



THE SWORDSMAN

Issue 39, November 2017

The Worshipful Company of Engineers

(Incorporated by Royal Charter 2004)



The Swordsman



Issue 39 November 2017

CONTENTS

Editorial

The Master - a profile

Junior Warden's lecture - 21 June

City Events

AGM (Common Hall) and Installation - 25 April

Election of Sheriffs - 26 June

Awards ceremony and dinner - 18 July

Luncheons

Brooch luncheon - 26 April

Almoner's report and luncheon - 5 May

Site visits

Static Systems Limited - 25 May

Out of town events

Rambling reports

Cardiff with Welsh Livery Company 23-25 June

RAF Cosford and Ironbridge - 30 June - 1 July

Out of town to Manchester - 21 to 24 September

Company news

Court report from the Master

Engineers Trust/IET Horizon Engineering Bursaries

Comings and goings

Addendum

The annual awards and winners for 2017

Forthcoming events dates

Front cover photograph : Manchester University School of Electronic Engineering the drummer from the 'Robot Orchestra'.



From the Editor

The fact that news never stops and the number and type of media channels increase exponentially means that identifying the highest mountain peaks of news in a landscape of such diverse media channels is not easy. Fear not, because the Editor takes it upon himself, equipped with a finely tuned set of antennae to spot the news of interest to himself

Volvo has announced that every Volvo it launches from 2019 will have an electric motor, marking the historic end of cars that only have an internal combustion engine and placing electrification at the core of its future business. Volvo's announcement trumped similar announcements that followed from Jaguar Land Rover (2020), General Motors (2023) and BMW (2025).

In a written statement to Parliament the Government announced the decision to award Stage 1 contracts, comprising design and construction preparation works for the HS2 new railway.

Since the date of the last edition we all saw one of the largest engineering disasters unfold on our television screens: the Grenfell Tower fire. The fire started on 14 June 2017 and engulfed the 24 storey

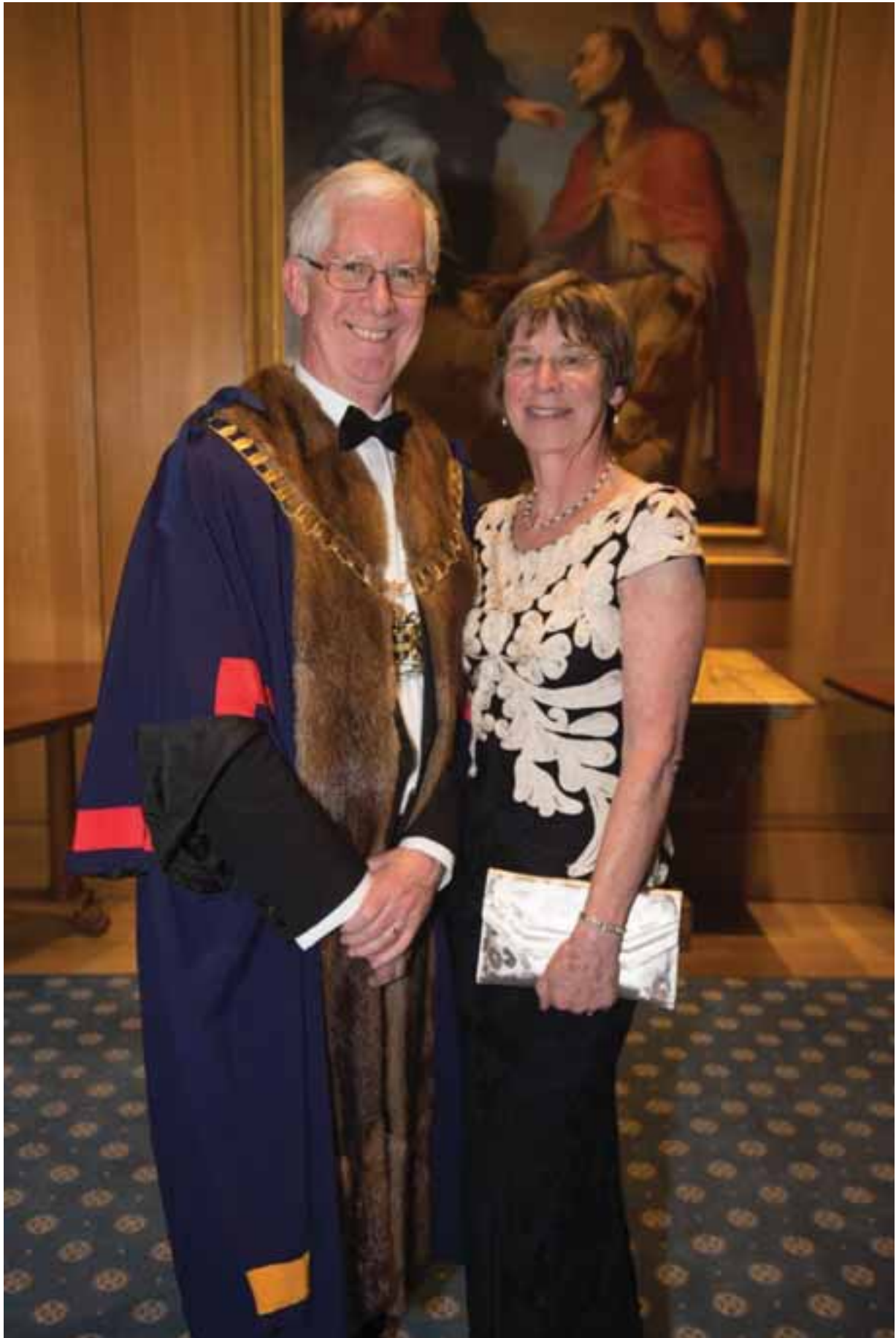
block in which over 80 persons lost their lives. The terms of reference of the public inquiry, chaired by Sir Martin Moore-Bick, a former Lord Justice of Appeal, were published on 15 August 2017. The opening session of the inquiry was 15 September. More than 500 individuals and organisations have so far applied to be "core participants" in the Grenfell Tower fire inquiry. The level of interest revealed in the inquiry is thought to be the highest ever received by any public inquiry and indicates the complexity of the task faced by the chair, Sir Martin Moore-Bick.

I hope that the profile of the Master, this being the second after Past Master Pollock-Hulf, is a feature that is appreciated. Please let me have your views.

Finally, I am constantly heartened by the willingness of those I ask to contribute to the Swordsman. Without their unflinching support the Swordsman would be impoverished and so, on the Company's behalf I say 'thank you' to each of them listed below.

Contributors: Gina Barney, Margaret Baxter, Dixie Bayly, Windsor Coles, Björn Conway, Peter Blair-Fish, Audrey Canning, John Canning, Suzanne Flynn, Barry Gasper, Richard Groome, Sue Hewerdine, Val Howse, Mike Inkson, Yvonne Joyce, Jennifer Liddell, Gordon Masterton, Jane Newsome, Colin Newsome, Graham Owens, Henri Pageot, Isobel Polluck-Hulf, Margaret Skinner, Penny Taylor, Malcolm Vincent, Simon Watts, Marilyn Wedgewood,

THE MASTER & HIS LADY



A PROFILE OF THE MASTER

Eur Ing RICHARD GROOME



Being practical and growing up in an environment with a dad who loved DIY and who became City Engineer for the Corporation of London, the Master Engineer, Richard Groome, developed a keen interest in engineering – and was even helping to pack up old London Bridge to send to the USA at 15 yrs old!

Chemistry was another teenage passion which he pursued ‘enthusiastically’, so it was not surprising he took up Chemical Engineering at Nottingham University. A diverse, stimulating career followed which he continues to thoroughly enjoy.

He describes himself as a ‘generalist’, as many chemical engineers are, able to understand and comment on many aspects of business and technical matters but without specialising in chemical engineering specifically. He has worked in various sectors, in different roles, manufacturing different types of product, and with a variety of technical and business challenges. His current Director’s portfolio in his own company includes non-exec director positions for the NW Ambulance Service and Your Housing Group, two executive directorships for a schools’ projects in Leeds and Peterborough with 14 schools, and for Solskin Ltd in solar investments - “Solskin means sunshine in Icelandic” he smilingly states. From his chemical engineering start, he has come full circle in also providing technical consultancy to the waste industry.

With each step of his career, he relished being stretched and challenged and loved learning new things and working creatively. Leaving something for posterity, was a ‘driver’ and motivating. In the food industry, he pioneered high speed processing and plastic packaging for the Express Foods Group and Ski yoghurt, making the company an acknowledged leader in plastic packaging innovation. The first Individually packed butter portions were manufactured under his direction, with corners made round from advice by wife Janet, and he rose to be the Technical Director for Eden Vale.

Recognising he needed more experience in sales and finance he changed industries and took over the general management of a fast-track buildings company, Elliott Group. He realised as his career moved on, that he was a closet salesman and could sell ideas and concepts at senior level. Meanwhile he

was of course, building up experience of business and business operations, with finance, sales, contract negotiation and strategy development; during this period he doubled the size of the rental division of Elliotts.

Modernisation, improvement, innovation, and making a difference are all hall-marks of his career. In his next role for Muller Dairies, he built a £22m food processing factory in England from scratch, finding the site in Market Drayton and overseeing its construction. It also meant operating in Germany for much of the time and he became fluent in German. This helped him significantly in the next career challenge, back at Elliott Group again, where he had a significant impact on the sales of their portacabins, developing, as a brand leader, mobile phone bases which he rolled out across Germany, Switzerland and Austria.

