Our courses are always up to date on the latest technology, so whether you're looking to learn completely new skills or to improve your existing knowledge to further your prospects, we're here to make sure you get first class training relevant to your needs.
Changing and yet enduring

I have mentioned in previous News view articles our plans to re-brand the IRSE, including the introduction of a new logo. We are intending to introduce the changes at the beginning of May, and there will be an article in next month’s IRSE News to introduce the logo and explain the reasoning behind the changes.

All organisations need to adapt and modernise over time, and that includes changing how we present ourselves to members, and how we are perceived by ‘not yet members’, the wider industry and the public. There are not many organisations that retain their logo for over 100 years! From May onwards we will start to use our new branding (quite different to the current one), although we will retain the old logo for a few specific purposes. But the change is not just about the logo. We are evolving IRSE News to give it a new look and feel. The May edition will showcase these changes and we welcome feedback on this new look. As you may be aware we have increased our use of social media, and all being well later this year we will have a new website. All this, and more, is aimed at ensuring the IRSE continues to be perceived as a modern institution that is relevant to the global rail industry and railways, and to ensure we are positioned to attract new members.

On the subject of change, you probably saw the advertisements for a new Chief Executive in the previous two editions of IRSE News. I am planning to step down in August, having served for three years as CEO, and over 40 years in the rail industry. We are currently in the process of appointing my successor.

Change is inevitable, and should be welcomed, but it is also good to celebrate the enduring value and appeal of the IRSE. At the end of January the Netherlands Section of the IRSE celebrated its 10th anniversary, and our president and I joined Section members on 25 January in Utrecht to mark the occasion. The Netherlands Section is a great example of just how good a local section can be. In its ten years it has grown to a membership of 220, it has a highly effective and forward-looking committee, and it regularly provides events for its members. Most importantly, it has a vision and a plan for its future direction and growth, which builds upon the IRSE’s overall Strategy and Implementation Plan.

Local Sections are a vital element of the IRSE – so if there is one that is geographically suitable for you, make sure you support it and attend the events that it offers.

Francis How, Chief Executive

Cover story

Our cover photo shows a freight train operated by mining company LKAB over the route from Kiruna, Sweden to the Baltic at Luleå and Atlantic Coast at Narvik, Norway. Trains are controlled with the assistance of Driver Advisory Systems (DAS). Each 750 m train consists of 68 ore cars, carrying up to 6,800 tonnes of iron ore.

DAS provides real time information to assist the driver with the control of traction and braking to keep trains on the optimum speed profile for the route. The connected DAS (C-DAS) on this route is linked to the traffic management system to synchronise arrival of trains at crossing points, avoiding unnecessary braking and standing at stop signals.

This month’s article on DAS describes the different systems and the benefits that they can deliver, together with the challenges in providing such systems to deliver the efficiency benefits safely.

Photo LKAB Image provided by Transrail – photographer Frederic Alm.

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Peter Symons, in his 2017 presidential address [1], predicts that “we can reasonably forecast that rail signalling, telecommunications, train control and traffic management systems, in short signalling systems, all the systems that form part of an operational railway, will have increasingly complex interactions, and that the rate of technological change will lead to much shorter asset lifecycles.”

To ensure that we as individuals and as an industry contribute to the safe and efficient movement of people and freight by rail, not only do we need to ensure that the ever-changing technology and environment described by Peter is safe and sufficient, but also, we are (or are being supervised by those who are) competent for the roles we are undertaking and technology that we are using.

Cassandra Gash’s presidential paper [2] took us through the engineer’s journey to the point of achieving conscious competence; this paper discusses how to retain your hard-earned competence, how to develop yourself further, how to motivate yourself to improve and continuous improvement for lifelong learning.

This was the fifth paper in the presidential programme 2017-18. It was presented in York, UK, on 8 February this year.

I have adapted Peter’s competency stages model [1] in figure 2 to demonstrate my point and challenge you. Are those who have slipped into lapsed ways still experts or practitioners in their defined field of expertise? Would you want lapsed rail systems engineers signing off a report or design, or handing back equipment into use on our running railways? Do you recognise lapses in others? Do you want to be in that position yourself? I hope that the answer to my final question is a resounding “no”, so please keep reading...

What can you do to stop yourself, and others, slipping into ‘unconscious incompetency’? By keeping up-to-date through lifelong learning, and keep encouraging others to do so!

Lifelong learning
Lifelong learning ensures your competence is maintained and develops you to whatever level you choose to go to throughout your working life. It may need to extend into retirement, if you can continue your engineering life as a contractor, or you volunteer your engineering knowledge or skills for the IRSE or other organisations.

Lifelong learning sounds onerous but doesn’t have to be. As discussed further on in this paper, it should be tailored to your own individual requirements.
We all learn in different ways [6] and it is good practice to encompass different types and amounts because all three are essential to our learning process:

• **Visual:** learning by watching, reading and writing. This includes reading technical papers, equipment or project specifications and writing things down when you are learning.

• **Auditory:** learning by hearing and conversation. This includes attending meetings and lectures, asking questions and listening to the answers and watching appropriate TED (Technology, Entertainment, Design) and other talks available on the Internet.

• **Kinaesthetic:** learning by doing. This includes work experience and making the most of experience opportunities in a ‘safe environment’ such as a training facility, site and technical visits.

No two rail systems engineers are alike, neither will they reach complacency or recognise the need for regeneration at the same time (see figure 3), so their lifetime learning plans will be different too.

Lifelong learning can be described using different terminologies such as Continuous Professional Development (CPD) (by engineering institutions and bodies such as the IRSE, UK Engineering Council, Engineers Australia, Institution of Engineers Singapore and European Federation of National Engineering Associations) or simply Professional Development (by engineering institutions and bodies such as Engineering Council of India and Engineers Canada).

No matter what you call it, lifelong learning requires planning, doing, reflecting and reviewing at regular intervals as your career and aspirations change, and recording your activities assists that process. The IRSE CPD map to success [7], repeated in figure 4, shows this cycle along with some types of learning activities.

**Lifelong learning is a long time! What’s in it for me?**

At present, many born in the 1960s and later are expecting to retire when they are 67 years old (UK, Spain, United States, Denmark and Australia) [8], which means our working careers are going to be significantly over 40 years long. To assume all of us will continuously learn and develop for over 40 years is a big expectation.

When talking to our members, a large proportion expect their employer to define and provide their lifelong learning opportunities and needs. Conversely, when speaking to senior managers across many sectors, they tell me that...
they expect the individual employee to be responsible for their own CPD and career development.

There are clearly mixed views, so I need to persuade you that it really is of benefit to you as an individual to be responsible for your CPD and career development while taking a steer from your management. A compromise, perhaps, but one that will ensure that you maintain some level of recorded competence.

What's your motivation?

We all have different motivators, reasons why we are in the railway signalling, telecommunications, train control and traffic management engineering business and our aspirations for moving on, or not. Many use Marlow's hierarchy of needs [9] to describe what motivates us, however I will use Mullins [10], who describes it as "motivation is a driving force through which people strive to achieve their goals and fulfill a need or uphold a value." He describes goals as outcomes which we are working towards, needs as basic requirements including food, housing and education and values as things which we as individuals consider important such as family, health and wealth.

What are your needs and values and therefore what are your goals to achieve these? Your ultimate goal may be to retire having ensured that your family have been well educated and that you have sufficient money to live comfortably for your remaining years. You may wish to be recognised as a leader or expert, through job title and/or industry recognition. You may be looking short term to the next promotion or saving for your own home.

Whatever your need(s) or value(s), I believe that a motivator for all of us is a need to remain employable and wanted for as long as we want (and need) to. And when I say ‘wanted’, I mean not only by your employer but by friends and family too because not only are you good at your job, but you are interesting and interested in others.

Exploring some motivators... your career:

Your career journey is a very personalised one, full of opportunities and hazards. Our motivation, and therefore goals, change according to our needs at a point in time.

Keeping in the same role for a while?

Many gain great satisfaction staying in the role for which they have worked hard to become consciously or unconsciously competent. However, very few of us can limit our technical knowledge to 'just' what we knew when we became 'consciously competent', so if this is your career plan, you must still remain up-to-date. Standards, equipment, software, processes, companies, technologies and infrastructure change, some at frequent intervals.

You need to know about and understand these changes, adapt to utilise them efficiently, and ensure your employer knows what you have done by recording and reviewing your activities.

Learning or improving skills like communicating and learning about your company's business plans may assist you to remain in role, giving you the skills to train others, request additional resources or funding for your work, or even to ask for a pay rise.

Want to progress?

Do you think that you deserve a promotion but your manager doesn’t realise how good you are? Or you may want to move on but are unsure where other opportunities are? Or you may know exactly where your next move should be.

In which case, your learning plan may include the skills and experiences that you feel are lacking in achieving these goals. You may consider activities like improving your communication skills, taking on additional responsibilities, learning about your employer's business plans, being seconded to another area, voluntary work where you can't get experience within work, networking and research. All these will give you experience and understanding to help you identify what skills and competences you need to move on. You may also consider learning and developing other skills such as your management or leadership potential, your technical flair or sharing your knowledge and experience with others.

Don’t forget, however, to remain competent in the role you are currently doing.

Opportunities for moving on?

As I said earlier, we are all looking at working lives of over 40 years. Some of us will remain on the same career path for the whole of this time, for others there will be opportunities to specialise, change career directions or even move to a completely different career/industry – as long as we are competent, or are capable of becoming competent in a new area.

The Institution of Engineering and Technology (IET) undertakes an annual survey of engineering employers in the UK to gauge the state of skills in the engineering and technology sector. The 2017 survey reported that 53% of those engineering employers were currently experiencing, or had recently experienced, gaps in engineering or technical skills at operative or semi-skilled level and 46% had experienced gaps in engineering or technical skills at a professional level [11]. This is great news for us competent engineers as it sounds as if there is a market for us, if we want to move on!

But what learning do we need to concentrate on to ensure that we are wanted by current and future employers? One place to look for inspiration is the IET survey [11] which has found that within the transport sector, only 34% of employers consider themselves fully prepared to meet the skills challenges presented by increased digitisation and automation.

Keeping up with changing technology?

Certainly, within the railway signalling, telecommunications, train control or train management engineering field, technology is changing rapidly, as I quoted Peter Symons in my introduction. The year I started my career in S&T engineering (1991), the Internet was invented, Leamington Spa Solid State Interlocking (SSI) had been installed for 6 years and high speed rail was well established in Japan. Technology has advanced very swiftly since then, for example Global System for Mobile Communications-Railway (GSM-R) becoming operational in UK in 2007 and the first part of the UK pilot of European Rail Traffic Management System (ERTMS) on the Cambrian lines commissioned in 2010. Technology changes will continue, as discussed at the IRSE’s Communications-Based Train Control (CBTC) conference recently.

Scholtes [6] identified two trends related to learning, one is average life span which is increasing and the other is the frequency of change, be it technological, social, economic or political. His thinking led him to believe that we cannot keep still in our learning, that we need to keep learning at increasingly swift rates to keep-up-to-date.

It is likely that the technology which will be used on our railways in 25 years time has not yet been invented, therefore there is no expert in it yet; career opportunities beckon for those who keep up with technology changes.

Those who are not working at the ‘cutting edge’ of technology, do encounter technology changes daily through changes in monitoring equipment, apps and software which we use to do our jobs. Keeping up-to-date with the changes in these is worthwhile, if only to enable you to input into these systems more efficiently and understand how they work.
**Changed your mind?**

Ambitions change as we change, grow and learn, so it is important to reconsider your motivations at intervals; which of your values and needs have changed, and therefore how will you achieve your new goal(s)? It is not an admission of failure to admit that your goals have changed, in fact it should be celebrated because you have recognised change and adapted to it.

**Keep learning, it’s good for your health!**

There are many health benefits to learning which can add to your motivation for lifelong learning. We read many articles saying that we should complete puzzles to keep our ‘grey cells’ ticking, this is based on medical research, and I suggest could be applied to lifelong learning towards your own career goals.

**Delay Alzheimer’s?**

Most scientists believe Alzheimer’s disease is caused by a build-up of proteins in the brain, with much research still taking place to understand why. The nerve cells become damaged and this leads to the symptoms of Alzheimer’s [12], affecting memory, decision making, communication and day-to-day tasks. Research by Genova [13] has led her to believe that it is not necessarily too late to delay the onset of Alzheimer’s, even for those who are at the tipping point of Alzheimer’s.

Despite the number of damaged nerve cells, there are still undamaged nerve cells and synapses which, when used to learn new things, create a cognitive reserve, building up new pathways through our brains. Genova recommends learning new things rather than revisiting old information, to build up new pathways. So rather than revise what you already know, why not learn and develop a new skill or area of expertise?

**Grow new braincells?**

By the age of 50, we will not have any of the braincells we were born with [14]! Fortunately, we are growing new ones all the time, but slowly.

This growth of braincells in our adult life, known as adult neurogenesis, does affect our memory and spatial recognition. Adult neurogenesis happens naturally of course, but external factors can play a part in the amount and speed of growth. Negative factors on adult neurogenesis include stress, drugs, sleep deprivation and poor diet. However, positive factors include good diet, exercise and learning.

Yet again, learning is good for your brain. The variety of the positive factors has shown to improve adult neurogenesis, so don’t just keep-up-to-date with Standards, go to lectures or read articles about different topics.

**Growth mindset**

How many of us have heard “no”, “fail” and other discouraging words when at school, college and even in the workplace? This can make us disengage with whatever we are doing, and certainly not want to try again!

‘Growth mindset’ is being used in schools across UK and USA, encouraging students to stretch themselves academically, giving inspirational quotes and examples (academic and sports related), and using terms like “not yet”.

Research [15] has shown that when people are stretched and challenged, their brains grow. The research also shows that when taught about this, students want their brains to grow so therefore stretch themselves willingly.

Therefore, chose your goal to be a stretching one but also achievable as you don’t want to ‘fail’. This is the equivalent of suggesting abandoning the Sudoku puzzle, which is solvable using set number patterns, for a cryptic crossword, which could be completed in a number of ways, only one of which is correct and expects you to know more than just the numbers between 1 and 9. In other words, do things that make you think!

**Inspiring the next generation**

Statistics vary by country, government and state, all agree that we will continue to need technical people to continue research, development, design, installation, testing, commissioning, maintenance and decommissioning of our railway systems in future.

To assist in the inspiration and development of those joining, or considering joining, the industry can be part of your lifelong learning plan.

**Mentoring**

Helping in the development of someone who has less experience than yourself in a particular area can be very rewarding for both you and them. There are formal mentoring schemes, such as the IRSE scheme [16], or less formal such as buddying up with new members of your team.

All such relationships are successful when there are clear boundaries agreed by both parties (including time and targets), and in addition for mentoring, when the mentor/mentee are not within a line management chain. Mentors/buddies can be senior or junior in age or grade to the person seeking assistance; it doesn’t matter as long as you have experience and/or knowledge to share with them.

The aim is to guide your mentee/buddy through a specific stage of their career journey. You might be the neutral and confidential person for them to check out their understanding of something technical or try their newly acquired negotiation skills, or advise them towards gaining professional registration or transferring grades in the IRSE, or guiding them through your company’s processes and procedures.

Being a mentee/buddy is part of lifelong learning. You will have to do some revision in order to ensure that the knowledge you are sharing is correct and up-to-date. You may need to do some training in or brushing-up on your communication skills, in particular effective listening. You are also likely to learn from your mentee/buddy; for instance, they might give insight into another part of your company/industry or point you are not aware of as a new source of information or work.

