to retain trusted and experienced staff members and execute a succession plan to recruit and train graduates and less-experienced personnel. It requires considerable effort with respect to developing people to satisfy future demand and balance that against urgent deliverables which must be supported by more experienced personnel, some of whom are contractors, to manage peaks and troughs in demand.

Serrie As Wendy and Nicki have pointed out – there is a lack of safety engineers, engineers with the relevant skills and women in the industry. Interestingly I am seeing more women in the safety realm in this area than I have seen previously in other more classical engineering areas. The other thing I am noting is that the backgrounds of the safety engineers is a much broader spectrum, from software, hardware, engineering and Human Factors, which all need careful consideration. I run a company called Women's Tech Hub, which supports women moving into tech and it has many women returners who have experience in the separate areas that are needed, but not the skills, confidence or training to move back into the industry. I believe they are a great untapped resource who could be reskilled into Safety and would solve a lot of the issues – if we could see some affordable reskilling options for these women then it could be a solution. The apprenticeship schemes would be a great solution here, but I don't see many schemes based around engineering, let alone Safety.

Sindhura I completely agree with Nicki's points – there is a general lack of Software Safety Engineers – regardless of gender, and there is a reliance on retaining trusted and experienced staff while trying to recruit and train graduates or less-experienced personnel. Additionally, finding candidates who are experienced and comfortable

in a heavily customer-facing role from the start, as is often required within a Consultancy environment, also adds another layer of complexity. I would also like to echo Serrie's point about seeing more women in the Safety realm than in more classical engineering areas – I would say that there is a growing representation of women within the Safety industry, particularly within the ATM domain, including women within management/senior management positions.

Advice to Hiring Managers

Nicki I would suggest casting your net wide and offer retraining to candidates. Bring in candidates of all ages and levels of experience from apprentices and graduates to principal engineers/consultants and managers to build well-rounded teams and support personal development with formal training, in-house training and work-shadowing/mentoring from more experienced personnel. Offer hybrid working and support carers and part-time workers to enhance inclusion and diversity in the workplace.

Sindhura Offer remote/hybrid working contracts. Over the pandemic we've learned that much of what we do can be done remotely and I've found that many clients now prefer to hold meetings online to save travel costs. By offering remote/hybrid working possibilities, we can cast our recruitment net wider given that potential candidates are no longer tied to office locations or surrounding areas. I currently work with a geographically diverse team spread across Europe, from the UK to Belgium, Poland, Romania and Spain; we interact daily without issue and meet face-to-face at the Eurocontrol office in Belgium when a face-to-face meeting or workshop is needed. Additionally, I've also found that mentoring and coaching of more junior staff is also possible remotely, with face-to-face meetings as and when required. It goes to show that remote working can be done and does not hinder project progress.

"Over the pandemic we've learned that much of what we do can be done remotely… and does not hinder project progress"

Serrie In Women's Tech Hub we suggest using a tool to avoid gendered wording on jobs – gender decoder is a great freebie although a bit basic. People don't want rockstars to code safety-critical systems! I believe that wording the adverts to explain that safety is a career that is there to protect people and assure that tech companies are not running ahead and putting people at risk is something that will entice women into the industry. Many companies tend to replace with like by like ... 'bob' did x, y and z so we need someone with that skill base, it's not always true as 'bob' either didn't do all they stated or they didn't actually do the work as others were doing it, or someone like 'bob' were at a stage that they were ready to move on – so taking on the same skill set is not necessarily good as they are also at a stage where the company cannot offer them onward career progression (else 'bob' wouldn't be leaving in many cases). I believe that recruiting from within and training into a role gives you a better solution. Upskilling within the workplace from below and using that as a clear career progression is a great opportunity to get loyalty and people are grateful for a culture that's supportive and gives flexibility.

Wendy Review your job adverts harshly, especially for hard-to-fill positions. I was recently unemployed; it took me 8 months to find work because I couldn't work full-time nor travel. I ended up going self-employed to get any work in at all. There are still far too many restrictive recruitment policies and work patterns around, which closed off many doors/opportunities. Many of these jobs can be done remotely and flexibly, but many line managers (or their clients) won't even entertain the idea, even for very experienced hires. A big cultural shift is needed to account for disabled workers and those with responsibilities, or simply those who wish to work part-time. Also significantly improve paternal leave for male employees and make it normalised, it's long overdue.