Next, fast track Health Centres, out-patient clinics, and GP surgeries became part of his buildings expertise. As Managing Director of Manchester and Salford Lift company he delivered an £80m portfolio of 14 brand new health centres through Public Private Partnership (PPP) and Public Finance initiatives (PFI) – a difficult and challenging diplomatic job which he describes as “*An amazing experience*”. An extensive PFI operational directorship role with John Laing followed, for the construction of public buildings and works; such as hospitals, waste management works, police stations, street lighting, and railway stations, and he chaired various Boards as he took the programmes forward. Running Projects, overseeing innovation, taking risks, and seeing the results were all part of the mix that he has so much enjoyed and continues to enjoy.

He also found time to become president in 2012 of the UK branch of IESF (Ingenieurs et Scientifiques Français) and run two Parish Councils as Clerk and Responsible Finance Officer. Yet always, he was and is, solidly grounded in the principles, approaches and processes of engineering. His passion for engineering is as fresh as it ever was.

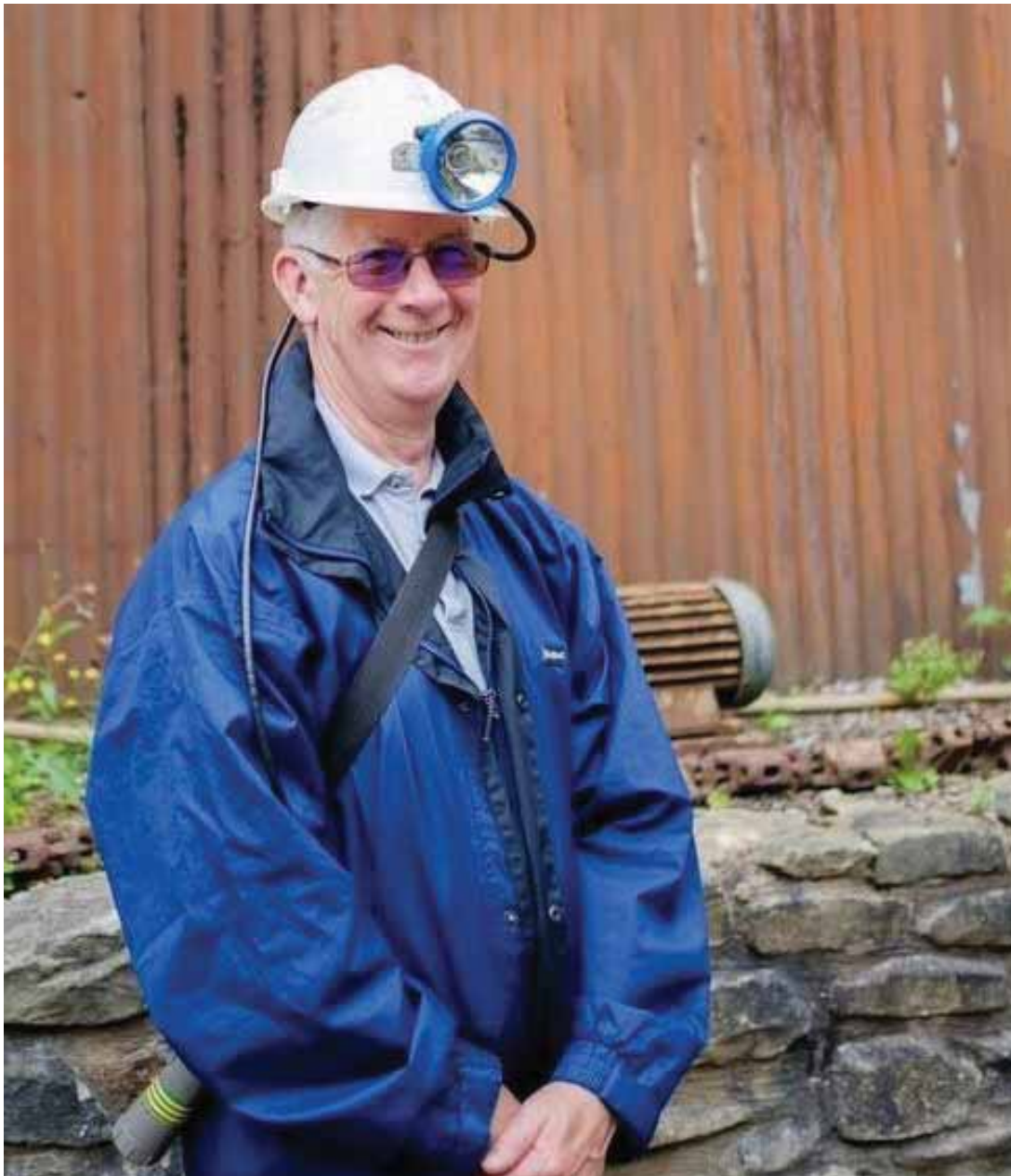
Now as Master, Richard’s theme concentrates on celebrating British Engineering and increasing public perception of what Engineers do. He seeks to raise



awareness of the Livery, secure better links with the City, and continue to explore how to encourage younger engineers' involvement with the Worshipful Company. Members of the Company are helping and supporting him. Richard reflects on comparisons with Germany where engineers have the same protected status as lawyers and doctors, and what could be learnt in the UK.

His passion is ever-present. *“Engineers”* he says, *“are enablers – they get on with things, they build things. Bright ideas come from everywhere. Encouraging their creativity; giving them the freedom to innovate; giving them their head without over- managing in an increasingly risk -averse culture, will create everywhere, the beauty that is engineering at its best”*.

Marilyn Wedgewood



Junior Warden's Lecture

Back to the Future - Part II: Infrastructure for a Changing World

Professor Gordon Masterton OBE FREng FRSE



AN ETHICAL PROLOGUE

My career has been in civil and structural engineering, not directly involved in high rise buildings but I was chairman for seven years of the Standing Committee on Structural Safety. I cannot stand up in public today without saying something of the horrific scenes we saw recently when Grenfell Tower was overcome by fire. It is not a sight I ever expected to see, nor ever want to again. I am extremely disappointed and frustrated that despite our highly regulated, supposedly risk aware systems and processes, this could still happen. Everyone remotely concerned with delivering any infrastructure, not just high-rise buildings, needs to be searching inwardly and revisiting their personal ethical principles and challenge any that get even close to compromising safety in favour of marginal cost benefits. I am not saying that is a root cause of the Grenfell Tower disaster because it is too soon for anyone to jump to conclusions. But if all engineers –

and architects and other allied professions – hold true to strong ethical principles on safety, we can at least say we did the best we possibly could to avoid this.

I was on the working party recently for a formal review of the Engineering Council/ Royal Academy of Engineering Statement of Ethical Principles, about to be launched. I am pleased that one of the bullet points states that engineers should “*hold paramount the health and safety of others and draw attention to hazards.*” The phrasing received some challenge and debate but the review group held its ground that, of all considerations, safety must be paramount and I am glad we did. Indeed, I think the Worshipful Company should consider formally adopting the new version of the entire Statement of Ethical Principles after the launch. It would align us with the professional engineering institutions who are obliged to comply. We could just choose to.



THE MALIGNED EXPERT

I titled my lecture 'Back to the Future - Part II'. It's 'Part II' because my inaugural lecture at the University of Edinburgh last December was "Back to the Future" - a title borrowed from the movie with Marty McFly, Doc Emmet Brown and the time-travelling de Lorean car. Doc Brown personifies the archetypal image of the eccentric inventor and engineer: and like it or not, image and perception are important. This is especially true now that we are told we live in a 'post-truth' society. Unsubstantiated impressions and opinions, the more extreme the better, seem to carry more weight than evidence based facts. Even some politicians have said that *experts* are to be distrusted, because their intellects, like Doc Brown's, are out of touch with the real world. (But more likely because the expert view does not match the politician's chosen dogma.)

We do need *experts*, especially *expert* engineers. We need them because they are the only way we will build a better future. The inquiry into the cause of the Grenfell Tower fire and loss of lives will need evidence-based *expert* opinion of the highest quality – not armchair “experts” only distinguished by their willingness to share their views on social media. Informed, expert views deserve a place on social media, yet rarely do they appear, leaving the field open to half-truths and obfuscation.

I chose “*Back to the Future*” as a title because it encapsulates my contention that if we are to design a better future, it needs to be informed by a deep and expert understanding of the past, as Santayana recognised when he said, 'Those who cannot remember the past, are condemned to repeat it.' (Ref. 1)

THE NEED FOR TALENT

The future of engineering depends on attracting the best talent into the profession. As engineers, we have a lot of work to do on our image - just look at Doc Brown. We do not get much help from the media, despite some excellent work being done in documentaries. But documentaries do not have as much impact on young people as drama series.

Many mid-career medical, veterinary and pathology professionals today will have been influenced in their early teens by watching ‘ER’, ‘All Creatures Great and Small’ or ‘Silent Witness’. It is the characters in drama and sit-coms that inspire children. Scriptwriters rarely write about engineers. Engineering UK has estimated that industry needs 186,000 new entrants with engineering skills annually through to 2024 (ref. 2). It's difficult to accurately forecast resource needs, but we produce nothing like that. We would greatly benefit from TV role models, so in their absence we need to work much harder to get the message to schools, teachers and parents that engineering is a wonderful career. We also need to engage properly with half the population. Having only 9% of women in the profession is an embarrassing imbalance.