**Inspiring engineers of the future**

Schools and colleges across the globe are cooperating with industry and institutions to engage their students in the wonders of Science, Technology, Engineering and Maths (STEM), and also consider their creativity within Arts (STEAM) to encourage them to consider future careers within these areas.

What you might do, prepare for or revise will vary according to what you know about the STEM or STEAM activity. Some engineers tell students about what they do in their day jobs, others run lessons (with assistance) around the curriculum and appropriate technology, some set and assess projects and competitions, some conduct mock-interviews for work or college and others arrange work-placement activities within their workplace.

These all require different skills and competencies, with no ‘one size fits all’, giving all of us opportunity to inspire the next generation, with many of them available. Contact your old school or college, or one that your children go to, or one in the locality of your place of work or home or one of the many charities and organisations which provide STEM/STEAM opportunities.

Be aware that in many countries the law requires those working with children and vulnerable adults to have security checks made on them, which take time and may cost a little money.
LIFELONG LEARNING

Why is the IRSE interested in lifelong learning?

Why should the IRSE encourage its members to keep learning for the length of their active careers and/or volunteering activities?

It’s the reason for being the IRSE!

First and foremost, the objectives of the IRSE, as defined in our Articles of Association [17], are:

“(a) The advancement for the public benefit of the science and practice of signalling (which for the purpose of this document shall mean the whole of the apparatus, electrical, mechanical or otherwise, methods, regulations and principles whereby the movement of railway or other traffic is controlled) by the promotion of research, the collection and publication of educational material and the holding of conferences, seminars and meetings.

(b) The maintenance of high standards of practice and professional care amongst those working within the industry and the promotion of improved safety standards for the protection of the general public.”

If we want to maintain high standards within our industry to ensure the safety of those using, working on, and in proximity to our passenger and freight railways, then we need to keep ourselves up-to-date as a minimum.

Healthy and competent industry

We want the railway industry to be at the forefront of technology and efficiency, attracting investment and excellent recruits, and of course encouraging people to use the railways as the best mode of transport for them and their goods.

An industry full of professional, competent and knowledgeable engineers is an excellent way to be attractive and stand up to competition in other transportation systems. It also is a way of attracting the next generations to work on our current systems and develop new ones.

Learning lessons from previous incidents

Whilst we are learning new information, and potentially consigning older information to the back of our brains, we as an industry need to ensure that that ‘older’ information is not forgotten.

Many rules, processes and specifications within our industry are in place due to accidents and incidents. Fortunately, major railway accidents are becoming rarer internationally. Whilst this is fantastic news, as an industry we must understand and remember the reasons behind these accidents, and what was implemented to mitigate against future incidents. Some technical solutions may be company or infrastructure-specific and therefore be confidential, but many other lessons can be shared across the industry through the IRSE and other industry bodies, and may prevent a similar incident.

Rounded engineers

Our rail control systems interface with many other systems to enable trains to run safely and efficiently.

Lifelong learning will benefit your work as you learn more about your project, what your colleagues do, how your design is built, or how your equipment is maintained. Gaining a systems view, figure 5, of how your work interfaces with others’ will result in a better job. Examples could be you finding out how your control system is powered, or the electromagnetic compatibility of the equipment you are planning to use on the rolling stock and electrification systems, or the fire safety regulations of the tunnels which will hold your telecoms equipment. When you understand more of the whole railway system, then you are able to give relevant timely information to your colleagues.

Demonstrating competence

The IRSE has a professional examination and licensing scheme which are two different, and unrelated, ways of demonstrating your competence and knowledge, neither of which are appropriate for all.

IRSE professional examination

The IRSE professional examination [18] is a Masters-level academic qualification which tests your knowledge and understanding of railway systems with a particular emphasis on safety. To pass the exam, you must pass four modules which includes a compulsory module on safety systems. The exam is held annually at the beginning of October.

There are currently no taught courses to assist you to achieve sufficient knowledge to pass all four modules of the exam, although the University of Birmingham in conjunction with the University of York are planning the launch of a Masters Degree shortly, the successful completion of which will exempt you from the IRSE professional exam. However, there are many dedicated and amazing volunteers who give up their own time to run study groups and study days, giving students guidance, sharing knowledge and opportunities to see equipment. There is also a large amount of information in study guides and the knowledge bank on the IRSE website.

Passing the IRSE exam is one route to obtain the grade of either Associate Member or Member of the IRSE and also can be used to ‘top up’ a Bachelors level engineering qualification for professional registration with UK’s Engineering Council. Many choose to take and pass the exam to demonstrate their knowledge and ability to their employer, future employer and colleagues. Also, many choose to study for, but not sit, one or more module simply to extend their knowledge and experience.
The IRSE is currently considering a ‘foundation’ qualification for the many for whom the ‘full’ exam is not appropriate or is too large a leap in one step. I think that this would provide more lifelong learning opportunities for our members, and therefore would be a great idea, particularly if it could be made modular to reflect the fragmented industry we work in. It is likely to include a safety systems module to encourage people to think of the railway as a whole system, not just their discipline/specialism. The debate about this ‘foundation’ qualification will continue for a while yet.

**IRSE licensing scheme**

The IRSE licensing scheme [19] is a competence management scheme for safety critical tasks, and is one way of demonstrating competence in signalling and telecoms safety critical tasks for some infrastructure owners. Therefore, some employers/clients mandate licence levels for various safety critical roles. Licence holders do not need to be IRSE members, and it is not linked to the IRSE exam.

Independent assessment of a candidate’s ability (underpinning knowledge, skills and experience) and their attitude towards the specific safety critical tasks they are undertaking, results in them being considered competent, not yet competent, or not. Licences are valid for five years, after which the holder must go through a ‘surveillance’ process. Subject to a satisfactory surveillance, the licence validity can be extended for a further five years at the end of which a renewal process must be undertaken.

Whilst the advantages of the licence scheme are numerous, including consistency of Standards and the ability to raise complaints and concerns, licence holders having to keep up to date with their underpinning knowledge and experience, the scheme is limiting for those who are trying to gain a broad range of experience and knowledge. Those who move between disciplines require new categories in order to hold a licence in this new area, potentially taking too long a time to be considered competent, or not. Licences are valid for five years, after which the holder must go through a ‘surveillance’ process. Subject to a satisfactory surveillance, the licence validity can be extended for a further five years at the end of which a renewal process must be undertaken.

Recently the UK Engineering Council mandated that we monitor the CPD records of a sample of registered engineers each year. From 2019, if people do not engage with this monitoring process, then they will be taken off the list of registered engineers.

Whilst this may seem harsh, it is nothing new for many engineers and other professionals. Engineers registered with The Institution of Engineers, Singapore [21] and Engineers Australia [22] must periodically demonstrate their professional experience and commitment to CPD in order to retain their registration status. Likewise, in the UK, our doctors, dentists and many others must demonstrate their professionalism and CPD annually, ensuring the safety of the members of the general public. Is it unreasonable to expect the same of us rail systems engineers, many doing safety critical or safety related activities?

**Should our employers help?**

Whist the emphasis of lifetime learning, and your general personal and career development, is your responsibility, I believe our employers should assist us.

An employer whose employees who are up-to-date, motivated and interested will get great benefit. The employer must demonstrate that their workforce is sufficiently competent, otherwise they will not win work. Financially they may be able to secure more contracts, and charge more, if their employees are registered, licensed and/or professionally qualified. Their motivated and competent workforce will deliver high quality work and will attract good quality recruits. Their projects and individual achievements may win awards, thereby attracting more work and recruitment.

By law in many countries, employers must give us health and safety training which we need to do our jobs, for example UK’s Health and Safety at Work etc. Act 1974 [23]. Contractually, only those with defined competencies may be able to sign off work. Industry good practice, such as the Office for Rail and Roads [5], may expect companies to have competence management systems in place.

However, many of our employers are under large constraints to produce high quality work in tight time restraints and within even tighter budgets. Training and development does cost and impact on timescales and budgets. Some employers perceive this as to great a cost for them to take on. Unfortunately, this could lead them to not being able to deliver in the future as their employees will not have sufficient competence to complete the project or win the next package of work.

**Good practice**

Some of our employers do encourage CPD and career development within a company, in fact 75% of the UK companies surveyed by IET for their skills survey [11] stated that they provide good career paths by which staff can progress to more responsible and senior positions. Development is country and/or company specific, so may include additional skills relevant to progression such as financial reporting or project management skills.

Some employers encourage their engineers to gain recognition such as engineering registration and/or membership of the IRSE to the appropriate level to their role.

Some encourage the development of their staff by paying for them to do further academic study; some cover the cost of the course with the agreement that the employee will provide good career paths by which staff can progress to more responsible and senior positions. Development is country and/or company specific, so may include additional skills relevant to progression such as financial reporting or project management skills.

Some encourage staff to share knowledge, listen to IRSE talks and encourage senior staff to support them through setting up study groups.

Some encourage staff to share knowledge, listen to IRSE talks and practice their communication skills by providing refreshments and meeting venue for ‘lunch and learn’ sessions, with the time shared between the employee’s lunch break and some ‘work time’.
Some employers have e-learning modules available for short targeted learning, either through their own system or through a third party. Some employers have ‘volunteer days’ where employees can take pre-authorised time to undertake charitable or other works, such as STEM activities, working with local organisations and volunteering with the IRSE.

**Not so good practice**

Unfortunately, other employers discourage employees from undertaking CPD in their working hours because they perceive that it is not productive, and therefore not good use of the employee’s time.

This will lead to their employees’ decline into unconscious incompetence, see figure 2, with the risk that their work will not be delivered to the high standards and tight timescales required, and will not retain the competence required to sign off work or win the next job.

**It’s a balance**

As I have said throughout this paper, it is an individual’s career and development, their own conscious competence that they need to retain and develop. However, employers can, and must, support them, and reward achievements.

A large proportion of our waking hours are spent at work, responding to emails outside work and commuting to and from work. Squeezing in more work-related activities, such as CPD, into non-work time skews our work-life balance, which is important for our physical and mental wellbeing.

There is a compromise, a balance which we can all reach, or at least aspire to, as indicated in figure 6. Employees shouldn’t, and in general don’t, expect to be spoon-fed everything they need to remain competent and employable; in my opinion they should be doing something themselves in some of their own time. On the other hand, employers should, in my opinion, give opportunities for further development to their employees. Both sides are the winners; the employer retains a competent and motivated workforce and can win work whilst the employee is motivated, feels appreciated and remains employed.

These are not new ideas, and are in place in many industries and cultures. For example, Lorriman [24] discusses how Japan’s industrial success is because of the competence of their staff, which in turn is due to managers’ concentrating on the development of their staff. In fact, so important is this, that special ceremonies are held when a manager or supervisor has coached and developed their own staff to achieve promotion above themselves, and the guest of honour is the manager to thank them for developing their staff so well.

**Lifelong learning: How much, what and when**

**Mandated amounts?**

Unlike many of the professional institutions, the IRSE has decided, at present, not to mandate how much CPD (i.e. lifelong learning) each of our members, including registered engineers, should do, shown in figure 7. The IRSE is trusting members to determine themselves how much is ‘sufficient’ in respect to their stage in their career journey, and their own development plan and this complies with Engineering Council’s requirements.

Should this be the case? Would we do more when obliged to do so? Would we learn more, or just participate to the minimum level?

I personally remain undecided whether to recommend that the IRSE does mandate the amount of CPD its members should do, or not. Some may develop interests and careers in areas which they may otherwise not have explored as a result of attending a meeting, reading an article or going on a training course.

Some may just go through the motions of flicking through an article or attending a meeting whilst browsing on the Internet. Previous experience of local sections when CPD ‘certificates’ were made available was that many came in towards the end of their meetings seemingly ‘just’ to gain their certificate. Whilst some of these could have been delayed through work, the perception was that the majority of these latecomers only came for the minimum time to gain what they saw as the reward, a certificate.

Meanwhile, I encourage you to think about how you are going to achieve your goal and the timescales you have set yourself to achieve it. This will thereby help you determine what you need to do, and how long you need to do it.

Don’t forget that some of your CPD happens naturally, for instance you are reading this article along with others in IRSE News, you talk to colleagues about projects and lessons learnt and you may be coaching and mentoring others.

**What CPD?**

Your CPD reflects your plan and your goals, so some of your activities will be different to your colleagues’. You do need to plan some of your activities, but others will be unplanned because opportunities will arise. The balance of your CPD will vary throughout your career, examples shown in figure 8.

**When can I fit it in?**

Amazingly CPD does add up! With planning and hopefully your employer on your side, several hours of CPD can be built up. Attending a ‘lunch and learn’ could be one hour’s worth of CPD, although preparing and presenting at one would be much more.

Reading and reflecting on an article in IRSE News may take 30 minutes or more. TED lectures are 10-20 minutes long and can be watched on the move, although a quiet environment helps.

Discussing your project and helping each other with technical problems may take place throughout your commute with colleagues.
Don’t duplicate effort

If you are doing a CPD-type activity for work, it also counts for the IRSE, so don’t duplicate activities; spend that time doing other CPD activities.

If you are recording CPD in a work system, then you can use that for your IRSE CPD submission. However, do make sure that it covers all the stages of CPD recording, because many work systems don’t make provision for the reflection on your activities, which can be very valuable in helping you plan what to do next. If this is the case for you, just note your reflections in a separate document which can be attached to your CPD records.

Summary
Not convinced?

You may have read this and still not be convinced that lifelong learning is for you; You may have had poor grades at school or even had enough of formal learning through the compulsory education years.

However, if you are determined enough, you can achieve what you want to. Angela Lee Duckworth [27] has researched people from many different backgrounds and industries and found that success is due to what she terms ‘grit’, that is stamina, rather than talent. Many schools who use the growth mindset model to encourage their learners identify optimism, social intelligence, curiosity as well as grit as the character strengths required to achieve [28]. There is hope for all of us, not just the ‘clever folk’. 
LIFELONG LEARNING

Don’t be a boiling frog

Peter Symons [1] advised us not to be frogs in water slowly being brought to boiling point by not noticing the gradual threats and changes around our working environment. I repeat that advice; be constantly aware of your technology and specialism changing (your water getting hotter), adapt and learn before it finishes you off.

It’s not a fad

Lifelong learning isn’t a fad, something that has become fashionable to talk about for now, and forgotten about in a few years time. It is highly relevant to you throughout your career journey, whilst you are working and retirement if you choose to carry on contracting or volunteer utilising your technical skills.

It’s for you

Don’t wait until you are asked for your CPD records – either by the IRSE for monitoring or when you apply for a higher membership grade, or by a potential new employer in a job interview. It’s your employment, finance, friendship and health benefits. Look after yourself and others around you, set yourself achievable targets which you can fit into your busy schedule and enjoy the process and outcomes of lifelong learning.

References

[18] Institution of Railway Signal Engineers, “IRSE Professional Examination” [Online]. irse.info/isexeexam
[26] General Dental Council, [Online]. irse.info/6d0sx
[28] Knowledge is Power Programme (KIPP), [Online]. irse.info/ubph8

Did you know ...

Do you know about TED Talks (www.ted.com)?