Final Thoughts

Serrie Most companies are keen to get women in – unfortunately it is very slow to change cultures and while they believe they are doing well getting loads of women through STEM into early careers, eventually those women get disillusioned due to the bias within engineering. We hear arguments like we have to take the best person for the job – but surely as women often out-perform in their degrees that questions whether they have got the best people in, the biggest issue is families and the breaks in careers and we often hear that the women aren't welcome back after a break – and the women also aren't keen to come back due to the bias they saw in their earlier career progression. It's not that women are being given an unfair advantage when they have taken a 'break' or that their brains disappeared when they had children, it's more that they didn't have a network to get back in or the acceptance from the industry to come back in at the level they left at.

" … the number of women in senior roles after a career break is woeful – they don't want special dispensation … they say they no longer have the energy for the fight (and why should they be fighting for a career they love and are good at?)"

Reskilling and support and returners incentives are great, but it needs the male engineers to understand that they are still equal and also to allow themselves to be managed by women who have taken a break and are still highly skilled managers. This is a bugbear of mine – the number of women in senior roles after a career break is woeful – they don't want special dispensation but some flexibility and accepting that they are in many cases the best person for the job. This is not considered from my experience talking to women in the industry, so they walk away to work in 'easier' industries, as they say they no longer have the energy for the fight (and why should they be fighting for a career they love and are good at?)

Nicki Perhaps introduce financial incentives to work placement students to get them into the workplace once they have attained their degree. Most would appreciate financial support to enter the workplace and may be more likely to stay with that company for a long duration. Workplace liaison with – and support to – universities and

visibility of safety engineering courses and career options would improve the situation. The confusion with health & safety advisors also doesn't help sell systems safety as a line of work and detracts from the engineering aspect.

Sindhura Young Safety Engineers are very few and far between – you don't often come across Graduates who immediately know they want to be a Safety Engineer straight out of university, and this could be due to a lack of understanding of what Safety Engineering entails, at least this was my experience as a Graduate. This could potentially be tackled by exposing students to Safety Engineering through modules/group projects within their Undergraduate courses, or as Serrie mentioned earlier, through apprenticeships focused on Safety (although these are also rare).

I'd also like to highlight the importance of trying to be a good role model for young engineers, particularly young women, who are early in their careers and can find the engineering industry a bit daunting at first. I've been fortunate enough to have met and worked with a number of great women and men over the years, some of whom have helped me advance in my personal and professional growth without them realising – all because they shared advice (both professional and general life advice) and set a good standard to aspire towards.

Wendy WES is now over a hundred years old. One day I hope there won't be a need for it, but I don't think it will be within my working lifetime. I have been mentoring disadvantaged students taking STEM subjects for several years now (via Brightside) but have yet to be matched with any female mentees at all. This makes me sad, but it also makes me not want to give up.

"…for several years now… I have yet to be matched with any female [student] mentees at all… "

Final Words

As per last year, the main message is, please, give women engineers a chance. Also, please challenge restrictive recruitment policies/adverts, especially for hard-to-fill positions. And, maybe, don't forget to put your women safety engineering colleagues forward for awards – even if they fail to get one, at least they will know that you believe they're worth it. Or if you're like me and dislike awards, try to advocate for them and be an ally in other ways.

Well, we hope you have enjoyed reading this article. This article is dedicated to all the women engineers working in safety, their allies in the workplace, and their supporters behind the scenes. Also, Women in Science and Engineering (WISE) and WES.

Wendy Owen

Wendy has 35 years' experience in systems assurance across a wide range of highly regulated industries covering energy, defence, transport and process sectors. Her career has largely been in engineering consultancy, also with time in manufacturing, regulatory and research. She is a Fellow of the Safety & Reliability Society and WES. She is currently self-employed, at time of writing working as an associate for Building a Safer Future (set up in the wake of the Grenfell fire) and Mott MacDonald (on Sellafield projects).

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