To keep pace with projected growth, the world needs to invest \$3.3 trillion in economic infrastructure annually through 2030.

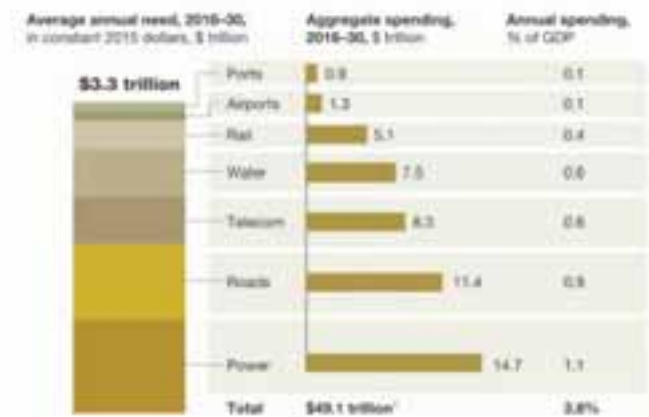


Fig. 1 (ref. 3)

Why is it important? McKinsey has estimated the world needs to spend \$3.3trillion per annum on economic infrastructure through to 2030 (Figure 1).

But we are short of engineers. So, how do we square this? Can we do more with less? Many industries have bridged that gap by improving productivity year on year - but not construction. In the US construction industry productivity has dropped 19% since 1964 and UK has flatlined (ref. 4).



THE PRODUCTIVITY GAP

How do commentators explain this? The World Economic Forum (ref. 5), citing Boston Consulting Group, believes this is due to infrastructure construction having multiple stakeholders; no mass production – every project's a prototype; fragmentation of the industry; low margin businesses; boom and bust cycles; and unstable workforce. I would have added to that - low investment in R&D, and being slow to innovate.

Construction is not integrated. There are many tiered supply chains feeding a smaller number of major delivery companies. Each of those relationships is an interface that requires management, negotiation, commercial deal making, with potential for breakdown. And mega-projects take a very long time to mature. The Crossrail project in London is the culmination of an idea that began post war.

Yet, when my old company Babbie Shaw and Morton designed the largest dry dock in the world for Harland and Wolff in Belfast in the 1970s, it was designed, built and commissioned just over 2 years from the decision to proceed, to meet an order commitment. Nowadays, that would not be enough time to do the environmental impact assessment, never mind document and negotiate the financial gateways, the risk reviews, the quality plan, the stakeholder interests, secure the planning permission. It's scarcely enough time to design and set up the document management system on the IT platform and get project controls software and reporting fully functional. Getting things done today takes much longer than it did 50 years ago. Productivity cannot have been helped by that.

The poor productivity record, the historically low investment in R&D and lack of IT agility, and the clunky processes and procedures, many of them still paper-based, show how fertile the construction industry is for disruptive technologies. Figure 2 shows that we distribute information as much as the high-tech media companies and we collaborate externally far more (ref. 6) Construction needs to be better at communication than the highest-tech industries, not lagging behind.

Exhibit 4: Information distributors



Exhibit 5: External collaboration



Fig. 2 (ref. 6)

DATA-DRIVEN INNOVATION

What might we do better? Excellence in project performance is usually measured around managing cost and time. Where is the open data kept that will allow us to abstract reference costs for estimating? Where do we look for data on similar projects that the government has already paid for? It is very difficult to find. Yet huge quantities of useful data are on excel spreadsheets in files assembled by construction managers and project controls teams that disappear when the teams disperse. It would help to be more transparent with portfolio and programme data. Public and professionals should have access to more and better performance-related information.

A bigger and better database of project forecasts and project performance, freely available as open data, would allow us to make more informed decisions on the type of project in which we should be investing. Some non-governmental organisations make data transparent and usable – the World Bank has published its independent evaluation group rankings since 2011, with data back to 2004, even though a quarter of its projects are rated as unsatisfactory (Figure 3). But national governments usually prefer not to share their bad news. It is still difficult to get



good quality, independently validated authoritative data on project performance.

Some forward looking public spenders are making more data accessible. San Jose in California for example. Accessibility encourages data-savvy analysts to develop useful tools and applications. Data can also help in streamlining execution. Project controls, risk analysis, contingency drawdown charts, all would add to the databank of evidence that we can mine for trends and regional and sectoral variations, to help us make informed decisions on improving performance. Our own National Audit Office does a good job in publishing its findings in a traditional, but transparent, way, but on a limited number of projects, and in summary form. Opening up the NAO data behind the reports, suitably anonymised if necessary, would be a valuable step forward.

Data can also help us take a longer view. Construction is simply the first phase of an asset's life. Optimising the asset's maintenance and decommissioning should be equally fertile ground for innovation.

But excessive zeal in chasing efficiency can be dangerous if that compromises the paramount ethical principle of safety. The sinking of the Petrobras P36 platform in the Atlantic Ocean off the coast of Brazil in March 2001 was a salutary reminder of the potential consequences of excessive cost cutting to the detriment of engineering safety fundamentals. Prior to the accident that killed eleven firefighters, a Petrobras executive explained and celebrated cost savings made: "the project successfully rejected prescriptive engineering, onerous quality requirements, and outdated concepts of inspection." As Ruskin may have said "There is scarcely anything in the world that some man cannot make a little worse, and sell a little more cheaply. The person who buys on price alone is this man's lawful prey."

The value of learning from such disasters is incalculable. We suffer from generational memory loss and often repeat mistakes on a 30-year cycle. We are sometimes ingenious enough to find new ways to fail. But typically, we are making the same mistakes over and over, which is plain stupid. Let us at least make sure we capture lessons learned and

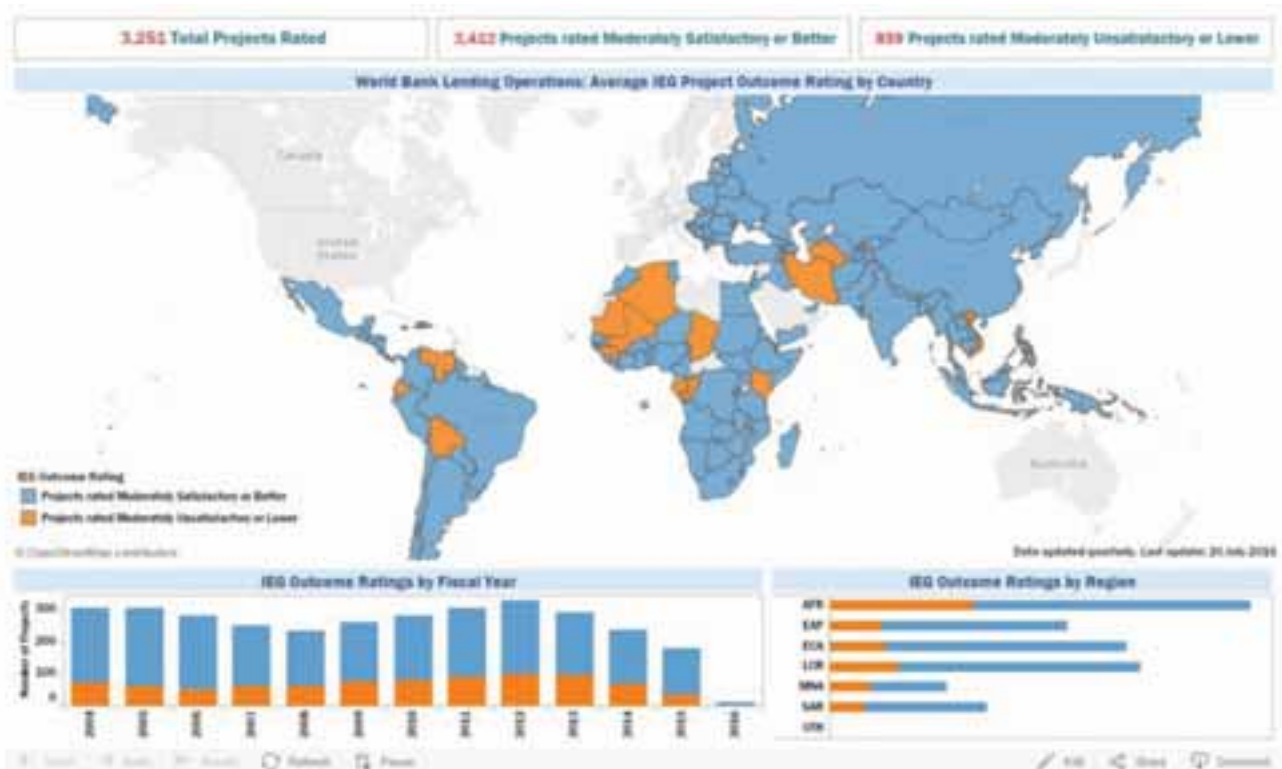


Fig. 3 (ref. 7)



remember them. A database of mistakes is at least as useful as a database of best practice.

In the UK, safety performance in the construction phase is something of which we can be modestly proud because the trend has improved (Figure 4) but we should still be ashamed that there are *any* fatalities. All of them are avoidable. We have come a long way from the days of building skyscrapers in New York when developers were asked to estimate

the number of fatalities during construction, and the working assumption was one per floor.

But the problem of delivering mega-projects safely and on time and on budget is real. We do not deliver enough of them to plan. There is plenty scope for beneficial collaboration between data analysts and engineers in project and programme management, without compromising project safety.