TED stands for Technology, Entertainment and Design and provides a forum for scientists, philosophers, musicians, business and religious leaders, philanthropists and many others to speak about numerous subjects. Judith suggests you may be interested to use it as part of your lifelong learning – you may not agree with what is said (just like you might not in reading a technical paper!), so why not discuss with your colleagues and find out more?
In December 2017 the New York Metropolitan Transportation Authority (MTA) in the USA announced the names of the finalists in the MTA Genius Transit Challenge. This is an international competition launched in May 2017 that seeks to identify innovative solutions to increase the capacity and improve the reliability of New York City’s subway service. There were 438 submissions from 23 countries. 64 applicants advanced to the second phase of the competition and 19 of those moved on to the finals.

The competition is being judged by a panel of technology and transportation experts. There is a $1 million ‘Genius’ award for the best idea in three separate categories:

1) Improve signalling in the New York City Subway System by identifying strategies to dramatically accelerate deployment of Communications-Based Train Control (CBTC) or to deploy alternate signalling solutions that offer technological advantages and can be deployed in a more rapid timeframe;

2) Identify strategies to rapidly deploy better subway cars to the Subway System, either through faster delivery of new cars capable of supporting modern communications and train control, or through rapid refurbishment of existing cars; and

3) Increase communications infrastructure in the Subway System, including tunnels, to support modern train control systems.

The winners are due to be announced in first quarter of 2018. The finalists in the signalling challenge are:

**Connected Vehicles and Ultra-Wideband for Communications and Location**

This application submitted by an individual, Robert J, proposes to combine Ultra-Wideband (UWB) and Connected Vehicle technologies. UWB can provide centimetre accuracy for all cars in the tunnels and can be deployed at a lower cost than CBTC. When utilized with existing or future Connected Vehicles, UWB would provide a high level of train location accuracy, which greatly improves train control.

**PTCS-2**

Metrom Rail proposes the Positive Train Control System (PTCS-2), an Ultra-Wideband RF based wireless train control system. PTCS-2 does not rely on a back office or centralized data structure; instead, intelligent wayside nodes replace conventional CBTC equipment. The system approaches train control much like an autonomous automobile system navigates, making the vehicle or train ‘smart’, resulting in a lower cost, easier to deploy modular solution.

**Rapid Signalling Deployment: a Dramatically New Approach**

Siemens proposes to dramatically accelerate CBTC deployment by (1) adding axle counters and eliminating all track circuits and train stops, and (2) reducing the design and procurement time by using a true ‘design-build’ approach system-wide. The introduction of the axle-counting system reduces the time to upgrade interlockings. CBTC can be tested during passenger service, significantly reducing service outages and costs. CBTC can evolve to be cloud based.

**Approach with Several Compatible Ideas Integrated**

Thales proposes several ideas to accelerate the deployment of CBTC. These ideas include bundling lines together into packages, creating a ‘one team’ approach with Transit Authority and suppliers, and creating a shared incentive procurement model. Additionally, Thales proposes to use LiDAR Surveying, CBTC-Interlocking integration, elimination of track circuits and most signals, train operation simulation, and communications to support big data diagnostics.

**Next Generation Positioning**

Thales proposes a new autonomous train car platform that will use sensors such as cameras, radar, GPS, and/or Light Detection and Ranging (LiDAR) technology for train positioning. With the use of advanced processing algorithms, the new sensors provide trains with the ability to sense obstacles and determine their speed and location while minimizing the use of wayside infrastructure. The new technology being proposed uses technology similar to that deployed in autonomous road vehicles.

**Acorn – Autonomous Car Operating Rail Network**

Arup proposes the Autonomous Car Operating Rail Network (Acorn) system, a newly-developed alternative to CBTC. Acorn establishes a virtual train-to-train communication path by use of open-source software and hardware with on-board processing and distributed architecture. This reduces trackside equipment, which subsequently can reduce delays by simplifying the signal system architecture.

The finalists are a mix of the established suppliers offering incremental improvements to proven CBTC technology and challengers from outside the industry. It will be interesting to see the final decision of the judges, and more importantly, how the chosen solution is taken forward into reality. More information at [www.geniustransitchallenge.ny.gov](http://www.geniustransitchallenge.ny.gov).
Currently, human error is undeniably at least a contributory factor in the causation of most accidents and incidents. Human beings are prone to making errors for a wide range of circumstances, some of them beyond their reasonable control. Yet humans are often held responsible for the consequences of those errors regardless of the contribution made by the system and the environment within which they were working. Historically, forgiveness has often been sadly lacking, whatever the situation.

A good example would be the prosecution and conviction for manslaughter of the driver of the train which passed a red signal leading to the Purley crash in the UK in 1989. His train struck the rear of a train which was crossing onto the fast line from the slow following a scheduled station stop; with the first six coaches of his train derailing and plunging down an embankment, killing 5 and injuring 88. Despite a guilty plea his sentence was subsequently reduced and then overturned as unsafe in 2007. This followed the analysis of human interaction with the Automatic Warning System (AWS) exposed at the public inquiry into the Southall collision (see below); and the recognition that ‘something about the infrastructure of this particular junction was causing mistakes to be made’ coming from new analysis of multi-SPAD signals showing that there had been four previous signals passed at danger (SPAD) at this location in the five years before the crash, far above the ‘all signal average’.

So, whilst it remains reasonable for employers, regulators and the general public to expect those employed in delivering transport to be diligent in their duties, that diligence must be judged in the light of all of the circumstances that contribute to any failure. More importantly those designing systems and processes (including the design processes to produce the systems) need to understand human performance and take it into account to minimise potential failure/error rates and mitigate any consequences. With the excellent safety performance currently being delivered by many railways it is vital that we do not become complacent and miss new risks emerging from a combination of incremental changes.

What are Human Factors?

The performance of all systems is dependent on people, processes, equipment/tools and the interaction between them. To date, even automatic systems have all been designed by humans who may leave unintentional embedded errors. ‘Human factors’ is a broad term for the analysis and optimisation of human performance in the workplace. It should consider the working environment, interfaces and processes from a human-centred viewpoint, by looking at the whole system and its influence on the way people make decisions and interact with the other elements and each other.

Another term used is ‘ergonomics’, a simple definition of which is ‘making life simpler and safer by taking account of human characteristics when designing things’. There are three branches of ergonomics corresponding to the elements mentioned above:

- Cognitive ergonomics (concerning people’s perception, reasoning, memory, motor response etc.).

To err is human, to forgive divine” – from “An Essay on Criticism” by Alexander Pope (1688 – 1744).

The quest to make life easier for the human in the loop – in this case the driver of an LNE steam locomotive in the 1940s in this Westinghouse publicity shot – is a long running story. Photo Westinghouse archive.

- Organisational ergonomics (the impact of organisation structure, policies, processes, culture, etc.).
- Physical ergonomics (how people interact with equipment and tools including things like work layout, the design of symbology, required reach, strength etc.).

Human factors may be considered a generic term for all of these areas. Whilst on a railway or metro the roles of train drivers, signallers/train dispatchers, and other front line staff tend to be the most affected by human factors, all railway staff are impacted to some degree.

Human factors is a relatively new formal discipline in the railway industry. In the UK, whilst some specific studies had gone on earlier, the first dedicated human factors team was set up within Railtrack’s Safety and Standards Directorate during the 1990s and was the origin of the current team within the RSSB (Rail Safety and Standards Board). Most other countries started to think seriously about such matters at around that time, whilst others have yet to begin formal consideration. Of course, many past ‘custom and practice’ ways of doing things (for example staff selection tests for particular roles based on certain aptitudes) were founded on human factors principles but often without much discipline or rigour. Concern is often raised about the potential for errors when workloads are high, but rarely when they are too low which can lead to boredom and distraction and thus also have a detrimental impact on failure free performance.

Examples

A few examples are now given to illustrate the different facets of human factors, and how they sometimes combine:

Cognitive Issues

The example given above (Purley) and a number of other accidents where the British Rail AWS system has been implicated are good examples of cognitive issues. The original AWS technology dated from the early 1950’s (and had its origins in even earlier systems of 1906 and 1930) and was based on a
magnetic interface between track and train. It was designed to alert drivers approaching a two-aspect distant signal as to whether braking needed to be initiated. It was not even originally fitted at two-aspect stop signals. It only had two states ‘clear’ and ‘warning’ (or more accurately ‘not clear’). For ‘clear’ a bell or chime was rung and an indicator remained black; no action was needed by the driver. If a warning was received a buzzer would sound and the brakes would be automatically applied unless a cancel button was pressed within a few seconds (nominally 2.75 seconds). When the warning was cancelled a yellow and black ‘sunflower’ indicator reminded the driver that the last signal was ‘not clear’ with the expectation that the train would be controlled appropriately. The indicator was reset the next time a clear signal is passed.

AWS continues to be better than no protection at all but the application of a system with only two states in later three- and four-aspect signalling territory potentially leads to ‘systematic automatic’ behaviour with routine cancellation of the warning. The warning is the same regardless of whether the signal is double yellow (preliminary caution), yellow (caution - prepare to stop) or red (stop). In heavy traffic the driver may be running with repeated double yellow or yellow aspects, rarely seeing green and repeatedly cancelling the warning and driving on. If the driver then approaches a red signal it is all too easy with concentration not at 100% (perhaps due to a distraction) to cancel the warning in an ‘automatic’ way and drive on into a dangerous situation. The later Train Protection and Warning System (TPWS) supplemented AWS by adding a train stop and/or a speed trap at high risk locations.

Who among us can genuinely say that we have not experienced problems caused by learned behaviour leading to automatic responses? In the UK and Japan, road traffic drives on the left side of the road. The steering wheel is on the right of the vehicle and the direction indicator stalk is normally on the left side of the steering column to conform with continental Europe and America where traffic drives on the right side of the road with the steering wheel on the left. The convention in UK vehicles until circa 1970 was to have the indicator stalk on the right-hand side of the wheel (the outside) and indeed some Japanese cars still have this arrangement. Drivers of older cars and some imported Japanese models can get confused if faced with a hire or loaned vehicle and will likely operate the windscreen wipers instead of the indicators. Rarely does this lead to an accident but potentially dangerous situations can arise. It is likely most people reading this will have had similar experiences. So why do people still think it is reasonable to design systems that require high levels of operator accuracy to two or more different conventions?

Organisational issues

AWS also provides a good example of organisational ergonomics and of procedural issues associated with human factors. On 19 September 1997 a high-speed train (HST) heading towards London collided with a freight train crossing a ladder junction at Southall near London. The HST was being driven with the AWS isolated due to a fault. It was also fitted with the Alstom/ACEC TBL1 automatic train protection (ATP) system as part of a pilot trial, but that was not switched on. The train’s journey had originated in Swansea, South Wales, where a triangle existed that originated in Swansea, South Wales, where a triangle existed that resulted from the inquiry, a new Railway Group Standard was developed governing the management of on-train safety equipment. For AWS, if the fault could not be rectified or the train turned, it required that the train stop at the next suitable station and de-train its passengers, then to proceed to a repair depot at either at reduced speed, or with a second trained person in the driving cab.

Physical issues

The third dimension of physical ergonomics yields numerous examples. A badly designed handle may mean loss of grip with failure to operate it at a crucial moment. Trying to lift something that is heavy and awkwardly shaped without the appropriate tools or fixtures may lead to personal injury. There are many more subtle reasons for equipment being badly designed in terms of the human interface; the use of similar meanings or small symbols which are hard to read in an emergency or critical commands being buried within a menu of other commands are examples, especially if a person is under pressure (see the description of the accident at Bad Aibling in Germany below).

Multiple causes

Professor James Reason’s ‘Swiss cheese’ model puts forward the thesis that accidents happen when gaps in our protective ‘safety barriers’ align with several failings happening simultaneously akin to the holes in several random slices of Swiss cheese occasionally aligning so that a hole appears right through. This is often the case with human factors where combinations of different failings come together and lead to an accident. Two examples (one railway and one non-railway) are described below; the ergonomic issues are not specifically identified by type; readers are asked to consider the situations and the subsequent events from a human factors perspective.
Modern control centres are often complex, high-intensity work environments. Do we always consider the human factors involved in operating such critical systems? Photo Network Rail.

The author personally recalls the non-railway example which concerned a workplace fatality. It happened in a factory which made hard rubber and thermoplastic mouldings, mostly for use in the manufacture of vehicle batteries. The old ‘black rubber’ car battery cases were made from around 70% ground coal, bound together with rubber, which along with vulcanising sulphur, catalysts and other minor ingredients, were all mixed up, several tons at a time, in a large machine called a Bridge Banbury mixer. This was heavy engineering with large smear mixing rotors driven by 120 hp motors through reduction gearboxes, and drop doors (outlets) on the bottom of the machines weighing around a ton activated by substantial hydraulic motors. A third machine had been added between the two original machines to increase capacity.

This addition resulted in two consequences relevant to the accident: The machines were numbered 1, 3, 2 left to right looking from the front, and the new machine in the centre had a short conveyor beneath it to take material to the next stage of the process, a two-roll mill (rather like a giant mangle), which due to the constraints of the original installation needed to be somewhat offset from the centre of the mixer. On the night of the accident the drop door of machine number 2 (the right-hand machine) suffered a failure and was being worked on by the maintenance team. During the same period the conveyor under machine 3 (in the centre) suffered a blockage. Despite clear instructions and training never to do so, the mill operator stopped the mill, climbed up on top of it, crawled up the conveyor duct and started to clear the blocked material by hand: perhaps trying to be helpful or perhaps because the factory operated a piece work system with operators paid on the output achieved.

The maintenance team believed they had rectified the fault and asked their electrician, who was a new employee, to go and perform a test operation of number 2 drop door. With hindsight, outcome was predictable. The electrician went to the control station, counted ‘1’, ‘2’ from the left and operated the drop door on the centre machine (which was, in fact, number 3). The mill operator in the conveyor duct under mixer 3 was crushed, dying almost instantly, a terrible and wholly avoidable accident, which had a big impact on everyone involved. The aftermath required many procedural improvements, the addition of guards, several different interlocks installed and the machines re-numbered in a logical sequence. With hindsight, most of the factors leading to the accident were very obvious; taken in isolation each seemed to present a very low risk, but when they all came together a man lost his life in a truly horrible way. The author learned a great deal and this was one of the events that fostered his interest in improving all aspects of safety.

The railway example is the collision at Bad Aibling in Germany on 9 February 2016. Here thanks must go to Peter Van der Mark, a former train driver and frequent writer on the importance of looking at things from a human perspective, also to the German speaking members of the ITC, particularly Jens Schulz. At the time of writing only a preliminary inquiry report had been published and nothing said here is intended to pre-empt or contradict the final report and recommendations of the official inquiry; further facts may emerge; our intent is only to highlight the apparent human factors issues.

At 6:47 in the morning, a 174 tonne ET325 six-car and a 111 tonne ET355 three-car train (modern EMU sets built to crash norm DIN/EN 15227) collided head-on with an impact speed of around 150 km/h (90 mph) near Bad Aibling Kurpark halt on the 37 km single track overhead electrified line between Holzkirchen and Rosenheim in Bavaria, Germany. There were initially 11 fatalities, and 85 injured (24 severely with one subsequently dying).

The line has five passing loops at stations, located approximately 5 kilometres apart with the section Heufeld via Bad Aibling to Kolbermoor being controlled by the signaller at Bad Aibling using a 1970’s SpDrS60 push-button relay NX (entry/exit) panel. The remote control of Kolbermoor appears to have involved some compromises in the normal technical controls/indications available to the signaller at Bad Aibling and these seem to have been a factor in what happened. The line can be busy in times of disruption on the electrified double-track (Innsbrück – Kufstein, Austria) – Rosenheim – Munich main line as it is the primary diversionary route. Freight services regularly use the line. The impression is a line having periods of intense activity interspersed with some very quiet periods. It runs beside the river Mangfall and in places dense vegetation restricts visibility. The line-speed is generally 120 km/h but the collision site was on a curve with a 100 km/h permanent speed restriction (PSR).