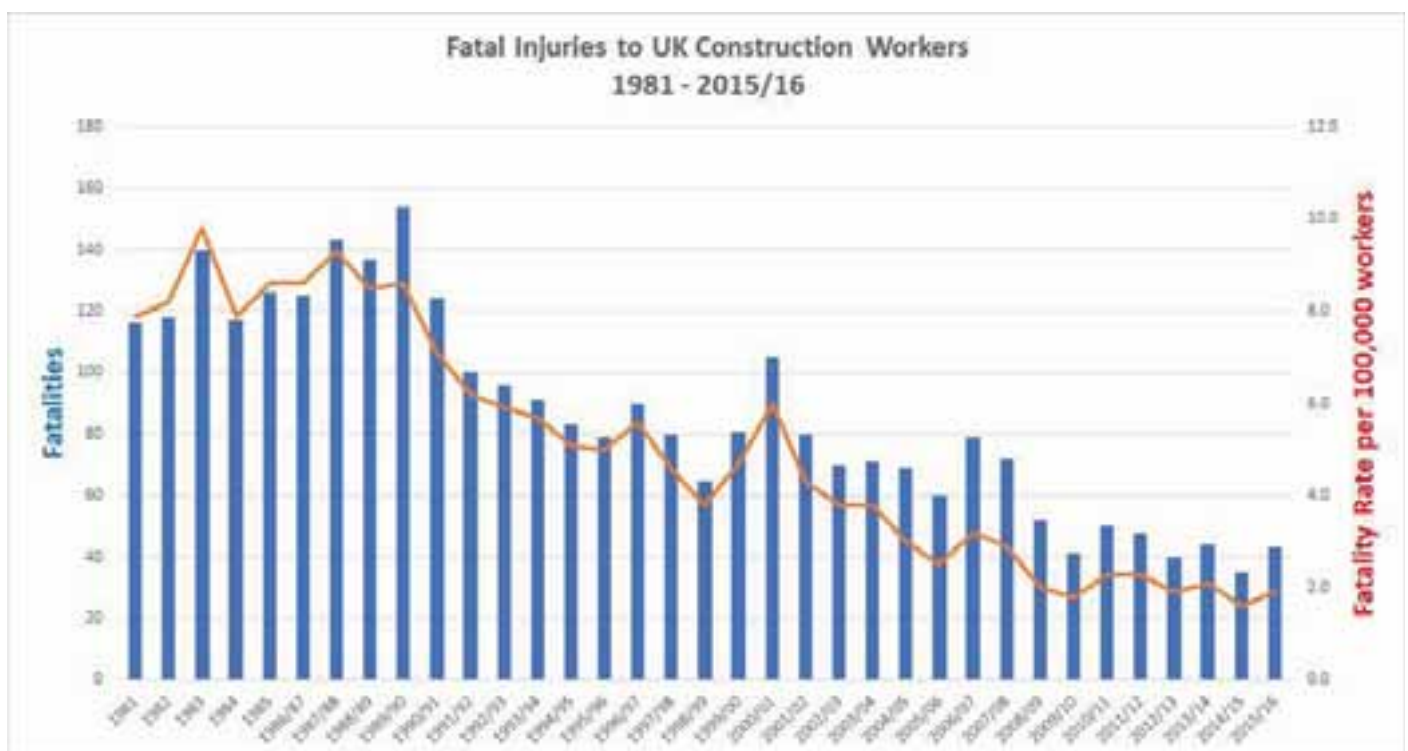


Fig. 4

PROJECT DELIVERY

I have gone on record to say that there are 12 critical strategic risks to be nurtured throughout a project: Safety; Project Governance; Contract Management; Scope; Schedule; Costs & Affordability; Procurement; Change; Systems & Engineering; Stakeholder Management; Compliance & Assurance; and Risk (ref. 8). Manage all of them well and there is a high probability of success. Fail to manage just one of them, and the project will have a high probability of failure. Ultimately, it's all about deepening the understanding of risk: awareness, identification, quantification, avoidance, insurance, mitigation and/or management.

The truly great engineers of the past had a sound appreciation of risk. My engineering hero is Thomas Telford, a mere 140 Presidents of the ICE before me, who tackled outrageously difficult projects but recognised that they were pregnant with risk and that his reputation hinged on actively managing these risks for a successful outcome.

Brunel on the other hand, much revered today, was never happier than when tackling projects that were high risk and turning them into even riskier prospects in his zeal for innovation, and his management style, often to the cost of his financial backers. Both were visionary innovators. Telford



was a risk manager. Brunel was a risk taker (but he had a tremendous talent for managing his image).

The approach to risk taken on the London Olympics project is a good example of how we should quantify the financial contingency (money set aside to deal with uncertainty and risk) and monitor and manage both in tandem (Figure 5). The most useful graph you can draw in a project is not the rate of spend, or the progress against milestones, it is the rate at which contingency is spent. The direction of travel of that graph is the one that will be the first to tell you whether the project will succeed or fail.

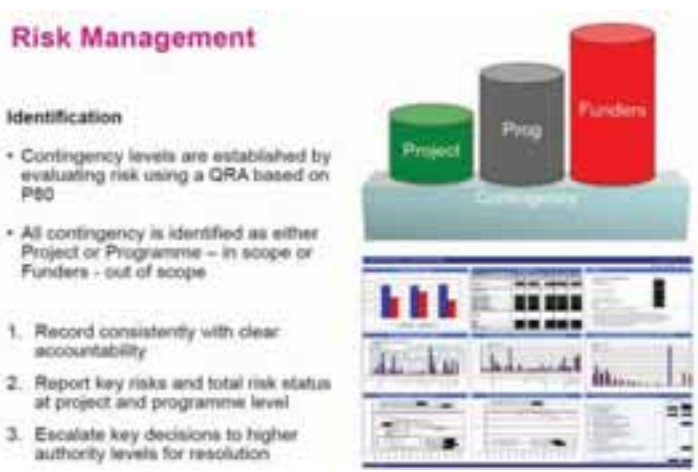


Fig. 5

The London Olympics projects did not trade off cost and safety. After an early spike, the safety performance became exemplary (Figure 6). There were no fatalities, and the engineering management of the Olympics is generally accepted to be a success story overall.

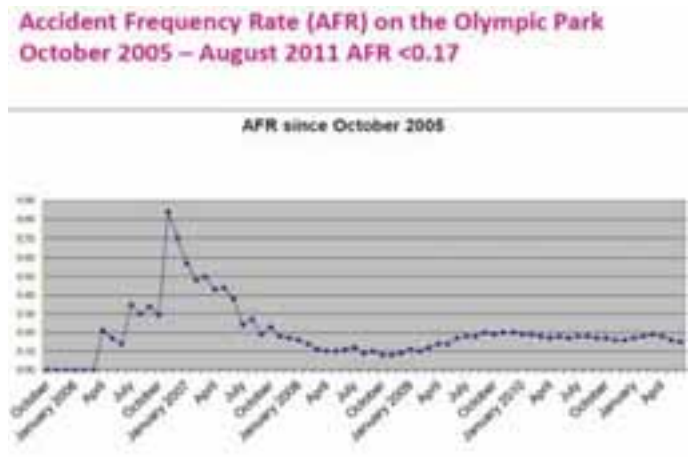


Fig. 6

INDEPENDENT PEER REVIEW

The next mega project in the UK was Crossrail, a new metro-rail route running from Reading in the west, to Shenfield and Abbey Wood in the east in 42km of tunnels constructed under central London with 40 stations, nine of them totally new. Overall affordability limit was settled at £14.8bn, although that's a P95 cost estimate (5% probability of exceeding it), so it would be rather disappointing if all of that was to be spent. But it is far better to announce a P95 figure and deliver under it, rather than a P50 figure with only a 50/50 chance of delivering. Why put politicians in a difficult position? It is far better to manage expectations. The Olympics and Crossrail (so far) have managed expectations very well.

Crossrail had a governance structure that required accountability to two masters (DfT and TfL) – not an ideal starting point – but managed through a Joint Sponsor Board supported by an independent Project Representative. In 2008, I led a Jacobs Engineering team bidding for that role, and we succeeded by fielding a group of very experienced senior *experts*. Our job was to provide oversight and assurance to our clients, independently from the Crossrail management team. We were a check and a balance in the system, providing our own view on how well Crossrail and its supply chain, peaking at 14,000 personnel, was managing the strategic risks to the programme. We were resident on the project, with full powers of access. We sat in on senior meetings, and could do deep dives into areas of concern, and we wrote independent monthly reports from a different perspective, using wider benchmarking than the delivery team. An additional benefit was that, as well as the client receiving an independent view, so did the CEO of Crossrail, and, whilst that may sometimes have been unpalatable or irritating, prompted immediate review and action. Strong project leadership is essential for success, but a robust and respected independent peer review is money well spent on a complex project, in fact any project.

Tunneling techniques have moved on since the first tunnel under the Thames, by Marc Brunel, although



the basic principle of an advancing shield with muck taken from the face remains the same. But in Brunel's time, the hazards of underwater tunneling were still being understood. After several floods, it was a heroic endeavor to complete the project. Young Isambard was almost drowned in one of the roof failures, which must have shaped his view of construction risks without, apparently, deterring his appetite for innovation.

Our modern equivalent of the Brunel tunneling shield is the tunnel boring machine (TBM). One of the burdens civil engineers must bear is being the butt of that cross-reference in yellow pages: "Boring- see civil engineers". Well there is nothing boring about the eight 7-metre diameter TBMs used on Crossrail. The key principle behind them is to maintain just enough pressure on the excavated face to match the pressure exerted historically by the soil that is removed. On the surface, there is then virtually no change to building and utilities foundations despite what's happening down below. It is a sophisticated, highly automated process.

The National Audit Office reviewed the project in 2014 (ref. 9) at about the 60% stage and I am pleased to say it they found that the independent role of the Project Representative had proved to be highly beneficial. Crossrail is not complete of course, so is still not a proven success, but no bad news seems to have emerged, although my project role ended with my retirement in 2013, so I cannot comment on recent progress.

So, infrastructure can be high-tech, sophisticated and hugely creative but seems to be not quite cool enough to attract more interest from young people. Well, maybe that is about to change.

TRANSPORT – THE BOLD, THE BRAVE AND THE RECKLESS

Despite Crossrail and HS2, perhaps conventional rail will not be the transport of the future. The University of Edinburgh student team, HYPED, has been working on competitions launched as open source ideas generation by Elon Musk, who has proposed the concept of the Hyperloop (Figure 7).



Fig. 7

Using a hybrid of MagLev/compressed air technology in vacuum-sealed tubes, average speeds of 760 mph are thought to be possible. Elon Musk does not plan to build the Hyperloop but is offering the idea to others to take the development risks. Student competitions are part of this ideas generation phase and the Edinburgh team last year travelled to Texas and came back with a trophy and are heading to SpaceX headquarters in August as the only UK team to qualify for the finals of the 2017 challenge. The idea is exciting and interesting and deserves the opportunity to develop. The images of Hyperloop show elevated tubes, but the challenge of threading a nearly straight or gently curving route through a congested country like the UK might make tunnelled tubes a better, and perhaps the only, pragmatic solution, despite the higher apparent unit rates. But with long enough lengths to be tunnelled, the unit cost of tunnelling should reduce as the market grows and responds with productivity improvements and efficiencies. The peripheral advantages of a north-south tunnelled spine would be extremely useful – think of all the utilities you could install in the service tunnels, and the pylons you could remove from the landscape; even north-south water distribution might be possible. Time will tell whether Hyperloop moves from science fiction to science fact but at least Elon Musk is pushing at the boundaries, and helping to make engineering "cool".

We should not underestimate social media as a potential source of inspiration. The image I chose



for the lecture title came from the 'Valiant' comic in July 1966, the social media of its day. It shows the 1960s conception of the Hyperloop. What foresight! At that time, work was expected to start on the Channel Tunnel in two years. In fact, it was to take another 22 years, finally being built between 1988 and 1994 -another project where deliberation and prevarication exceeded the build-time.

Figure 8 is another image from magazine culture – an elevated propeller-driven transport system. But this was not science fiction, it was George Bennie's Railplane, with a test-track built near Milngavie just north of Glasgow in 1930. Bennie thought these could reach 120 mph but without financial backers, and outright opposition to disruptive technology from the established railway, the prototype test track was finally sold for scrap in 1956.

Back further to 1847, at the height of the railway boom, Brunel built the South Devon atmospheric railway (Figure 9). This was an attempt to create a railway without powered locomotives. A slotted pipe was laid and carriages with pistons attached were conveyed by pumping air out of the pipe ahead to create a differential pressure. But the whole system was a machine, in fact it was a system of systems, and a single leak brought it to a halt. And the location of the leak was unknown -no sensors or automated fault tracking feedback in those days. Maintaining the integrity of a 34-mile-long machine susceptible to weather and rodents, who liked to nibble on the tallow coated leather that covered the

slot, proved to be impossible. (Other leading engineers, like Stephenson, had advised against it). More successful was this electrified cable aerial transportation system developed by Edinburgh's first Regius Chair of Engineering, Henry Charles Fleeming Jenkin. It was called the telpherage system and the prototype was built in Sussex in 1885, opening just a few months after Fleeming Jenkin died. Figure 10 shows both the man himself and his invention.



Fig. 8



Fig. 9



Fig. 10

THE PARADIGM SHIFT

The fatal flaw of forecasting is the difficulty of allowing for step-change disruptive technologies. Even Robert Chote, the chairman of the Office for Budget Responsibility, whose job is to forecast the economy, has said, “All forecasting is landing a jumbo jet on a postage stamp.” (Ref. I will not be doing that for infrastructure.

Figure 11 shows Schrodinger’s illustration of the quantum jump, readily analogous to achieving irreversible changes in engineering infrastructure: such as James Watt’s separate condenser; the internal combustion engine, or powered flight. Inventions where an idea acquires sufficient energy through its enthusiastic adoption that a new stable equilibrium is established, with little prospect of returning to the previous norm. Because these quantum jumps or paradigm shifts confound trend analysis, they cannot be predicted. But we must encourage them by continuing to invest in a wide

enough range of research and development that may include, somewhere, the next big idea that explodes out of the trough of today’s accepted norms and takes us into one of our divergent, rather than extrapolated, futures.

I have suggested that the construction industry and infrastructure is ripe for innovative change. The relatively immature embrace of digital solutions and informatics is, in my opinion, the most likely means of nurturing some important step-change breakthroughs. The exciting untapped areas for infrastructure applications are the cloud, mobility (the smart phone), the Internet of Things (IoT), Big Data and combinations thereof.

Large scale data storage can store vast libraries of mistakes to avoid and successes to emulate, integrated into databases of national performance, helping to reduce costs; smarter mobile devices will give better access to the bandwidth we need to access useful data, even on the job site. An IoT for infrastructure is feasible if we make more use of embedded and personal sensors; safety could be improved if workers can be detected before they move into areas that don’t match their training records. (One of the key weaknesses in infrastructure's system of systems is not the hardware or the software but the wetware failures of human fallibility). Sensors could also give real-time information on the strength of concrete, reducing the

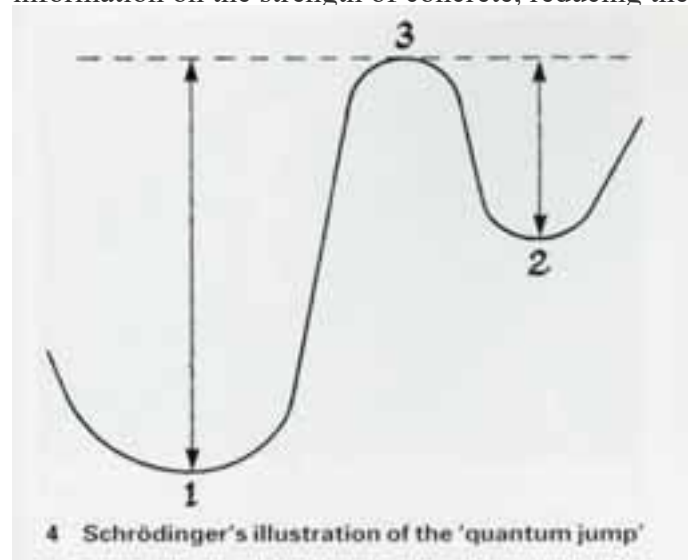


Fig 11



time to strike formwork, or to backfill against a retaining wall, etc. Efficient sequencing and scheduling is key to a successful construction project.

Although paper drawings are largely replaced by digital, many subcontracts, records, variations, change control, and payments in construction are still paper-based. How hard do we want to make it to analyse trends? Simply digitising change control could form a hugely valuable data set in a risk area that is a major source of cost overruns. Too often in construction we simply do not have the data amassed and filtered to be able to analyse root causes of problems, and therefore remedies. The necessary historical data exists, but it is inaccessible. These are just a few examples of how we need to augment intelligence with data, and vice versa.

INFRASTRUCTURE PERFORMANCE MEASUREMENT

Just as value changes with time, so will our perceptions of what success should look like. Should we be paying a lot more attention to data that measure against the Sustainable Development Goals (ref. 12) such as inclusivity? Figure 12 shows that living standards in the UK have increased since 2007 for the over-60s, but decreased for the under-30s. Should infrastructure research and development aim to do something to help address that? Ultimately, infrastructure is not an end in itself, but is a vehicle for improving societal wellbeing. Bhutan has decided that its measure of Gross National Happiness is more important than its Gross Domestic Product. (Ref. 13).

Our first PhD student in the Centre for Future Infrastructure, Henrietta Baker, is attempting to realise some of the potential of the huge volume of forensic data collected about past and present infrastructure, avoiding failures by learning from them, or near misses, and increasing the probability of successful outcomes. Henrietta’s definition of infrastructure includes people, a key component of the system of systems – a necessary component, but sometimes also a weakness. An early finding is that people dislike talking about “failure”. Elon Musk, popularising a term first coined in the 1960s, may

have solved that for us. When one of his unmanned rockets exploded he described it as a “Rapid Unscheduled Disassembly” – or, even less emotively than “failure”, - an “RUD”. I supervised six MEng students this year, which was an uplifting experience. Marcus Wright and Thomas Findlay studied how to re-define infrastructure success by using the Sustainable Development Goals and assessing infrastructure’s contribution to them. This promising approach will be written up in a paper for a conference on Next Generation Infrastructure in September this year. (Ref. 14).