As timetabled the two services were due to cross at Kolbermoor station. The westbound service M79506 from Rosenheim to Holzkirchen entered the Kolbermoor station loop on-time and...
was booked to wait 5 minutes for the opposite service to arrive, but it left on time on a proceed aspect without the eastbound service arriving. The eastbound service M79505, from Munich via Holzkirchen to Rosenheim was due into Kolbermoor from Bad Aibling, but was running 4 minutes late. The signaller stated that when he tried to set the route from Bad Aibling to Kolbermoor the signalling did not accept his input for M79505. His reaction was to consider this a ‘phantomstörung’, a spurious fault, and he then used the Zs-1 signal facility to override the stop aspect at Bad Aibling and repeated the error using the same facility at Zentral Blocksignal 313 between Bad Aibling and Kolbermoor, presumably to speed the train towards the booked meeting at Kolbermoor. Maybe he expected the on-time westbound service M79506 to wait for the booked crossing despite having previously (and perhaps automatically) given it clearance to Bad Aibling (and thus a proceed aspect) which had prevented him from clearing the signal for M79505. The Zs-1 ‘Ersatzsignal’ as defined in the German railway signalling handbook, has two variants, the first is a small triangle of steady white lights under the main signal, the second a single flashing white, both are meant to allow a train to pass a failed main signal without the need for oral contact between signaller and driver. The first type is used within Bad Aibling area. Having already passed its signal, the driver of M79506 was unaware of any issue with the route ahead. The driver on the delayed M79505 at Bad Aibling adhered to regulations on a Zs-1 aspect at Bad Aibling by passing the PZB ATP magnet at the signal at 40 km/h (25 mph) until clear of the single-line turnout and then accelerated to 100 km/h (60 mph) in accordance with the rules. The signaller eventually realised his first pair of linked mistakes and attempted an emergency stop message on the GSM-R train radio. In his stressed confusion he made another mistake and used a wrong call destination field on his GSM-R computer screen sending the emergency message to station staff along the line. This mistake was quickly noticed resulting in a second successful call, but by then it was too late, the collision had become unavoidable.

There are a number of ergonomics issues here regarding the design and use of the Zs-1 within the overall signalling and operating system:

The rules for the use of the Zs-1 Ersatzsignal require that the line ahead is checked clear and then the aspect may only be used when the associated main signal cannot show a proceed aspect because of a known fault or the need for a ‘special move’ protected by the relevant rules. Clearly that was not case on the day of the accident.

The use of Zs-1 is logged on an automatic counter and the signalling book has to be filled with the logged number and an explanation as to why the Zs-1 signal was used. Following the accident, various media reports suggested that Zs-1 signals were being used outside of the rules and that other accidents had resulted.

So one must ask:

a) Why was it so easy to use the Zs-1 aspect? The decision was taken by a signaller on his own, without further recourse to either another person, a well-structured checklist or any other equipment confirming the validity of the decision in terms of train safety. A single (if repeated) human error (perhaps consequent on an earlier automatic and unconscious action) produced a catastrophic situation. Pressures on system capacity are leading to more and more pressure to install secondary override systems to keep trains moving. These might compromise the fail-safe principles the industry has refined over many decades and great care must be taken in returning to reliance on human decisions, however much they are wrapped up in some form of technical implementation.

b) Why was it so easy to overlook section occupation? Like many other relay signalling installations, the Siemens SpDrS60 panel shows the set route as a string of yellow lights on the track panel diagram. If a track circuit becomes occupied the string of yellow lights changes to a single red occupied section light. A long single track section between stations, may be overlooked as showing occupied. The illustration of the SpDrS60 panel in the interim report indicates that track circuit occupation may not provide reliable perception by a distracted operator. Checks on the Internet do not materially change that impression.

c) Is it really safe to allow a service departing on a Zs-1 aspect to travel at line speed when the Zs-1 aspect is used because of degraded/faulty signalling? Even if the rules prescribe several types of signaller checks that the track ahead of the signal is clear, there is evidence from at least three accidents indicating uncertainty as to whether those checks are always effective, particularly if one person controls a long section of line. ‘Proceed on sight’ at a reduced speed would seem more prudent, but introduces more delay. Any such genuine equipment failure might be better protected by the use of a ‘sweep train’ to remove any uncertainty.

d) How effectively were the signalling records used as part of the safety management system? The checking of the signalling book, the signalling fault book and the Zs-1 signal occurrence counter figures by supervisors does not appear to have been either frequent or thorough, nor do lessons learned seem to have been followed through. That could be interpreted as either a lack of safety leadership or, worse, a tacit agreement with misuse.

e) Why was the wrong radio screen destination field used to distribute the emergency message? It is surprising to find that the GSM-R human machine interface design was such that the emergency stop message to train drivers, which is almost always used under stressed conditions, required the clicking of the correct button amidst an array of message destination fields. It is likely that the collision could have been avoided had the first message been received in the cabs. In an emergency situation absolute clarity is required both where the message is initiated and where it is received.

f) Is it really wise to provide a Zs-1 signal at a main signal that provides the entry protection to a single line section, at least without some structured procedure or system to mitigate the risk of an oncoming train?

There were also potential low workload issues, with reports indicating that the signaller had been playing a game on his smartphone immediately prior to his original error. This distraction might have contributed to the earlier clearing of the route for M79506 from Kolbermoor without subsequently being conscious of that action. One wonders how well the signaller had been trained and supported to cope with varying workloads though the shift.

It seems there was no single cause but again, the ‘holes in the Swiss cheese’ aligned.

**Maintenance**

Human factors issues are not constrained to design, construction and operation, but can impact on maintenance. When developing enhanced safety rules associated with maintenance work that extend the total time taken, how advantageous might these be viewed by a work gang on a cold winter night at 2am in the pouring rain?
Some examples of human factors related issues in maintenance:

- Work being undertaken by staff without the necessary competence (or licence) to avoid delay – this has many risks.
- Wrong interpretation of status information provided from the signalling system (e.g. track circuit information on train whereabouts).
- Unintentional use of incorrect documentation or work procedures.
- The use of inadequate or unsuitable test equipment, because the right equipment is not available; again to avoid delays.
- Test equipment or wire links which remain unintentionally in place after test/fault diagnosis.
- Performing defined testing only in part (e.g. due to time constraints or because the work is thought to be ‘simple’).

Issues particular to the interface between maintainer and signaller:

- Misinterpretation of information provided (e.g. too late/early, the wrong line/track/location etc.) – this was a primary motivation for the introduction of formalised communication and the use of the phonetic alphabet.
- Not, or wrongly, performing actions in response to a maintainer request (e.g. to prevent switch moving due to local work).
- Ignorance of declaration/communication of temporary safety relevant restriction/procedures.
- Not knowing of temporary safety relevant restrictions or operating procedures in place (e.g. transfer to the next signaller).

Maintenance example - the control of turnouts/points

Many different circuits are used for point control ranging from 4 up to 7 wire connections per motor. Each system has some disadvantages. As an example, the German 4-wire control of a standard turnout (which has external locking, mechanical internal control of the blade position, and sometimes includes blade detection devices) requires a safety check after any change within the wiring. This includes a so called ‘position test’, which is mandatory, in order to check if the physical position of the turnout matches with the position of the point control unit within the interlocking. Evidence shows that there have been missing or wrongly undertaken tests, which have led to accidents or near accidents. It is questionable whether this relatively cheap point control (only four wires for some kilometres) justifies the risk, given the dependence on fallible human testing.

Another related example from the UK relates to the remaking of the cable termination of a point machine, due to insulation degradation/damage. The work was viewed as simple and a full correspondence test was not done even though the rules require one. Unfortunately, the 20+ year old installation had a double fault situation, created by reversing the connection at the interlocking end to obtain correct functionality rather than correcting incorrect core numbers at the point end. This minor maintenance task resulted in the first train of the day being routed into a siding (fortunately without any further consequences other than the maintainers involved being prosecuted and fined for health and safety offences). It demonstrates that a required correspondence check is also there to protect against past errors.

It is human nature to cut corners if a task is considered simple or familiar. The old saying ‘familiarity breeds contempt’ can be very true.

Lessons learned: so what do all of these examples teach us?

Multiple equipment conventions sometimes coupled with new system developments, will always create risk at interfaces, AWS being a prime example. A thorough impact analysis on adjacent systems and end to end processes is vital when anything is changed in a complex technical and operational environment. Different suppliers with different conventions to achieve the same end result, may result in hidden consequences buried way down in the lower levels of system operation.
Many trains are fitted with multiple signalling systems for operation on both high speed and conventional lines, and across national borders, but the transition between these needs to be considered from a human factors perspective both in normal operation and partial failure conditions. The transition to another system after a period of consistent operation needs careful control and mitigation against repetitive behaviour, low workload issues and distraction. Examples include the Morpeth curve in the UK where a significant permanent speed reduction occurs in the middle of an otherwise high speed section leading to three major derailments between 1969 and 1994 (a TPWS speed trap has now been installed), and the Santiago de Compostela derailment in Spain in July 2013 occurring because a significant PSR was missed near the entry to a conventional line after a period of sustained high speed running on new infrastructure, with the legacy ASFA system offering no speed control or enforcement.

Another aspect of human behaviour which emerged from the UK Southall inquiry relates to why the ATP system present was not used. At that time the ATP system was in pilot trial mode and not in operation on a continuous basis. Whilst the driver concerned had been trained in its operation, he had not used the system for some time and in evidence, said he was not confident to use it. This perverse logic means he was more comfortable to drive a train at 200 km/h with no protection system at all than risk a reliability issue with a system he did not yet feel wholly familiar with. Humans often over or under estimate their own capabilities. During the ATP pilots there were examples of equipment deliberately being damaged, with some drivers saying the imposition of such a system was “an insult to their intelligence”. Thankfully once the ‘teething’ problems were resolved, attitudes changed and drivers came to appreciate the support the system gives. In human factors terms, asking someone how comfortable or uncomfortable they feel about a particular task or about their workload overall is a useful piece of evidence to support analysis but should not be relied on in terms of determining whether a risk is tolerable.

Recommendations

Most major railway projects now include a requirement for human factors studies to be conducted and their results acted upon. However, this is often still an ‘add-on’. Human factors approaches are inconsistent, lack cohesiveness and in some cases are still quite immature. Human factors knowledge and awareness is too concentrated within specialist teams and tends to focus on physical ergonomics with little consideration of the other elements. Human factors needs to be embedded into engineering, operational and maintenance processes and should be a consistent agenda item at project, design and gate reviews with appropriate expertise present to scrutinise the issues.

Human performance should never be taken as a given. Even the most diligent person is capable of making a mistake for a variety of reasons including unconscious behaviour and distraction. Systems therefore need to provide layered protection and risk assessments should be cautious in assuming that different issues cannot occur simultaneously.

All engineering and operations staff working in the industry should be trained in human factors awareness to the extent that they can recognise potential dangers and call in a specialist if the risks identified are potentially intolerable.

All companies and organisations working in the industry should either employ appropriate human factors specialists or have an arrangement with a human factors expert who can provide support.

An attitude persists in some places that ‘we set rules and people must obey them; if they do not, then they are at fault’. Many administrations still take a hard line when a human error is part of an accident or incident causation, quickly blaming and possibly prosecuting the individual. Safety management systems should always include provision for the collection and analysis of incidents involving human error in both normal and degraded operation, so as to identify and act upon the risks that make errors more likely or even inevitable. This should include monitoring automatic or fall-back systems being used inappropriately as a day to day measure to ease workload or maintain a train service. The Zs-1 Ersatzsignal is one example; another is constantly running against a service brake over-speed intervention level for an ATP system.

All material changes to systems or processes should include human factors as part of their impact assessment with a particular focus on interfaces, workloads (including workloads which are too low as well as too high), training, competence assessment and management. A particular emphasis should be placed on the interfaces between systems, seeking out potential hazards from learned or habitual behaviours in one system that might occur in the territory of another. Training and awareness alone may not be enough to mitigate these hazards, and sometimes it will be necessary to change system configurations or operational processes to improve barriers. The transition from automatic train operation (ATO) to manual driving on an adjacent section brings particular concerns and it is known that the RSSB human factors team is already working in this area.

Automatic systems are designed by humans and diligence is needed to maintain ‘state of the art’ testing and validation of such systems to reduce error rates. Error free software is a very rare commodity. Automatic testing and the use of formal methods can improve test coverage and in the future the structured use of ‘self-learning’ systems potentially offers new ways of ensuring that unsafe conditions are not created.

Managers need to better engage with employees and their representatives on human factors issues. Employers and employees must both act responsibly, with employers prepared to respond to real safety concerns with appropriate measures; and representatives not ‘playing the safety card’ by claiming safety issues where none exist, simply to protect jobs or status. The railway is entering a period where there is likely to be increased competition from autonomous road vehicles, and improvements in efficiency and increased automation are unavoidable. Work practices will change but maintaining a safe system and treating people fairly must be constant objectives. No one in the rail industry wants to see a return to contraction and closures.

The ITC trusts that this article will raise the overall knowledge and understanding of human factors in the rail industry. It is a vitally important subject area, the analysis and control or mitigation of which needs to permeate everything undertaken, particularly the management of change.

This article is based on a presentation given at the IRSECON17 international convention in Dallas last year. Logged-in members can view this and other presentations from the event by visiting irse.info/8u47y.
The purpose of the IRSE’s International Technical Committee (ITC) is to provide thought leadership and disseminate learning on technical topics relevant to train control and communication systems. This provides value not only to IRSE members but also to the wider rail industry. The committee’s particular strength lies in its international membership, enabling engineering principles and practices from a diverse range of countries to be brought to bear upon the subjects that are debated.

In this latest report Ian Mitchell describes the concept of driver advisory systems and looks at the benefits they can bring to the efficient operation of a railway.

This paper provides an introduction to DAS, and a discussion of the benefits that they can deliver and the challenges that need to be addressed to ensure these benefits are realised safely.

**What is DAS?**

The key component of a DAS is a human machine interface in the cab that provides information to the driver that is updated in real time as the train moves along the railway. The information is derived from a variety of sources, including the current location and speed of the train, the timetable or other planned schedule for the train, infrastructure characteristics such as gradients and permissible speeds, and train characteristics such as acceleration and braking rates. The message to the driver can be *prescriptive advice* such as ‘coast’ or ‘run at 120 km/h’, and/or *contextual information* about the route ahead that helps the driver to make decisions on optimum control of traction and braking.

A number of different system architectures are possible, with the main variations being in the method of determining train location and speed, and distribution of data processing between onboard and ‘back office’ systems. For example, in the system used in the Lötschberg base tunnel in Switzerland, where there is no dedicated onboard DAS equipment, all the calculation is carried out at the control centre with advice to driver sent as a text message that appears on the standard ETCS driver machine interface (DMI) in the cab. At the other end of the spectrum are onboard systems that are pre-programmed with all the necessary timetable and infrastructure data to allow the information to the driver to be calculated entirely on the train using GPS (Global Positioning System) location information as in a road vehicle satellite navigation system. Most of the popular DAS solutions fall somewhere in between, with the real time data processing carried out onboard, but with a data connection to a back office server (usually using public data communications networks) for download of timetables and infrastructure changes, such as temporary speed restrictions.