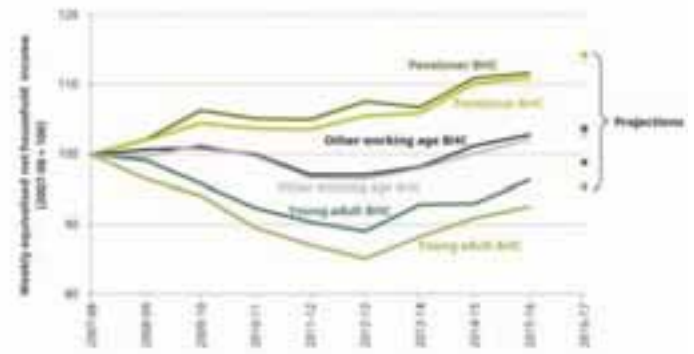


Fig. 12

Dean Shahfar and Matthew MacFarlane studied performance indicators for road transport and for walking and cycling. Cameron Bain and Jamie Thomson reviewed how successful we have been with our forecasting of infrastructure needs – and how we might improve. All produced important insights.

INFRASTRUCTURE AS A SYSTEM OF SYSTEMS

There is a growing interest in Future Infrastructure as a rich source of collaborative research and teaching opportunities, and it must be as cross-disciplinary as possible. We live in a world of multi-dimensional complexity. There are no single discipline problems – if ever there were. Infrastructure is not just a systems problem, it is a systems of systems complex web. If we lose GPS capability in a critical satellite, we will not be able to dock super-tankers safely, we will not get fuel to refineries as planned, we will constrain the distribution of fuel for transport and power, we will suffer blackouts and disruption to food supplies.



Without effective and resilient infrastructure systems of systems it has been said we are three meals away from anarchy, and if the system of systems IS dependent on one critical satellite controlling the docking of super-tankers, it would be good to know. At the moment, we do not understand many of these critical dependencies until they break, like the single fractured steel tie on the Forth Road Bridge. We saw how much that disrupted commuting, ambulance services, policing, freight logistics, and political stability.

The iconic symbol associated with engineers is the hard hat. The *smart* hard hat may be the iconic symbol for the future. A US company, Dacron, released a prototype in October 2016 with a smart visor that interacts intelligently with equipment and surroundings. If it means that workers can identify hazards, reducing injuries and saving lives, as well as gathering and logging smart data, this might well transform the construction industry. The cool look might also transform the image of the engineer. The interaction of engineering skills is getting increasingly cross-disciplinary. Is the smart hard hat civil engineering, or electronic, or computing, or quality, or project management? There are at least five engineering institutions with some sort of interest in its success. Is our engineering institutional structure fit for purpose to deal with this, never mind multi-disciplinary projects like Crossrail or HS2? But that's a different topic, for which the recent Uff review (ref. 16) is required reading.

BACK TO THE FUTURE

In this lecture, I have looked back at attempts by others to influence or anticipate the future. The future cannot be foreseen by trend extrapolation. All we can confidently forecast is that it will be different. We have a duty to try to make our infrastructure as safe, functional, flexible and adaptable as it can be.

Engineers are not politicians but I believe we should also strive to eliminate humanitarian inequalities where they exist. Access to infrastructure should be a basic human right. If engineers can meet the demand for improved access to better quality

infrastructure, the likelihood of conflict should decrease. Some have said the next global conflict may be about access to water. It does not need to be.

Infrastructure is a critical component of our happiness and well-being, and critical to our attempts to reduce carbon emissions, conserve resources, and create a sustainable future. It is also an essential means of bridging inequalities, improving inclusivity and therefore defusing potential sources of conflict. Engineers of all disciplines, not working alone but with others, must find better ways to design infrastructure tailored to societal wellbeing, by measuring performance holistically, and studying past successes and failures, progressively assembling the infrastructure data-banks to inform better decision-making.

We need to turn hindsight into insight, and turn insight into foresight. We need to look back to the future.

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COMMON HALL AND INSTALLATION DINNER AT HABERDASHERS' HALL



25 April 2017

The Court Room at the Haberdasher's Hall was 'standing room' only for Common Hall and the handover of the office of Master from Isobel Hulf-Pollock to Richard Groome.

Reproduced below are the speeches of the outgoing Master to the incoming Master and that of the new Master.

Master 2016-2017 Isobel Hulf-Pollock

You will all be aware that there was a fire in the basement at Wax Chandlers on 11th April 2017. Many things have happened since then.

Today, we are in clean, smoke free gowns, but without our silverware which is still away from cleaning and tonight we will use the silver from the Haberdashers.

Our Clerk Caroline and Sandra have worked tirelessly to recover from this incident and get the office re-located to Ironmongers where the staff have been most helpful.

And they have been doing that whilst also preparing for the Court meeting, this AGM meeting, the Installation dinner to follow and the Brooch lunch tomorrow. My sincere thanks to both of them. The Master carries out the responsibilities of being Master in many different ways. The principle characteristic is that of stewardship. i.e. you must endeavour to hand over the Company to your successor in at least as good shape as you found it. I will leave you all to assess the verdict on that.

I have built on the strategy as defined by PM Chris Price and PM John Baxter, converting their thoughts into an action plan.

In some areas, there has been progress, and in other areas there is more work to be done.

Our Finances are strong but needs stabilising after the transition from SAGE to Quick Books and you



will hear more about finance in the Honorary Treasurers report.

Membership is stable. We have welcomed and clothed more new members during my year than normal, but we would like even more new members to achieve our target.

We held a new member event in February which had very positive feedback from those attending.

The new 3-fold leaflet which is available to you tonight, was created for this event and has proved to be a useful marketing tool thereafter.

Our committees have worked well to support all the activities of our Company and thanks to the response to our call for new volunteers, next year's committees will have 17 new faces spread across each of the committees. This will create a strong pipeline of new talent and refresh our ideas for the future.

We have had a lively programme of events with excellent attendance, and some oversubscribed.



And together we have explored my theme, “Engineering Across Time: Past, Present and Future”. Together, for example, we have visited the past at HMS Warrior 1860 where I am a Trustee, seen the present at Sheffield Assay office and seen the future on visits to Merseyside, Crossrail and the tunnel boring machines for the Northern line. These machines have been called Amy after aviator Amy Johnson and Helen after astronaut Helen Sharman.

Together we have travelled on trains, on coaches, taken off and landed at Heathrow on BA simulators.

Together we have walked, according to my fitbit, over 25,000 steps per time, along the canal in Derbyshire, then from Tower Bridge to Greenwich and around all the Livery Halls of London.

You may not realise it, but our events have taken us to 4 UK World heritage sites this year.

Have I had a good year? Most certainly.

I have been the proud ambassador of our Company and have had the honour of representing you on many occasions including 3 occasions this year in the presence of HRH Princess Anne – at the RAE awards dinner, the WISE awards dinner, and at the annual meeting of RedR.

I have actively supported the Mayoralty and the City of London at many events including a late evening at the Old Bailey with the Sheriffs.

I have enjoyed dinners at HMS Victory, HQS Wellington, Mansion House, Guildhall, and the Livery Halls of the Mercers, Drapers, Pewterers, Grocers, Stationers, Skinners, Plaisterers, Clothworkers, Haberdashers, Merchant Taylors, Old Bailey, Farmers & Fletchers and of course the Hall we shared with the Wax Chandlers.

I have been hosted by Scientific Instrument Makers, Playing Card Makers, Fan Makers, Horners, Upholders, Musicians, Farmers, Cutlers, often in the company of many other Masters and the Lord Mayor & the Sheriffs.

I have dined with World Traders, Blacksmiths, Pewterers, Skinners, Plaisterers, Framework Knitters, Plumbers, Paviers, Tin Plate workers, Coachmakers, Master Mariners, Chartered Architects, Constructors, Firefighters, to name but a few of the Livery Companies.

It has been a momentous year of change – both inside and outside the Company:

A change of Clerk, a change of office, a change of accounts system, together with the launch of WebOffice, Microsoft 365 and a cloud based system for files, and many other smaller changes.

Externally, there has been Brexit and now the snap election called for 8th June. We have even had a coal free day.

More important and personal to me, is the Government’s Green paper about the UK Industrial strategy which was then followed by the release of the UK Measurement Strategy which I had been working on for some time.

It took place at the NPL northern hub in Huddersfield which we visited on my OOT to Yorkshire.

Measurement – you now realise measurement is everywhere – which was also highlighted on our most recent visit to Renishaw organised by IPM Pat O’Reilly – Pat, I can call you IPM for just a short time longer.

Robin was very proud when I was appointed OBE in 2015. During this year, I have received some special awards in further recognition of my contribution to engineering. Firstly I was honoured with an Honorary Doctorate from the University of Leeds. Secondly, I was named as one of the Top 50 female engineers by the Daily Telegraph. Thirdly, the IET made me an Honorary Fellow of the Institution of Engineering Technology. What will next year bring?

Who knows?

I look forward to being IPM and working with advice from Fellow Liverymen and past Lord Mayor,



Sir Michael Bear, to consider how we can work more closely with the City in promoting engineering.

By co-incidence, 2018 is designated the Year of the Engineer and 2018 is the 100th anniversary of the RAF – 2 great opportunities to promote engineering and tie into the next Lord Mayor's theme of "Building London as today's most trusted City".

Thank you all for making this a very special year for me. As the famous song from Carousel says: You'll never walk alone...and I have not - thanks to all your help and support this year.

I will miss the regular interaction with my Wardens who have been tremendous in their support, their dedication, their ideas, and their actions. We have had a great time together, as well as the constant flow of emails and reports, plans, ideas and discussions.