Signal engineers are often accused of being concerned only with stopping trains to ensure safety, rather than controlling their movement in the most efficient manner. Driving a train efficiently is left to the skill and experience of the train driver. However, the development of train control systems in the last half-century has shown that this need not be the case. Automatic train operation (ATO) is now a standard feature on urban metro railways, with the primary aim of maximising use of the available capacity, and energy savings as a secondary benefit; driverless or unattended train operation is increasingly common.

Driver advisory systems (DAS) aim to provide similar benefits for main line railways, leaving the driver in full control of the train, but providing real time information that facilitates the control of traction and braking to keep the train on the optimum speed profile within track, signalling and timetable constraints. Stand-alone systems (S-DAS) work independently of the signalling, and focus on achieving energy savings for trains running to their pre-planned timetable, by coasting or running at reduced speeds to avoid early arrivals and unnecessary braking. Connected systems (C-DAS) add a link to a traffic management centre to allow a train’s schedule to be dynamically updated to avoid conflicts with other trains that are running out of course.

Driver advisory systems – opportunities and challenges
Prepared on behalf of the IRSE International Technical Committee by Ian Mitchell
The interface to the driver can be via an existing system in the cab, such as an ETCS, GSM-R or train management system DMI, but in most cases a dedicated DAS touch screen is provided. This can either be built into the cab, or on a portable device carried by the driver. At the start of a journey, the driver will enter information such as the train running number and any variable train consist information. The system will then look up the timetable for the train and match it with the current location. The DAS will then display the relevant contextual information (e.g. current location and information about the route ahead) and/or prescriptive advice (e.g. countdown to departure time). When the train starts to move the display is updated to reflect the current location of the train and whether it is running ahead or behind the planned schedule.

**What are the benefits of DAS?**

The aim of DAS is to guide the driver to control traction and braking to follow an optimum speed profile. The factors that determine the optimum may vary depending on the type of railway operation, but they will typically include complying with the planned arrival and passing times at stations and junctions, and minimising energy consumption.

So far energy saving has proved to be the biggest benefit from DAS. The opportunity arises because practical timetables inevitably include an element of ‘slack’, for example to allow for the possibility of a temporary speed restriction somewhere in the route, or where new more powerful trains have been introduced but the timetable remains unchanged to avoid conflicts with other services. This means that a train driven to its full potential of acceleration and speed will always arrive early. In this situation on-time arrival and energy saving can be achieved by running the train more slowly. A good driver will learn to do this, but experience shows that without advice there will be a range of driving styles and many will be a long way from the optimum. DAS using an algorithm carefully matched to the type of operation and the rolling stock characteristics calculates an optimum energy saving speed profile for the driver to follow.

A secondary benefit is that an energy saving speed profile will seek to minimise energy loss through braking, and so there may be maintenance savings as a result of reduced brake wear – this is very much dependent on the type of rolling stock, the benefit will be much greater for a freight train relying on friction brakes than for an modern electric passenger train with regenerative braking.

Less easy to quantify are benefits that arise from avoiding unnecessary signal stops as a result of arriving early at a station or junction and having to wait for the planned path to become available. Passengers become frustrated when a train stops unexpectedly, especially just before the station at which they wish to alight, so a smooth journey without stops will increase customer satisfaction. There can also be a safety benefit as a result of fewer red signal approaches, and hence fewer opportunities for signals passed at danger.

Finally, a train stopping due to early arrival at a pinch point before a station or junction, and then having to accelerate from a standing start when its path becomes available, may end up passing through the junction or the station approach at a lower speed, and so will block the path of other trains for a longer period. Timetabled planning allows for this sort of scenario by including a margin between the theoretical capacity of a railway network and number of trains that can be scheduled in a practical reliable timetable. In theory, widespread adoption of DAS should result in more trains arriving in their planned slots and allow this margin to be reduced, creating additional capacity without expensive infrastructure enhancements.

**S-DAS and C-DAS**

As DAS has evolved, a distinction has been recognised between stand-alone (S-DAS) and connected (C-DAS) systems. S-DAS works solely on the pre-planned timetable and the advice it gives may not be useful if for any reason the train’s planned path is unavailable. C-DAS has a link to the traffic management system (TMS) for the route over which a train is operating so that it can take account of other trains running out of course, or re-scheduling decisions made at the control centre.

Despite the limitations, most DAS deployed today are S-DAS. The reason for this is that S-DAS can be deployed by an individual railway undertaking on a specific fleet of trains, without the need to implement a real time interface with an infrastructure manager’s TMS. Co-operation with the infrastructure manager is needed to obtain static route data such as gradients and distances, and quasi-static data such as temporary speed restrictions and timetables, but this information is generally already available for briefing to drivers and to configure driver training simulators. On this basis, many railway undertakings have been able to make a good business case for DAS installation, with payback from fuel savings within a few years.

C-DAS is clearly a better solution, but the technical and commercial obstacles to achieving it may be significant. While a wireless interface from the train to a back office server is a standard feature of most S-DAS systems, data exchange is generally only required at the start of a journey, whereas for C-DAS it is important for the onboard equipment to be able to receive an updated schedule at any time while the train is moving. This puts a much higher performance and availability requirement onto the communication channel. However, the problem is technically solvable as data communication to trains for other operational and customer applications is becoming increasingly common.

In practice the bigger issue is the need for real time data exchange between the railway undertaking’s DAS and the infrastructure manager’s TMS. An attractive technical solution is to make the interface between the TMS and the DAS ‘back office’ server - which is already provided in most situations. This puts the ‘air gap’ interface to the train within the DAS system boundary and avoids many of the interoperability issues that have arisen with other systems such as GSM-R and ETCS. However, agreeing the format and content of the information to be exchanged and upgrading the TMS requires significant investment. In a typical European context there may need to be agreement between multiple railway undertakings operating on a route; some may not be interested in DAS, and those that are may have different requirements and suppliers.

Sometimes a system is described as C-DAS because it makes use of train running information data feeds for use in passenger information applications, but the usefulness of this option is limited. What is really needed when traffic is disrupted is not just the current movements of other trains, but the plan being implemented in the control centre to manage the situation for the remainder of the train’s journey. The ideal is a TMS with a dynamic re-planning function, which devises an updated schedule for each train on a time horizon of at least 15-30 minutes, with it disseminated to the trains via DAS, at the same time as to the route setting systems in the control centre. This will not work where route setting decisions are made as trains approach points of conflict manually by signallers or by automatic route setting systems that take tactical decisions on train priority. C-DAS requires a more strategic approach and is inevitably linked into the TMS strategy.
The final obstacle to C-DAS is making the business case. Much of the potential energy saving can be realised by S-DAS. The additional benefits of C-DAS should be an increase in the capacity of the railway network and more rapid and predictable recovery from perturbed running following incidents as is achieved by metro systems that implement automatic train regulation and automatic train operation, but these are difficult to quantify. It is significant that specific successful implementations of C-DAS have been on relatively simple but heavily used railways to optimise capacity utilisation of single line sections by managing the speed of trains approaching points of conflict.

What are the risks?

DAS suppliers are keen to point out that their systems only give advice, and the safety of the train remains the responsibility of the driver supported by the existing train protection systems. The DAS itself is not usually developed and validated to the standard required for a safety critical system. Nevertheless, introducing another source of information into the cab may have an impact on the train driving task, with the possibility of increasing the risk of a driver error with safety consequences.

The two main hazards introduced as a result of DAS are:

1. DAS provides incorrect or inappropriate advice that causes the driver to exceed the maximum permissible speed or limit of movement authority for the train.
2. DAS distracts the driver so that he/she fails to take action when required to maintain the safety of the train (e.g. an obstruction on the line or a restrictive signal aspect).

This is very much a human factors issue with the design of the DAS driver machine interface at its centre. As the concept of DAS is relatively new, there is no standard interface, and the amount and type of information presented varies enormously. There appear to be two quite different approaches that have been adopted: one is to provide the driver with as much information as possible to maximise understanding of the route and the operational context, and the other is to minimise the risk of distraction by limiting the display to the specific advice to the driver for the current location.

The first approach is particularly popular with freight operators, especially for very long heavy haul trains where the ability to show where the rear of the train is with regard to gradients and permissible speeds can be helpful to the driver. In this context the extra understanding for the driver is judged to outweigh the risk of ‘head down’ driving as a result of the quantity of information provided.

The second approach tends to be favoured by high speed passenger operators, where a driver is expected to observe signal aspects in frequent succession and the risk of distraction is perceived to be higher. Great Western Railway in the UK has adopted this approach. When the train is moving the DAS display only shows an advice speed below the permissible speed for the location or a coast instruction. No advice is given if the train is running late (and so should run at full speed) and on the approach to stations when the driver should be braking.

A specific area of concern is the management of temporary speed restrictions (TSR). Here the risk is that if DAS does not know a TSR has been applied, it will not take it into account in calculating the train’s optimum speed profile, and could advise the driver to drive at a higher speed. Conversely, if the advice from DAS takes account of TSRs, there is a risk that drivers will grow to rely on this source of information. The Great Western Railway implementation partially addresses this issue by indicating to the driver that advice has been suppressed because of a TSR without displaying the actual TSR speed, so the driver is forced to pay attention to the primary source of information.

More sophisticated C-DAS applications where the information provided to the driver takes account of real time signalling information introduce the risk that the driver will start to rely on the DAS display as a movement authority, instead of paying attention to the primary signalling safety system (e.g. lineside signal aspects). Of course the safety impact of any driver error will be mitigated by the train protection safety system in use on the train - a SIL 4 system such as ERTMS/ETCS that continuously supervises permissible speeds and braking curves will provide more comprehensive protection against incorrect advice or driver error than a simpler legacy system such as AWS/TPWS.

**DAS and ATO**

If a train driver in future is simply following the DAS instructions, the obvious next step is to bypass the driver and let the system directly operate the traction and braking controls. This would improve the accuracy of following the optimum speed profile by eliminating the time for the driver to respond to the advice, and could allow more sophisticated driving strategies that would be too complicated to explain to a driver on a DMI.

The ideal solution is full ATO as implemented on metros, but this requires significant additional functionality to brake the train to an accurate stop at stations and at the end of movement authorities. An intermediate step would be an ‘intelligent cruise control’ that drives the train automatically when running under clear signals, but returns control to the driver when a restrictive aspect is encountered or a station stop is approached. This is already offered as a factory fitted DAS option by one US locomotive supplier.
Both full ATO and intelligent cruise control options raise a new raft of human factors issues, as we are taking away the primary workload of the driver, but expecting him/her to remain alert to intervene when required. Some of the issues are similar to those that are arising from the deployment of adaptive cruise control and lane holding controls on semi-autonomous road vehicles. For ATO it is generally accepted that a SIL 4 continuous train protection system is required to mitigate against errors in the ATO system, and there is a strong case for the same to apply if an intelligent cruise control is being considered.

Conclusions

1. Driver advisory systems are now a well-established element of the railway ‘system of systems’ and clearly fall within the IRSE’s mission to embrace “the whole of the apparatus, electrical, mechanical or otherwise, methods, regulations and principles whereby the movement of railway or other traffic is controlled”.

2. Most existing DAS operate in a stand-alone mode managing train movement to the pre-planned timetable. These systems are already delivering significant business benefits in the form of energy saving.

3. A connected DAS with real time information exchange allowing the train to be given an updated schedule to avoid conflicts with other trains that are running out of course can deliver further capacity and performance improvements. A precondition for this is that the infrastructure manager has invested in an advanced traffic management system and co-operates with the railway undertaking to provide an interface to DAS. Successful applications of C-DAS have so far been limited to a few special applications where an intensive service has to be managed over single line sections – the costs and benefits for application to a complex main line network are not yet well understood.

4. The DAS human machine interface in the cab requires careful design to convey useful information without distracting the driver. There are a very wide range of approaches in use, and further human factors research to compare these and determine best practice would be valuable.

5. Where a C-DAS is implemented that takes account of real time signalling information, the driver may start to rely on the DAS for movement authority information in place of the primary signalling system. Ideally C-DAS would be implemented alongside a comprehensive train protection system such as ETCS; if a more basic protection system is in use, then the risk of misleading the driver needs to be carefully considered.

6. DAS provides a subset of the functionality that is required to implement ATO on a main line railway, and an ‘intelligent cruise control’ could be a step towards full automation, but there are significant human factors and safety issues to be addressed. In some applications it may be appropriate for an onboard ATO system to provide DAS functionality to support manual driving on sections of line not equipped for full ATO operation.

The IRSE held a seminar “DAS and ATO for Main Line Railways” in 2014. The presentations at that seminar can be downloaded from the Seminars and conference papers page in the Knowledge area of the IRSE web site. Also see the paper “Integration of traffic management and train operation for the main line railway” by Dr Xiaolu Rao in the April 2017 IRSE News.

Did you know ...

That all IRSE International Technical Committee reports are available on our website?

Visit www.irse.org, and click on “International Technical Committee” under the Knowledge tab.

The LKAB iron ore railway in the north of Sweden has installed the CATO system developed by Transrail Sweden AB to optimise traffic flow on their single line railway.

LKAB Image provided by Transrail – photographer Frederic Alm.
What is ‘Women in Rail’, and how can it help the industry?

Adeline Ginn, founder of Women in Rail

Women in Rail (WR), a charity founded in 2012, comprises men and women from the UK railway industry, working together to address the current challenges within the rail industry by helping to redress the diversity imbalance. It has been reported that just 16.4% of the rail industry is female, yet the power of a more gender-balanced workforce has been proven time and time again, across a range of industries.

Studies have shown that companies with more women on their boards outperform their rivals with higher return in sales, higher return on invested capital and higher return on equity. With a more gender diverse workforce comes different experiences and skill sets, as well as new ideas and ways of working, all of which ultimately bring about positive change.

Our aims are to attract more women into rail. We must do more to encourage female talent from schools, colleges and universities, inspire the next generation and support the UK wide Women in Rail campaign for industry. We are also looking to showcase and support the development and retention of female talent and achievement, in both operational and non-operational rail industry roles, across the country.

How can WR support the industry?

Regional operations

Although we are a national, network organisation, WR has regional groups all over the country, run by like-minded women from all over the rail industry. The WR groups aim to provide their members, women and men in the Rail industry, with a supportive and friendly local network for their professional development, personal growth and confidence. Many of our regional groups are working in partnership with other localised organisations such as Young Rail Professionals.

WR offers direct support to women in the rail industry through frequent networking events which take place across the UK. These events range from quirky, unique workshops e.g. social media success and cocktail-making, to themed conferences which aim to bring together both men and women from across the rail industry, allowing them to network and share experiences.

Mentoring

To help improve diversity and gender balance in the rail industry, WR launched a mentoring programme in 2013. The cross-industry programme is offered to those that feel they could benefit from some additional support from a more senior industry professional. The programme helps them gain a deeper understanding of the sector and allows the mentee to harness their talent and reach their full potential.

In 2016, 191 mentors and mentees signed up to the WR Mentoring Programme – a record number which is anticipated to increase year on year. If you are interested in finding out more, please visit womeninrail.org/mentoring

Career development

In terms of development opportunities, WR encourages key stakeholders to identify their female talent, engage with their employees and work with them to foster the next generation of female leaders, helping secure and retain talent. Key partners include National Skills Academy for Rail, Young Rail Professionals, Rail Safety and Standard Board, Rail Supply Group, Rail Delivery Group and of course, the government. WR is the diversity champion on the UK rail sector skills delivery plan.

Working with stakeholders who share the same beliefs and initiatives enables the rail industry to unite and therefore be an attractive career choice for young women. WR position themselves to those of all ages, including those who are still in school and university. WR identified 20 rising stars of rail which showcased women who are in the early stages of their career and have positively impacted on their peers, colleagues and customers through their dedication and passion for their jobs and for the rail industry.

Progress is slowly being made to redress the diversity imbalance in rail. Here Network Rail, Thameslink project and contractors celebrate Women in Engineering Day. Photo Network Rail.
New approach to UK level crossings

UK: The picture to the right shows one of the first trains to use Ardrossan Princes Street Automatic Full Barrier Crossing Locally monitored (AFBCL) crossing in Scotland, which was commissioned 28 January 2018.

The AFBCL, a locally monitored crossing with full barriers solution, is based upon the Automatic (half) Barrier Crossing Locally monitored (ABCL). The crossing appears to members of the public to be the same as a Manually Controlled Barrier; however, from a railway operations point of view it is a locally monitored crossing.

The AFBCL fully closes the road and footpaths, therefore reducing pedestrian risk. As with all locally monitored level crossings, the design is such that a train can stop short of the crossing if it is not clear or if the crossing has not operated correctly (which is indicated by the display of a Drivers White Light (DWL). The train driver must check the crossing is clear and the DWL is lit before proceeding over the crossing. In addition, a LIDAR (Light Detection And Ranging) unit is used to scan the crossing surface for pedestrians and maintain the exit barrier in the raised position until the crossing is clear. However, should a person (or vehicle) become trapped, then the train driver is required to stop and use a Drivers Release Unit (DRU) to open the exit barrier only.

Automatic train operation to be tested on Dutch freight corridor

[RGI] NETHERLANDS: Automatic Train Operation is to be tested on the Betuwe Route dedicated freight line this year, following the signing of an agreement between infrastructure manager ProRail, freight operator Rotterdam Rail Feeding and technology supplier Alstom.

It is planned that an RRF locomotive will run approximately 100 km from the port of Rotterdam to the CUP Valburg freight terminal using ATO on the sections of the route which Alstom has previously equipped with ETCS Levels 1 and 2. Under the Grade of Automation 2 tests a driver would remain on board to supervise the operation. Automatic shunting will also be tested at CUP Valburg.

Based on its experience with metros, Alstom envisages that ATO could enable freight operations to be optimised and train performance made more consistent. This would lower energy consumption and increase line capacity without requiring expensive changes to the infrastructure.

AEGIS achieves certification

UK: A new option for the supply of independent engineering safety assessment and certification is now available with AEGIS Certification Services Limited receiving accreditation by the United Kingdom Accreditation Service (UKAS) for the full range of rail sector safety certification services.

These include EU wide Notified Body, UK Designated Body and RIS-2700-RST Rail Vehicle Verification Body, together with an Assessment Body under Common Safety Methods for Risk Evaluation and Assessment (CSMRA) and a RIS-1710-PLT Plant Assessment Body. These latest accreditations follow the assessment of processes and staff competence across a wide range of railway engineering disciplines including infrastructure, energy, signalling and rolling stock.

Swiss Railways tests ‘autopilot’ driver assistance system

Switzerland: SBB (Swiss Federal Railways) has tested a new digital assistance system for train drivers on the Bern-Olten route. A Stadler double-decker train automatically braked and accelerated in the presence of the driver with the help of a new driver assistance system. In addition, the train follows a predetermined speed programme for a particularly energy-efficient ride. This level of automation is comparable to that of an autopilot: the driver in the train cab monitors and intervenes when needed. The new driver assistance system is based on the existing train control system European Train Control System (ETCS Level 2) as well as an SBB developed system for energy efficient driving called Adaptive Steering (ADL).

These tests are part of the SmartRail 4.0 program in which SBB and industry partners are pushing ahead with the digitisation and automation of timetabling, operation and train control. For passengers, the programme aims to create added value in the form of lower costs, higher punctuality, more capacity and new services.

Thameslink implements remote temporary speed restrictions

UK: In another first for the UK the Thameslink project has successfully demonstrated the application of a speed restriction being remotely applied to a train using ETCS and ATO on an open line.

A live trial took place on 25 January and successfully allowed the shift signaler manager at Three Bridges Railway Operating Centre to manage speed restrictions remotely using the service control terminal.

Via the terminal the shift signaler manager can programme a speed restriction so that it matches the limits of the speed restriction displayed on the track or in line with the advised emergency speed restriction on a signal to signal basis. This means that any train operating in ETCS and ATO will automatically be controlled to the reduced line speed.
The GB Digital Railway Programme is tasked with improving the capacity and performance of the British railway network by means of new technology such as ERTMS/ETCS, Traffic Management and Driver Advisory Systems. The Programme is of critical importance for the railways’ future, moving us from yesterday’s technology to tomorrow’s in order to deliver a railway that is operationally fit for the 21st century, and playing a central role in the move towards “mobility as a service” as part of an integrated national transport capability.

A little over a year ago Mark Carne, the Chief Executive of Network Rail and David Waboso, Managing Director of the GB Digital Railway Programme, met with representatives of the Institution of Mechanical Engineers and the Institution of Railway Signal Engineers. Their request was that the engineering institutions engage with, support and communicate the importance of the Programme.

In response, during 2017 the IRSE ran a series of workshops with industry representatives to discuss the key challenges facing the Programme. This was done with the support of WSP, who facilitated and hosted the workshops. The final output is an IRSE White Paper, which explores the challenges and opportunities associated with implementing the Digital Railway Programme. It makes pertinent observations on the industry’s readiness to deliver the Programme.

The foreword and conclusions of the IRSE White Paper are summarised below. While the focus is specifically on the situation in Britain, many of the same challenges apply to established railway networks elsewhere in the world. You can download the complete document from the IRSE web site at irse.info/btshm.

The London Bridge station area and Thameslink project are at the vanguard of the delivery of the GB Digital Railway. Photo Network Rail.
In this paper we voice constructive criticism about some elements of the Programme, and about the industry's capability to deliver it. In doing so we are endeavouring to be realistic, pointing out where change is needed. We also see opportunities, and some reasons to be hopeful. There are some good things being done, and the industry must engage and grasp them to build the capability for this transformation. Above all, the industry absolutely must make the most of this opportunity to modernise our railway.

We hope that the paper will make a positive contribution to help move the Programme forward, and to removing some of the hurdles that it faces. We stand ready to collaborate with the industry about how to continue making progress.

Conclusions

Our view of the key issues that need to be addressed can be summarised as follows:

Aligning industry objectives: Getting stronger commitment in practice to the Digital Railway Programme by the industry players is critical. We think that the best way to achieve this may be to reposition and incentivise train operating companies as the industry players that are actively driving the demand for improved capacity, connectivity and operational flexibility to meet their plans for growth and improved commercial performance.

Target implementation: We support a targeted initial approach to implementation, as it appears to offer a more practicable way forward, and may make the funding more readily justified and affordable, particularly if it can be demonstrated that quantifiable benefits arise from individual route-based projects. However, we caution that the drive to implement ETCS must not be abandoned, and that ‘network wide’ factors must be taken into consideration, rather than allowing an uncoordinated patchwork of projects to emerge.

Confidence, collaboration and culture: Collaboration is key to the success of the Digital Railway. It will inevitably mean compromise, and will require strong visionary leadership as well as, in our view, changes to industry structures and processes that inhibit collaborative behaviours and the building of trusting relationships. Cultural changes are needed, perhaps supported in some cases by frameworks, legal and commercial agreements that engender collaborative behaviours and promote win-win outcomes.

Resourcing: Successful delivery of the programme will depend on having the right expertise, particularly in client organisations. Although such resources exist within the industry, we do not think they are yet being utilised to best effect, and are probably not deployed in sufficient numbers in those parts of the industry where it matters most for the success of the programme. Future expertise and resource requirements should be assessed, and mechanisms found for acquiring them.

Contracting: The industry’s approach to contracting for digital systems must change radically, involving suppliers on a long-term basis, giving them both assurance of workload (to encourage them to invest in people and other resources) and incentivisation through performance-based contracts. New sources of funding and financing must be explored.

Delivering efficiently: A major obstacle to progress with the Programme as a whole and with individual projects is demonstrating that there is a positive business case, which is not helped by the widely held view that signalling projects are wasteful of resources. Addressing these inefficiencies is one of the most significant opportunities for reducing costs, for both conventional projects and the DR Programme.

Technology options and optimisation: If the industry does not embrace the next generation of digital train control (including ETCS), it will have to continue replacing today’s lineside signalling by more of the same. We think this is not the right way forward, and that the continued use of fixed block lineside signalling in the 21st century cannot be justified. Either way, a programme of ongoing train control system renewal/enhancement is a necessity, and it may be that a programme of ETCS fitment should be mandated through legislation.

The imperative now is for action, to make tangible some of the benefits of the technology that is available. The opportunity is considerable, and the downsides of stagnating for even longer than has already happened are serious. The industry needs to come together as never before to create a new world-class railway, one that can compete effectively with other players in the transport sector who are undoubtedly at present outstripping the railways in terms of technology innovation and revolution. This is the ‘burning platform’ that the industry needs to tackle.

As a follow up to the White Paper, the IRSE organised a Discussion Meeting with key industry stakeholders in January. A report of this meeting will appear in next month’s IRSE News.

What do you think?

Does the concept of the Digital Railway provide the step change that the railway industry needs? Or do you think that the benefits being proposed are unattainable? Do you think that the approach taken by the GB programme is ground-breaking, or has another country achieved similar aspirations before?

Remember that if you have views you’d like to share about this, or any other article in IRSE News, we’d love to hear from you. Our mantra of “inform, discuss, develop” depends upon members sharing views and ideas.

Why not write to the editor (irsenews@irse.org)? We always welcome letters for our ‘Feedback’ column.
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IRSE MATTERS

News from the IRSE
Francis How

IRSE Annual General Meeting and Dinner:
27 April, London
The IRSE’s Annual General Meeting and Dinner will be held in London on Friday 27 April 2018, when our new president for 2018-2019, Markus Montigel, will deliver his Presidential Address. All are invited to the AGM, which takes place in the IET at Savoy Place.

If you or your company/organisation wish to book places at the Dinner (which takes place in The Savoy, next to the IET, please visit irse.info/a781m for booking details, or contact Hilary Cohen in the IRSE office via hilary.cohen@irse.org. This ever-popular event sold out in about six weeks last year!

Presidential Programme Technical Meeting:
15 March, London
Efforts to improve safety for track-workers have led to many railways adopting a principle that working on or near the track and having lines open to traffic simply do not mix. However, working in a full possession or in a selective possession protected from other lines by a physical barrier has an economic cost, which tends to be highest where there is also the greatest risk, on densely used multi track lines. With the pressure on capacity and the trend towards 24/7 operation some have started to question whether these controls have gone too far and a more pragmatic approach should be taken.

With this in mind, and with developments in train control and communications technology, it is timely for the IRSE to review the current situation and future possibilities in respect of track-worker safety. In particular the ability to quickly and securely take and hand back possessions appears to offer the opportunity to maintain current safety levels and principles with reduced ‘down time’.

On Thursday 15 March Rod Muttram will be presenting a paper written by himself and Wim Coenraad (past President of this Institution) on the subject of “Track Worker Safety: where are we and what lies ahead?”. The meeting takes place at the IET, Savoy Place, London, starting at 18.00 (refreshments from 17.30). This is the sixth and last technical paper in the Presidential Programme series for 2017-18.

Requirements Management for Systems Engineering:
19 April, Birmingham
We are holding a Seminar on 19 April 2018 on the subject of Requirements Management, at the University of Birmingham (UK). You can book online using the link below.

The day will include:
• Workshop session on what makes a good requirement
• Requirements Management on HS2 Mainline North
• Innovation Using Goal Structuring Notation
• Requirements of the EULYNX Project
• Requirements Management of GRIP 5-8 Projects
• How to Sabotage a Project Using Requirements Management

More information and how to book can be found online, visit irse.info/pr7ig.

IRSE Council
The IRSE’s governing Council met on 8 February, and the following topics featured in the discussions:

• Arrangements for the introduction of the new logo for the IRSE, and associated branding changes, were discussed. There will be more about this in the April edition of IRSE News.
• Changes to the IRSE’s Articles of Association were approved in connection with nominations for vacancies on Council. These will now be presented at the AGM.
• A revised version of the IRSE’s Continuing Professional Development Policy were approved (more about this in a future edition of IRSE News).
• Reports were received from Local Sections in Malaysia, North America, Switzerland, and the Netherlands.

For more information on IRSE activities visit our website
The best place to visit for information on institution membership, activities, publications and up-to-date news is our website at www.irse.org.

Do we have your most up to date details?
Please take the time to check your details on our new database system. Visit www.irse.org, click on the Login to IRSE link, enter your email address and password, and click on My Record on the left hand side of the screen.
Introduction – Martin Fenner

After two and a half years of planning, ASPECT 2017 was hosted in the Land Transport Authority Headquarters in Singapore from 27-30 November 2017. The event sold out with over 240 delegates registering to attend the main two day conference, and managed to attract the sponsorship and support of sixteen companies and a further three exhibitors. The intention to move away from ASPECT’s previous home of London was to attract a new audience both from our existing membership and our potential membership and the feedback suggests this was achieved. The event attracted large numbers of delegates attending from Singapore, and nearby countries in the region, together with strong support from Australasia, Continental Europe, the UK, plus Southern Africa, Japanese and Indian representation.

We are very grateful to our hosts at the Land Transport Authority for making the event possible in such a world class venue, and to our event partners the Institution of Engineers Singapore and the Singapore Rail Academy – without whose support the event could not have happened to the high standards delegates received.

On a personal level it was a challenge to chair this event being based in the UK, but the fantastic Local Section Committee under Robert Cooke’s leadership ensured that I had confidence that we would succeed in our goals. When deciding to move the location of ASPECT from London to Singapore, we also decided to try to stick to a tried and tested structure from previous events, only change one thing at a time. This meant we could focus on the new elements relating to Singaporean culture, tropical weather conditions, local financial regulations and managing time difference across the committee. The feedback from delegates has been fantastic, and I’d recommend this approach for future events.

I was once told that the biggest worry as an ASPECT chair was waiting to see what the response to the ‘call for papers’ is. After all, if the socials are unpopular, or the food isn’t up to scratch, or the venue doesn’t meet expectations there are ways around these issues – but if you don’t have good papers you don’t really have a conference. Fortunately the response for ASPECT 2017 was phenomenal, and we were over twice subscribed for our original target number of papers.

Once you have some papers, it’s possible as chair to turn attention to items such as budget, managing the balance between expected costs and predicted income. This is a bit of a black art as inevitably IRSE delegates like to book at the last minute, and even the costs side of the balance can cause difficulties. In this case, some things in Singapore are cheaper than I’m used to and some much more expensive. Overall though, a huge marker of success for ASPECT 2017 was the response we received from sponsors – with Platinum Sponsors SMRT and SBS Transit, Gold Sponsors Frauscher, Siemens and Thales, Silver Sponsors Belden, Hollysys, Masstron, Nexans, SNC-Lavalin and ST Electronics, and Bronze Sponsors JMD Railtech and Wago. I’d like to thank all of our sponsors for their early support of this event and their contributions throughout the event.
Local section chair viewpoint – Robert Cooke

When offered the chance to host ASPECT in Singapore, my immediate reaction was yes, but we needed to gain local support before we could commit. This was not just the local IRSE section but also key local organisations such as the LTA and the operators SMRT and SBST. Once we had solid local support we felt able to commit but there was always the thought that if the UK with 2500 members can only attract 150 people to the last ASPECT how was Singapore with only 50 members going to achieve a similar attendance? Thus, we set about searching for a cost effective venue that was low risk, which as Singapore is one of the more expensive places in the world to hold events soon became the key challenge. We began with a strategy that only committed to certain parts of the events, such as social events, once we had solid bookings in order to reduce our financial risk.