They, together with the support from Christine, Janet, Marilyn and Linda have ensured that the Ladies programme of events has continued as before.

I included thanks to many others in the written report – most sincerely, thank you all.

And specifically a huge thank you to my family represented here tonight by my sister Karen and husband Peter. They have both constantly supported me throughout and we look forward to being together again this coming weekend in Northern Ireland celebrating a significant family birthday.

When I was installed last year, I commented that I was following in the footsteps of giants. Now I am coming perilously close to becoming the Immediate Past Master.

As I hand over to Richard, please be assured that I will be there to support you in the exciting year ahead in my next new role as Immediate Past Master. And what with Past President title, that's now two Past It's to my name.

I'm very proud to have been the first lady Master of the Worshipful Company of Engineers.

Thank you for that huge privilege and honour.



The 'handover' from Isobel Polluck-Hulf to Richard Groome who had just been clothed as the new Master

Master 2017-2018

It is a huge privilege and honour to be standing here as the new Master of the Worshipful Company of Engineers and I thank you most sincerely for my election.

When you take on this prestigious role, you stand on the shoulders of giants, and I refer of course to the Past Masters. Because I have been in the Company for 27 years (being just 39 when I became a Liveryman), I can honestly say that I knew or know all the previous Masters either to speak to or as good friends, right back to our Founder Master Peter Gadsden, who was a Shropshire friend as well as in London. These gentlemen, and now a lady, have never been slow in giving advice, even when they were not asked for it!

I take over the Company at a time of significant challenge for UK engineering, with our achievements continuing to amaze (and you will hear about Crossrail for instance, later), but our profile in the UK psyche being arguably the lowest for a long time. The recently published Uff Report



The 'new team' front row l to r, Gordon Masterton, Barry Brooks, David Johnson and Richard Groome supported by a back row of Past Masters, l to r, John Robinson, Graham Skinner, John Baxter, Pat O'Reilly and Isobel Polluck-Hulf

indicates that our professional engineering institutions do not appear to be serving the best interests of the profession, and do not always work coherently with the Royal Academy and other stakeholders.

We have made significant progress in STEM initiatives and are slowly increasing apprenticeships once more, but our education of future engineers is a long way away from the system required by a 21st century technology based UK. I have worked in Germany, where the Technical training is much more focussed, and engineers are held in the same esteem as doctors; and I have also seen the French Engineering system where one body is the overarching control organisation for all engineers and scientists. As we hurtle towards the brave new world of Brexit, we need to think much more proactively about where we are going as engineers. We also have 2018 designated as the Year of the Engineer, and at present, little has been proposed to celebrate this.

So I intend to have a theme which celebrates British engineering and increases public perception of what we do. Very much part of that is to increase our profile in the City of London, and we have already started discussions on how that might be achieved. To give you a flavour of the year ahead, we will be visiting the awesome production lines at Rolls Royce Aero Engines in Derby, and the world

leading hospital infrastructure systems company Static Systems (started by Past Master Lawrence Turner). We will be viewing the latest engineering training offered by the RAF at Cosford, and then celebrating that organisations' centenary with a significant City reception and STEM exhibition next March. The world leading Graphene Institute in Manchester is on our list, and several heritage visits including the reopening of Howells School Main Hall near Cardiff and the Victorian Swimming baths in that northern powerhouse again, Manchester, where our OOT will be based.

Once again, we have pure social events such as the Hampton in Arden dinner organised by Penny Taylor.

And, just to keep an eye on your health and well-being, Audrey Canning has three walks planned in the next twelve months.

I have to thank all the individuals associated with these events for their meticulous planning (well they are engineers after all) and their dedication, all in their own time.

I am also acutely aware and hugely grateful for the support given by the Wardens, now joined by Prof Gordon Masterton who recently completed the Haynes Workshop Manual for the Engineers Company, a riveting read if you have not seen it yet.



We also have a brand new team in the Office, our Clerk Caroline and our Executive Assistant Sandra, who have dealt with a number of weak areas and are now pushing us forward. A significant recent challenge was the fire in Wax Chandlers Hall which forced them to activate a disaster recovery plan. As engineers, we have written these and operated them, but I am embarrassed to report that this Company did not have one! Our team sprung into action and had us established in a new base within a week; I am hugely respectful and grateful to Caroline and Sandra for the extreme effort they put in to achieve this.

Our new base is at the prestigious Ironmongers Hall and I am pleased to report that, at the Court meeting earlier, the decision was taken (as our lease at Wax Chandlers is nearly finished) to move there more permanently and achieve useful cost savings in the process. This elegant solution has been put together again by our new executive team.

Two other key supporters are the Hon Treasurer PM John Banyard, and our Chaplain, Peter Hartley. Thanks to you both for your contributions. Many of you here also serve on our committees, and without your contributions we could not function. Those of you that have not had this experience, I urge you to try it, your Company needs you!

And of course, my greatest supporter here tonight is my wife, without whom none of this would have been possible. During the year ahead we will be celebrating our 40th Wedding Anniversary, and I have to say that anyone who has put up with me for 40 years deserves a medal!

Finally, I need to pay tribute to our first Lady Master Isobel, who has completed a meticulously planned and highly successful year despite losing her dear husband Robin right at the start. Robin has been with us in spirit throughout, particularly at events like Watermans' Hall. Through Isobel, I have learnt the importance of back up plans, and I have seen her strength and fortitude; she is a significant act to follow.

On behalf of the Company Isobel, a huge thank you for a well planned and eventful year, and a tribute to our first Lady Master.

The guest speaker was Sir Terry Morgan, Chairman of Crossrail since 2009 , who outlined some of the reasons for the success of the project including the apprenticeship scheme that has provided opportunities for over 700 young persons on the project.





Reception before Common Hall in the Haberdasher's Hall



'Between' toasts after the Installation Dinner at Haberdasher's Hall

ELECTION OF SHERRIFFS

26 JUNE 2017



Together with the Master a select group of Liverymen joined many others from other Livery Companies at the Election of Sheriffs at Common Hall in Guildhall at noon on Monday 26th June – by tradition on Midsummer’s Day.

elected Bridgemasters. Ale Conners (including Dr Christine Rigden of the Worshipful Company of Constructors) and auditors were also elected.

Timothy Hailes (a lawyer, Alderman and member of the Worshipful Company of Merchant Bankers) and Neil Redcliffe (an accountant and member of the Worshipful Company of Basketmakers) were elected Sherriffs. Peter Bennett (a member of the Worshipful Company of Chartered Surveyors) and Martin Howard (a Freeman) were

Afterwards we repaired to Stationers’ Hall for drinks in the garden followed by an excellent lunch.

Peter Blair-Fish



AWARDS CEREMONY AND DINNER AT THE ROYAL COLLEGE OF PHYSICIANS

ATTENDED BY HRH THE PRINCESS ROYAL



Master Engineer Richard Groome addressed the attendees.

Your Royal Highness, Vice Lord Lieutenant, Masters, Wardens, Liverymen and guests, welcome again to our Annual Awards Dinner which I hope you enjoyed as much as I did. This event would not be possible without the support and expertise of the Engineers Trust, which is now managing charitable funds of just under £2m, and I would like to personally thank both the Past and Current Chairs, John Robinson and John Baxter, for their considerable input. I also need to recognise and thank the Trustees, and the Award Coordinators, for their voluntary efforts. It is also important that we recognise our links to the Royal Academy, the Professional Engineering Institutions, the Engineering Council, Women's Engineering Society and our other partners, and thank them for their valued involvement. I have been in the Livery for some 28 years now, and in terms of our influence extending and our name being better known, this is the best that I have seen. I am sure this will continue to go from strength to strength.

I am delighted to welcome our principal guest tonight, Her Royal Highness The Princess Royal, although 'guest' is a slight misnomer as she is a Liveryman of this Company. She is well known for her charitable works and serves as a patron of more than 200 organisations, as well as undertaking a huge workload as a senior member of the Royal Family. She is also a competitive equestrian, having won many medals, and is currently working on

equine therapy for physically and mentally handicapped patients. Since 1988, she has been a member of the International Olympic Committee and is president of the British Olympic Association.

The other most important guests here tonight are our Award Winners, with your sponsors. I am sure I speak for everyone here when I say that we have been amazed and delighted by your achievements, which bode really well for the future of engineering: well done, all of you.

Our other prestigious guests here tonight include six Masters of the following Livery Companies and the Prime Warden of the Shipwrights, Armourers & Brasiers, Carmen, Fuellers, Lightmongers, Information Technologists and Security Professionals, two Past Masters of the Livery Company of Wales and senior representatives from the military.

My personal guests here tonight include the world-wide adventurers, the extended Sadd family, international infrastructure financier Andrew Charlesworth with his wife Nina, Rolls Royce senior executive Christine Cox with her mother Rosemary, who are also charity workers in Africa, Past Master Constructor David Hattersley with his wife Betty and other friends from Ingenieurs et Scientifiques de France.

You are all most welcome.



Finally some very special thank yous. Our hosts and caterers tonight have done a sterling job, and we also would like to recognise the complex musical requirements placed on our band, who did really well.

We were delighted to see the Honour Guard of Air Cadets to welcome us, this is a new idea suggested by the Clerk, which I have seen at other Livery Companies and I am sure you will agree that it added to the evening. Those of you who spoke to the young cadets, thank you, this is a very good STEM initiative which will plant the seeds of engineering into these fertile brains.