Traditionally, IRSE HQ has always collected delegate fees for major events like ASPECT, but collecting money in the UK for a Singapore event was both logistically challenging and also introduced exchange rate risk, so the Local Section took on the challenge of setting up the payment system which proved more complex than anticipated – with PayPal and anonymous bank transfers making life more complicated than expected. Partnering with the Institute of Engineers Singapore (IES) gave us access to a professional conference organising team that proved essential both on the run-up and during the event.

Continuity for prestige events is essential, and so having many of the organising committee as previous ASPECT organisers was very useful for us conference ‘newbies’ in Singapore. Early on in the planning, the Australasian section asked whether we would be interested in holding a joint one day seminar in the same week as ASPECT, whilst this in theory was a lot of extra work, in practice we could get economies of scale by combining brochures and registration costs with ASPECT. And so Friday was dedicated to the themes of platform screen doors, maintenance and CBTC principles. This gave a full Monday to Friday programme of activities, so for anyone travelling far it could provide good value. Having hosted ASPECT 2017 in Singapore, I would strongly encourage other local sections to step up and offer to host in the future. Don’t underestimate what it takes, ensure there is good local support from the section and wider industry, but don’t forget that previous organisers will be there to help make the event a success and take ASPECT onwards and upwards.

Introductory day chair – Andrew Ng

Prior to the main ASPECT conference, an Introductory Day was organised on Monday 27 November. The aim of the Introductory Day was to provide an overview of the four conference themes, namely metro technologies, condition monitoring, high speed rail, and professional development, to the younger members and individuals who are new to the railway industry. The Introductory Day began with four theme lectures, followed by four younger members’ paper presentations by IRSE younger members from the UK and South Africa who had responded to the YM call for papers. Following these we hosted a panel discussion about the
issues and challenges related to the conference themes, and closed the day with a networking drinks reception. This enabled delegates to network with friends and colleagues from all over the world. As chair of the Introductory Day, I was delighted to see over 120 delegates at the Introductory Day; their feedback was positive and encouraging. Therefore, I would strongly recommend the continuation of an Introductory Day in the next IRSE ASPECT conference.

Papers advisor – Daniel Woodland

The overall coverage of ASPECT was, as always, broad. The ASPECT 2017 call for papers focused on four specific themes, which whilst achieving a little more attention than others, were woven into the broader topics of Automation, Signalling, Performance, Equipment, Control and Telecommunications. A specific (longer) presentation was commissioned on each of the four themes as part of the Introduction Day, and content was also included in the main conference sessions:

• Metro Technologies. The Introduction by Andrew Love of SNC-Lavalin on “Why are Metro and Mainline technologies so different?” was followed later in the week by metro related content in pretty much every session of the conference – looking at topics including specifications of systems; migration; integration; test and commissioning; asset management; reliability improvement and the need (or otherwise) for secondary train detection. The complexities of signalling a brownfield site came up as a repeated topic of interest.

• Condition Monitoring. Trevor Bradbeer of Balfour Beatty introduced ‘Remote Condition Monitoring: Are we on the right track?’ which was followed by a specific asset management session looking at innovation in this field and use of asset management data.

• High Speed Rail. The introduction by Gao Ling of CRSC on ‘High Speed Railway Signalling in China’ was followed by consideration of ETCS and Korean, Indonesian and Japanese approaches – as well as exploration of the potentially disruptive ‘hyperloop’ technology.

• Professional Development. Dr Daniel Woodland of Ricardo Rail presented “Training and Development for Signalling, Control and Communication Engineers” (a call for members to develop personal development plans and make use of the IRSE’s ‘Route to CPD’ – see the IRSE website). This was followed by a dedicated session on the Wednesday which explored best practice models for development of signalling expertise, an example of cross-cultural exchange and learning, as well as a look at maintaining ‘dying’ technological know-how (in relation to use of signalling relays).

Papers secretary – Nevin Reddy

Probably one of the most rewarding tasks in the organising of ASPECT conferences has to be the papers management. This is where the committee peer review the abstracts, papers and presentations and need take an in depth look at what is going to be offered at the conference before it is presented.

For every conference it is a new learning experience and with this ASPECT conference held in Singapore it has proven to be even more interesting. The task to manage the papers starts at least one and half years before the conference and is one that is shared by all members of the committee. It starts with developing the call for papers (including choosing conference themes) and then authors submitting their abstracts which the committee filters through to decide on which ones will best suit the conference. Participation from all ASPECT committee members brought a wide experience to decide on a programme that we felt conference attendees could enjoy.

Abstracts were received from 22 Countries and 42 companies, and acceptance of papers had to balance technical content, with global representation across the various companies within the industry. This year we saw a good supply of high quality abstracts submitted, which gave the opportunity to host parallel sessions for the first time at an ASPECT conference. Once the committee selected the abstracts and set the draft programme then the year-long challenge starts. It is at this point that we take our hat off to the all authors that were able to dedicate time out of their busy careers to be able to produce the high quality papers that were of suitable standard to be presented at an international conference of this nature. Although not all of the authors that were originally selected were able to complete the papers to be presented we acknowledge their efforts during the course of the year and thank them for their support.

On the first round of receiving the papers the committee members who had volunteered their valued time, put in great effort to do detailed reviews and editing. With so many papers being from countries were the native language is not English, in some cases this can be a challenge for both the author and reviewer.

There were many challenges along the way with communication across the globe being one of them with a number of authors changing their lead author and email address or changing companies during the process. Ultimately, we managed to ensure that a full conference comprising of 35 papers across two days were presented to an enthusiastic audience. From the feedback received, thanks to the professionalism and collaboration of the authors and ASPECT committee, the papers were presented with the content and quality we expect for a conference of this nature.

Animated conversations between sessions.

Nick Wright, one of our many excellent presenters.
**Exhibition coordinator – Graham Hill**

I have been a member of the ASPECT organising committee since 1999, so when the request came to help out again for 2017 with the conference to be held in Singapore and not London, this new challenge was gladly accepted. Organising a conference and exhibition normally has its logistical problems to overcome, but trying to organise the exhibition in another country with limited knowledge of the area and suppliers was going to difficult. So with the help of the local IRSE section, a general plan for the exhibition facilities was drawn up to enable the exhibition to be an integral part of the conference and allow for networking with the delegates during the whole conference period. After a few discussions with the LTA facilities and management, a final plan was agreed for the exhibition area and the planning for the exhibition stands and exhibitors could continue full steam ahead.

We contacted numerous companies and potential sponsors to drum up the interest not only from an exhibitor point of view but also from the ASPECT delegate point of view. We had a fantastic response from sponsors wishing to take up packages that combined exhibition space with other benefits, and one month before the conference start date we had a full exhibition space with a blend of suppliers and railway authorities from 15 local and overseas companies.

With a month to go, the focus turned to making sure that all of the final arrangements were in place with the logistics – with both the stand supplier and also the exhibitors, whilst co-ordinating with the rest of the ASPECT organising committee to ensure a smooth conference for all attendees.

On arrival in Singapore, it was all down to making sure that everything went to plan with the setup of the exhibition stands, organising the networking opportunities during the breaks within the conference sessions, and after the event to manage the breakdown of the exhibition facilities. The exhibition area worked extremely well and without any major issues. The marquee holding the exhibition allowed delegates to discuss and mingle with exhibitors during all the conference breaks, and the feedback received was extremely positive – both from delegates and from the exhibiting companies.

I also had the chance to help with the selection and proof reading of some of the conference papers, and could provide general support during the conference including chairing a session. These, together with the networking opportunities the event provided me, meant that the 2017 ASPECT conference was an enjoyable experience for me and also a great way of gaining some more professional development along the way.

**Technical visit 1 – Bishan Depot and Kim Chuan Depot – Martin White**

The site visit to Bishan Depot included viewing of a train fitted with the Thales CBTC equipment. This has been supplied as part of the SMRT North- South and East-West Lines resignalling project. The on board CBTC signalling equipment was inspected by delegates, which included the Vehicle On Board Computer (VOBC) equipment, and train radio equipment. In addition the new driver’s displays were seen.

The trains are presently dual fitted with the legacy fixed block ATP equipment together with the new CBTC equipment. The temporary changeover circuitry that is used to switch between the two systems was explained to the visitors and inspected.

After viewing the CBTC fitted train, the party moved to the SMRT Maintenance Control centre. This oversees and monitors all main systems involved in running the North-South/East-West Lines (NSEW Lines) of SMRT. These are signalling, traction power, and trains. The control centre communicates to the appropriate field staff in the event of a fault and if necessary gives advice to help resolve the problem.

At Kim Chuan Depot we were shown the Operations Control Centre (OCC) for both Circle line supplied by Alstom and NSEW lines supplied by Thales. This gave delegates the chance to see the contrasting types of display used for each system. The OCC for NSEW Lines is presently running in shadow mode, and will be brought into use in 2018. In addition, we visited the area for NSEW Lines is presently running in shadow mode, and will be brought into use in 2018. In addition, we visited the area where North East Line (NEL) trains are maintained, and had the opportunity to inspect a NEL train.

**Technical visit 2 – Gali Batu Depot – Daniel Woodland**

The Downtown Line is Singapore’s newest line and was opened in three stages, during 2016/17. They have 92 three car through gangway Bombardier trains. 58 to 60 trains run in peak periods, delivering a 2.5min headway. More trains can be run for special events. Off peak, 34 trains operate a 4.5 min headway.

The Downtown Line has been fitted with Siemens Sirius CBTC (using 2.4GHz radio), with a fall-back coded track system. The system operates as driverless (GoA4). This means that staff should only need to drive manually during failure conditions. However, so that they can keep the skill to do that current, training/practice in manual driving is done during off peak periods. As an unattended train, it has no driving cab but an emergency driving panel located next to the emergency detrainment doors at the front and rear.

The full line is controlled from the Gali Batu control centre. The system will also work from local servers if central control is lost, it
can also be locally controlled from stations and there is a backup control centre at Changi. The 750v DC traction power is also controlled from the centre, along with tunnel ventilation.

The technical visit to Gali Batu took in the signalling equipment room, control room (from an impressive viewing gallery above), the depot layout (from another impressive viewing area) and the depot workshop. The latter part of the visit also included time to look under and within one of the trains, to see how equipment had been fitted and the arrangements for manual driving and passenger detrainment.

Besides the areas viewed close up, the view across the depot enabled the guides to point out stabling sheds and a building for storage and maintenance of the line’s seven battery-powered engineers locos.

The guides were a mine of interesting and useful information about both the specific solutions used on the Downtown Line and the issues of GoA4 operation.

Technical visit 3 – ST Electronics – Helen Kellaway

A smaller group of ASPECT delegates chose the option to attend the ST Electronics technical visit. On arrival we were directed into STE’s demonstration suite where we given an introduction to the company’s history and its core groups; Large-Scale Systems, Communication and Sensors, and Software Systems.

The Large Scale Systems group develop various metro system products such as command and control communication, automatic fare collection, platform screen doors, passenger information systems and enterprise asset management. Additionally the group also develop security management systems such as access control systems and have expertise in system integration including lifecycle support and making systems more robust. Within the Command and Control domain STE delivered the Beijing traffic control centre mass transit network management and support systems and maintenance management system which covers 18 lines, 334 stations and a total of 554 km of line.

STE also manufacture platform screen doors, both full and half height installed in various locations around the world including Singapore's North-East, Circle, NSEW, Thomson & Sentosa Express Lines and lines in Malaysia, Taiwan, Saudi Arabia and Toronto to name but a few.

The various configurations of their automatic fare collection systems are also present in many places around the world including Singapore, Thailand, China and the USA. Each system has been developed specifically for the customer’s needs. It was highlighted how culture plays a huge part in the development of these systems with the design of ticket vending machines for USA customers having robustness requirements that were more rigorous than those designed for Asian customers for example.

The project footprint for STE’s passenger information systems was also far reaching with systems installed on a number of Singapore Metro lines and India Metro trains as well as driver interfaces in Thailand, China and Taiwan MRT trains and San Francisco stations.

There was then a demo of their operations control centre (OCC) facilities such as station opening which allowed an operator to open each station on a line including activating the lighting, escalators and lifts from a single control point in the OCC. Incident management was also possible from the OCC where diagnostic information was collected and displayed against assets. In the event of a fire on a train the OCC is able to control infrastructure to ensure the safe exit of passengers such as displaying exit information on passenger information systems and controlling escalators to direct passengers out of the station.

These systems allow a user to see the overall performance of a line and then delve into the specifics of the assets on the line to identify the location of equipment faults and manage the maintenance of them in order to ensure a smooth running service or put special conditions into operation to ensure minimal disruption.

Delegates were then taken on a tour of the automated ticket system examples produced, and had a chance to try out the facial recognition prototype which removed the need for a physical ticket as your face automatically identified you and the linked you to your ticket account. Again culture plays a huge part in where these more modern systems were deployed compared to systems that provided users with a physical ticket that was used to operate the barriers, although many of the systems were able to issue a ticket chosen by the users whether that was physical or virtual. Additionally, these examples offer areas for advertising to be displayed and could target specific advertising to customers based on their demographics.

Next, we visited the platform screen door test facility where a number of screen doors were being soak tested for various customers around the world. On the displays for Singapore’s Thomson Line the passenger information was projected onto the panels either side of the screen doors which included details on the arrival time of the next train, where to buy tickets for travel and also which direction and stations were served by the next train due to arrive. There were also lights to indicate to the passengers when it was safe to enter the train. Additionally trap tests were carried out by lucky delegates on these doors to ensure that the doors would open should something be detected as trapped between them, although only if it was a rigid object since clothing is still difficult to detect.
On our transfer back to the hotel a few of us mentioned that we got more than we expected from the visit – from what started out as an expectation to see platform screen doors turned into witnessing a detailed enterprise asset management system, fascinating passenger information systems and clever automated ticketing systems. I even heard one delegate mention that it was the best IRSE technical visit they had ever been on.

**Conclusion – Martin Fenner – Aspect 2017 Chair**

I hope these contributions from the ASPECT Organising Committee have helped give a flavour of the event, and the preparations required. The committee delivered a fantastic conference, and certainly proved that hosting ASPECT in Singapore was a justified decision, and I’d like to add my personal thanks to everyone who contributed to this success, as always there are many unsung heroes.

Looking to the future, there is a fantastic opportunity to host the next ASPECT in a new location, perhaps in late 2019. Discussions are ongoing but maybe reading this has inspired you to encourage your local section to pitch for a future ASPECT, or indeed you want to support the organising committee yourself, do get in touch with the Institution if that’s the case.

Singapore proved a welcoming, exciting, and technically dazzling venue for ASPECT 2017, with the quality of the conference matched by the city itself and the variety of food on offer.

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**Spread the word!**

We would like to produce short articles about the basics of signalling in a ‘back to basics’ series covering the principles, and why they’re important. If you could help to contribute we would love to hear from you. One of the IRSE News editors would be able to assist with the production and checking of articles before publication.

If you would like to write for IRSE News please contact us, all of our contact details are on p37.

Help to spread the word and to ...
S&T comes to life – an educational visit to Great Cockcrow Railway for the IRSE Staff

Judith Ward, Professional Development Manager, IRSE

One autumnal day saw 10 IRSE staff pulling levers at the Great Cockcrow Railway in Chertsey, Surrey. What brought them there? Judith Ward explains…

I joined the IRSE staff team in January 2017, and as the ‘tame engineer’ in the main office, I frequently get asked what various terms and acronyms mean when they appear on application forms, in articles and so on! Also, many of my colleagues were keen to know what I used to do as a ‘signalling engineer’ so they could gain an idea of what all IRSE members (our customers) do.

Whilst I’d never be able to describe the full spectrum of IRSE members’ roles and work (because I don’t know myself), I had an idea… wouldn’t it be great if my colleagues gained an understanding of how signalling, telecoms, train control and traffic management fit into a whole railway system as well as see (and use) some of the equipment they had only read about. I therefore proposed an educational visit to a small railway rather than lecture them for hours on end.

The Great Cockcrow Railway is a 1/8th scale model of a 1950s railway, owned by the Ian Allan Company. It is run by volunteers and is open to the general public on weekends and some week days during the summer school holidays. For our educational day, we had the whole railway to ourselves.

In our initial walk round part of the layout setting up the signals, the challenges of maintaining a 1/8th scale railway were very clear: there was a ‘landslip’ to clear (rabbits had been digging in the cess); gantries had to be approached with great care (even for short people like me); even point switches are prone to be stuck with twigs or very small stones! Whilst the differences in scale are obvious, it was clear that many of these issues could be problematic scaled up for any ‘big(ger) railway’.

We were then taken for a ride around the full layout which is approximately 2 route miles long, with the ‘S&T engineers’ amongst us pointing out and explaining how the driver interprets and reacts to the signalling whilst maintaining a smooth journey on various gradients.

The signallers kindly allowed us into the three signal boxes to see them at work and listen to the communications via block instruments. Hardwick has a 23 miniature lever Westinghouse ‘L’ type frame previously part of Crewe South Junction; Everglades has another Westinghouse ‘L’ type frame with 31 miniature levers previously at Croydon South; and Cockcrow Hill has a 16 full size lever frame from the Waterloo and City line. Then, under very close supervision, the Hardwick and Cockcrow Hill signallers tutored us to signal trains through whilst keeping trains running, a challenge easier said than done!

Other S&T features on the railway were shown to us during our day, including the relay room, flashing aspect sequences, train describers and point machines. We were also allowed to drive the battery-operated train and a steam train, both short distances and under expert tuition.

After a day immersed in the railway, the Team emerged much wiser of some of the terminologies only previously come across in membership, registration or licensing applications and the importance of S&T as
part of the whole railway system, ensuring the safety of drivers, passengers and anyone else who came near us. All the group enjoyed the day and judging by the questions they are now asking me, they certainly have understood a lot more – their questions are getting harder, unfortunately!

We would like to thank John ‘The Controller ’ Alexander (possibly better known through his day job at Network Rail or as one of IRSE exam committee) for ensuring we were not only safe but also learning at all times. We would also like to thank to all the volunteers who made our day interesting, educational and memorable.

I’d also strongly recommend that anyone who wants to see a different aspect of a railway to get in touch with their local miniature or preserved railway to ask whether there are any vacancies, or opportunities – it’s a brilliant way of understanding the railway as a whole system and frequently you don’t need previous experience as there are so many volunteers to assist you.

Correction ... In IRSE News 241, the Minor Railways Section article about the level crossing workshop held in September 2017 mentioned the kind support of John Tilly. Unfortunately the spelling of John’s surname was incorrect in the article - our apologies to John, and once again we would like to thank him for the invaluable support he gave during this event.
Towards the foundation of the Japanese Section

On 1 November 2017, the IRSE Japanese Section was founded.

It was rather a long way to the foundation of the section, and this was finally accomplished by the support of many people. The trigger was the IRSE ITC (International Technical Committee) meeting which was held in Tokyo on 6 April 2016. ITC’s mission is to provide an international and independent perspective on Railway Control Command and Signalling by a group of widely recognised experts, and one year previously it had been decided to hold the International Signalling Seminar in Tokyo immediately after its meeting.

The ITC discussed what subjects should be dealt with and how the seminar should be managed, and Dr Masayuki Matsumoto, East Japan Railway Company, contributed significantly to the realisation of the seminar. The ITC meeting and the seminar were the IRSE’s first activities in Japan, and this was important not only for the IRSE but also for Japanese signal engineers. This was a good opportunity for the IRSE to understand Japanese railway signalling, and for the Japanese representatives to know more about the IRSE. More than 40 Japanese people attended the seminar. We regret though that Christian Sevestre, ITC chair at the time, was unable to attend the meeting.

During the seminar, Hugh Rochford, secretary of the ITC at the time, told us about the French Section, which was formed in January 2016. He was deeply involved in the French Section, and offered us useful information including their experience, which serves as a base for the Japanese Section.

In June 2017, six influential IRSE members in Japan, gathered and discussed the formation of the IRSE local section in Japan, considering railway signalling from a global point of view. These members, who were all the promoters of the Japanese Section and later approved as committee members at the inaugural meeting, concluded the early establishment of the Japanese Section with the objectives of: to extend and deepen knowledge worldwide in the field of railway engineering; to elicit new ideas for current activities and thereby contribute to the further professional development and training of members; and to facilitate the informal pooling of experience among members.

There were, however, some conditions to approval by the IRSE as a local section. The most critical one is the minimum number of local section members, i.e. 40. At that time, the IRSE members in Japan were only about 20, but fortunately more than 30 applied for IRSE membership and we finally reached 51 members.

Apart from the petition by local members, there were a lot of procedures to be prepared for the formation of IRSE JP. The very appropriate and helpful assistance of Francis How, chief executive of IRSE was very much appreciated. Even during the busy convention in Dallas, the details for the formation were discussed, two weeks before the council meeting in London where it was finally approved.

Inaugural Meeting

The inaugural meeting was held on 1 November at the Tokyo Branch Office, JR East, and 41 out of 51 members attended the meeting.

Masayuki Matsumoto introduced the activities of the IRSE. Yuji Hirao, as a representative of the promoters, explained the formation process of IRSE JP and the objectives of the section. Then he proposed the Articles of IRSE JP, chair and the committee members, and strategy and activity plans. All proposals were approved by the local members, and finally the establishment of IRSE JP was declared.

Although there are some specific features of the IRSE JP, cooperation with railway associations in Japan should be unique as stated in its Articles as follows:

- To more effectively accomplish the object and purpose of the local section, IRSE JP may undertake activities in cooperation with the Japan Railway Engineers’ Association and the Japan Railway Electrical Engineering Association.
- Interested members of the Japan Railway Electrical Engineering Association may attend events of IRSE JP as guests, who are expected to apply for the IRSE membership.
These organisations with a long and glorious history have significantly contributed to the railway engineering domain, and cooperation with them is important for IRSE JP, with the advantage of a worldwide view.

The committee members of IRSE JP section are as follows: chair Prof Yuji Hirao, vice-chair Dr Masayuki Matsumoto, secretary Takashi Kawano, treasurer Hideki Komukai, Toshiaki Sasaki, Dr Katsuji Akita, Prof Hideo Nakamura, Shigeto Hiraguri, Hiroshi Ito, and Makoto Yagi.

Following the inaugural meeting, a celebration party was held. We had the honour of the attendance of Isumi Kawaguchi, director of engineering planning division, Railway Bureau, MLIT (Ministry of Land, Infrastructure, Transport and Tourism), Dr Katsuji Akita, president of Japan Railway Engineers’ Association and Hiroki Nakagiri, chief executive of Japan Railway Electrical Engineering Association. The guests each made a speech with their expectations for IRSE JP, and there were really valuable suggestions for us to consider our direction to proceed.

Social events are important as well as technical events to communicate with and understand local section members. IRSE JP will arrange a social event after every technical (lecture) meeting.

**Activity Plan**

IRSE JP periodically (five or six times in a year) holds lecture meetings as technical events. Subjects being considered are:

1. Effects, on railway signalling, of radio, image processing, security, artificial intelligence (AI), big data, IoT and road vehicle self-driving technologies
2. New train control systems, ATO and railway digitisation
3. Safety standards, RAMS, CSMs and EU legislation, and safety management.

The first lecture meeting was held on 25 January, when IRSE activities and the RAMS international standard were discussed. The second meeting is planned on 16 April, with the honour of the attendance of Peter Symons, the president of IRSE. The detailed programme for this meeting is under discussion.

As the first Japanese IRSE member, I am personally very pleased about reaching this milestone. I would like to thank all the persons who helped us form IRSE JP! Without their kind support, it would not have been possible.

For more information on the Japanese Section contact Yuji Hirao at hirao@vos.nagaokaut.ac.jp.
November Technical Meeting: Driver only operation
Tony Pinkstone

Chair Simon Prins welcomed members and guests to the meeting on 16 November 2017, and sadly reported the deaths of Paul Bates and Denis Bowly. Quentin Macdonald then gave a short eulogy on the two former members of the York Section, Denis having been Chair and committee member for many years. This was followed by a minute’s silence in tribute.

Simon then welcomed Pete Stevens of Atkins to give his paper on “Driver only operation CCTV design principles”, drawing on his experience with two recent schemes, East Kent Stage II (the extension of platforms etc. for 12-car operation and a new station at Rochester), and Crossrail Anglia.

Closed circuit television (CCTV) is required to cover the whole length of the platform/train interface and present to the driver a screen-view enabling him to assess when it is safe for the train to depart. There must be no image freeze or time delay and at a screen-view enabling him to assess when it is safe for the train length of the platform/train interface and present to the driver experience with two recent schemes, East Kent Stage II (the extension of platforms etc. for 12-car operation and a new station at Rochester), and Crossrail Anglia.

A target of 1m diameter must be visible along the whole length of the platform and must not take up more than 10% of the screen height. The picture must cover up to 1 m from the platform edge and up to 2 m in height. There must be no more than 2 m overlap between cameras where multiple cameras are used, with no train doors in this overlap. An angle of 2 degrees is applicable for cameras with a short focal length. To enable the designer to see the data required about the train formations and positioning of doors on the trains. A driver vision plot is required for the monitoring of the operator, allowing for the cab design, the cab side window and factors such as the end vestibule connection on some stock. The position of the stop board and relevant signals must be considered along with 4/8/12 car and bi-directional operation. Site constraints such as contrasts in lighting under and outside platform canopies, low sunlight at dawn and dusk, reflection on wet surfaces and snow need consideration. Other factors are platform signage, passenger information monitors, and lighting columns. Problems arise with curved platforms such as Strood where an allowance for 10 to 12-car operation required nine cameras per platform.

On Crossrail Anglia, coverage is required for other train formations in addition to the 205 m long Crossrail Class 345 stock. Half the cameras face in each direction. The images are cropped, flipped and spliced together to give a composite view which is then transmitted to the train via a leaky feeder. The platform/train interface area is 1.3 m from the platform edge to a height of 2.4 m. For maintenance purposes, cameras can be lowered for access.

Recommendations for a project of this nature are that the Train Operators are engaged at an early stage and a thorough site survey is made using scale drawings. The 2 m overlap for 2-degree cameras must be adhered to, but the platform/train interface can be subject to a design tolerance of 10%. The designer must consider site constraints such as canopy design, constructability and maintainability, and coordinate with other disciplines. The designer must verify the design on site, gain approval of the camera views from the train operator and obtain the approval of the signal sighting committee.

A question and answer session followed, and to conclude Chair Simon thanked the speaker for his paper, which had filled in some of the technical background to one of the hottest topics in the industry at the moment.

In IRSE News next month ...

• Specifying train control systems
• ASPECT 2017 – view from the Younger Members
• Digital Railway discussion event

... and all our usual features including Section News, Industry News and News from the IRSE
MEMBERSHIP MATTERS

ADMISSIONS

We have great pleasure in welcoming the following members newly elected to the Institution:

COMPANION
Palmer  M  TTC  Canada

FELLOW
Belmonte  F  Alstom  France
Li  Z  Beijing Hollysys  China

MEMBER
Baker  C  HDR Inc  USA
Hackbarth  G G  Rio Grande Pacific  USA
Kamalasuriya  S J  Sydney Trains  Australia
Magdij  O M  Mex Technical Services  UK
Marriott  M J  Network Rail  UK
Omanakuttan Nair N  Koci Metro Rail  India
Tam  W P  MTR Corporation  Hong Kong

ASSOCIATE MEMBER
Gao  Y  CARS  China
Nazruddin  Y Y  Institut Teknologi Bandung  Indonesia
Newton  D A  Network Rail  UK
Nicklin  R A  Network Rail  UK
Venkatasamy  S B  Siemens  UK

ACCREDITED TECHNICIAN
Feeney  M  Tube Lines  UK
Kelleher  H J  Network Rail  UK
McKenzie  H  Coyles Personnel  UK

AFFILIATE
Austin  W  HS2  UK
Avvaru  L K  Aarvee Associates  UK
Bradley  S  CH2M  UK
Jowett  P  TIL  UK
Lau  C  MTR Corporation  Hong Kong
Maple  A J  Westbrook Comms  UK
Marin Aznar  J  Siemens  UK
Parkinson  R  Balfour Beatty  UK
Prosser  R  UK
Steele-Hurley  J  WSP/OPUS  Australia
Thorpe  S A  Talyllyn Railway  UK
Vetsch  H-P  Switzerland
Wong  P H  MTR Corporation  Hong Kong
Wu  H T  SNC Lavalin  Canada

TRANSFERS

MEMBER TO FELLOW
Gordon  A M  TfL  UK
Nicholson  D J  Atkins  UK
Rendell  S S  Rail Planning Services  Australia
Sijabat  L A M  PT Len  Indonesia

ASSOCIATE MEMBER TO MEMBER
Dunsford  R  WSP  UK
Krishnamoorthy  R  Thales  UK
McGroarty  T  GHD  Ireland

AFFILIATE TO MEMBER
Hazel  G  Invensys  UK
Shenoy  R R  Thales  UK
Tuohy  P  Irish Rail  Ireland

AFFILIATE TO ASSOCIATE MEMBER
Kamaruzaman  E  MRT  Malaysia
Obidike  U T  Siemens  UK
Willis  T C  Alstom  UK

AFFILIATE TO ACCREDITED TECHNICIAN
Ford  N  Siemens  UK

RE-INSTANTIEMENTS
Gion A, Walker J D, Tso K K and Turner C.

RESIGNATIONS
Eichhorn M and Wadey P.

Current Membership: 5332

FEEDBACK

Have we forgotten “Have we forgotten the driver?”

January IRSE News is excellent – four decent meaty technical articles. Paul Darlington always writes at a good level, giving explanations that assume no prior knowledge whilst tackling the matter at hand; the SSI article similarly is written at a good level. Is it possible to get hold of the original “Have We Forgotten The Driver?” from 1988 please.

Alan Beavers, UK

We have obtained a copy of Tony Howker’s paper “Have We Forgotten The Driver?” for Alan, however as it is often quoted within the industry, and 30 years in November since it was presented, we are looking to reproduce the paper in IRSE News later in the year, along with a commentary on what has changed in the intervening years. IRSE News welcomes all feedback so if you believe there is any other paper that would benefit from ‘a revisit’ please let us know.