You will also notice that as well as sporting his new hat, our Beadle has been undertaking some binary fission, as there were two of them here tonight; Peter and Alan, many thanks, you were an essential part of this evening.

This complicated and important event was largely put together by our Learned Clerk, Caroline, and her Executive Assistant Sandra, who have my huge thanks and admiration for a job well done. They were ably assisted by no less than two Clerks on reception, who incidentally are both Past Masters from fellow livery companies.

I now ask the members of the Worshipful Company of Engineers to rise and Toast, 'Our Guests'.

—o0o—

HRH The Princess Royal responded on behalf of the guests to the Master Engineer's toast and in doing so spoke with real enthusiasm of the achievements of engineering and in particular the award winner's achievements.

She emphasised the need for mentoring and supporting young engineers which she explained was an important role of the Engineer's Company which it takes very seriously.

A personal impression - 'Celebrating inspiring young engineers'

What an impressive evening! The Engineers (as usual) put on a fantastic event – good venue, great food and entertainment, impeccable organisation, and a stellar guest... I was very impressed... but what impressed me even more was to hear the citations and see the award recipients. By the end of the ceremony the front two rows of the Royal College of Physicians auditorium were filled with an inspiring array of our current and future engineering talent. It was great to see a good mix of commercial engineers and services engineers, men and women, school pupils, undergraduates, post graduates and those in the early stages of their careers. Her Royal Highness The Princess Royal added further to the recognition of the talent before us by presenting the prizes personally (the awards had been billed as being 'in her presence'), and by delivering a moving and very well researched speech after dinner.

Dinner was very convivial and my wife and our guests visiting from Australia really enjoyed the evening. I was lucky enough to be seated next to an Arkwright Scholar, Nicholas Roberts – an enthusiastic prospective engineer studying at Highgate School. Nicholas told me how he was being mentored through the Engineers and had been able to visit his mentor's engineering organisation – something that I would have loved to have had the opportunity to do at the same stage in my education!

Over the years I have given ad hoc donations to the Engineer's Trust and for the last few years I have made a monthly direct debit donation without too much thought about the impact that the Trust has on young engineers. I left the dinner with a very clear insight into the valuable contribution the Trust makes and I felt very proud to be a member of the Worshipful Company of Engineers.

Björn Conway

Editor's note: a full list of the prize winners and a description of the prizes are set out in the Addendum.

LADIES BROOCH LUNCH

26 April 2017



The Brooch Lunch took place this year on Wednesday 26th April. It is always a very special event in the Worshipful Company of Engineers' calendar, but this year it was particularly special as it was the very first event in the Engineers' new home, The Ironmongers' Hall.

The lunch was hosted by Past Master Professor Isobel Pollock-Hulf, who welcomed 15 Past Masters' Ladies, and also Mrs Fiona Hartley, wife of the Chaplain, Dr Marilyn Wedgwood-Johnson, the First Wardens Lady, and Mrs Linda Brooks, the Middle Wardens Lady. And of course there was a very special welcome to Mrs Janet Groome, whose husband Richard had the previous evening been installed as the Master Engineer.

As guests assembled, we were given a glass of 'bubbles', which we enjoyed in the very grand hallway of the Ironmongers' Hall. Lunch was then served upstairs in the elegant, oak panelled Drawing Room.

proceedings commenced. Past Master Isobel Pollock-Hulf welcomed everyone and gave a brief overview of the highlights of her very successful year. She then presented Janet with the Master's Lady's Brooch, which she will wear throughout her year. Becoming custodian of the brooch is always a daunting responsibility, as all past master's ladies will testify! Janet then spoke about how proud she was that Richard had become the Master Engineer, particularly as Richard's father had also been a liveryman and he would have been extremely proud to see his son installed as Master.



L to R. Margaret Baxter and Doreen Robinson

The first event in the Ironmonger's Hall had been a great success, and everyone wished Richard and Janet all the very best for their year.

Margaret Baxter



As always, we enjoyed a delicious menu which consisted of tea smoked beetroot and mozzarella, followed by fillet of sea bream and then a dessert of mascarpone flavoured with vanilla. Coffee and chocolates were served and the slightly more formal



L to R. Jeanette Roche and Fiona Hartley

ALMONER'S REPORT & LUNCHEON AT THE RAF CLUB



5 May 2017

The Chaplain and Almoner have been now been working together for three years and have been proactive in identifying, specifying and implementing a strategy, which resulted in the formation of the Almoner's Group. A progress statement and summary document was presented to the F&GP Committee in February and to the Court in March. The way forward for the forthcoming years was discussed and particularly the need for lower cost events was identified.

The almoner's group is flourishing and the network of interested members has grown. The Almoner's Lunch held at the RAF Club is now firmly established in the events calendar and this year's Almoner's Lunch took place on the 5 of May. Once again we were made extremely welcome, with an opportunity for old friends and new to meet informally and enjoy the hospitality provided us at this excellent venue.



At the RAF Club. Left to right: Mrs Rita Hanford, Mrs Elizabeth Monk, Mrs Margaret Lines, Mrs Hilary Mitchell, Mrs Doris Mills

The lunch has now been widened to include all widows, widowers, partners of Liverymen and friends who could benefit from the Almoner's activities. Any person from families feeling that they could benefit from this activity are very welcome.

To widen the possibility of low cost events, both Ruth Cousins and Rita Hanworth from the Almoner's Group have taken the initiative to widen the Almoner's social activities for widows and widowers, by writing to all those on the Almoner's database. For other members who would also benefit from this kind of activity, the following ideas have been identified to be able to keep in touch throughout the year.

This group could meet to have lunch and enjoy a visit to an exhibition or garden, Museums or Art galleries, a concert, a play, an opera, a walk along the river, in one of the parks or garden. In fact we are keen to support activities that might be of interest and be more enjoyable if done with others.

Current Almoners activities and benefits include:

- Almoner's Annual lunch – at the RAF Club
- List of company functions, which can be applied for from the office
 - The Ladies Lunch
 - Out of Town meeting or an opportunity to attend part of the weekend
 - Mini Out of Town dining and social gatherings
 - Carol Service (4 spaces reserved). Available to book late autumn.
- Receipt of a copy of the Swordsman

The Almoner's committee and office are keen to communicate with people who have lost contact, or would benefit from some respite activity. This means that we need to keep the Almoner's Database up to date, so anyone interested in the activities of the Almoner's Group should write, e-mail or telephone either the Office, the Almoner or the Chaplain and make sure that your address and contact information is current. Please do not hesitate to make contact.

Barry Gasper Hon. Almoner

VISIT TO STATIC SYSTEMS GROUP LTD WOMBOURNE, WOLVERHAMPTON



On an unusually hot day, 25 May, Past Master Lawrence Turner welcomed over 20 engineers and their partners to the premises of Static Systems Group PLC ('SSG'). This was not the first visit to SSG, the first having been 10 years earlier as Lawrence reminded us.



Phil Wade, who is the director of marketing, explained that SSG was founded by Lawrence in his bedroom in 1964 and has grown as a family business to over 200 employees including his two sons, Adrian and Chris who are engaged full time in the management of the business.

The business started with the design and manufacture of a nurse call system which replaced a patient's need to shout down the ward to catch the attention of a nurse ! The nurse call system was a welcome improvement to a patient's 'hospital experience'. The nurse call system is still the backbone of the business but it has also branched out into fire and security alarms.

The growth and longevity of the SSG is based on the fundamental principles laid down by Lawrence at the outset which are:

1. investment in technology and R&D;
2. the offering of apprenticeships and care for an employee's career development;
3. organic growth;

Phil Wade was proof of the principles in action having started as an apprentice and completed over 40 years of service in various roles culminating in his current role as director of marketing.

SSG has adopted and adapted new technology and pioneered the introduction of solid state devices such as the thyristor, otherwise known as a "static switch" hence the company's first trading name Static Switching. The timeline of innovations has included time division multiplexing in 1985 which reduced wiring and equipment. Software improved and enabled features such as call logging, paging and flexible transfer of calls between wards, so important for night shifts. The introduction of LonWorks and IP protocols meant that central programming was possible and made maintenance easier.

As well as technical innovation and advances the need to consider infection control has also driven innovation in the design of handsets and other equipment that SSG manufacture.

SSG is a good example of the success that comes from sticking to its principles and adopting new technology to ensure that its products retain their leading position.

After a tour of the works the Master thanked Lawrence for his hospitality and presented him with a Stirling engine and his pleasure was clearly evident from the broad smile and fascination with the engine's action.

Raymond Joyce



RAMBLING REPORTS

The Chilterns and the Forest of Dean



Gateway to the Chilterns: Saturday 6th May

The 5th Livery Walk was a bluebell experience! Walking from the Ashridge National Trust Centre with our NT Ranger we proceeded to the Bridgewater Monument built in memory of the originator of British Inland Navigation for an introductory talk.

Ashridge is the largest nationally owned woodland (over 5,000 acres), founded originally as a deer park in the 13th Century, became a Monastery in 1283, then, following the Dissolution passed to the King, and then to the Egerton family, a park landscaped by Capability Brown, several iron age Burrows and a stately mansion decorated by Rene Courtauld.

Onward to Clinkmere Pond, engineered with layered flint, clay and straw we learned that ponds were often created on County boundaries, in this case between Hertfordshire and Buckinghamshire. We stopped to explore the wonders of the living world – tree sap stolen by squirrels, oak gourds formed by parasitic wasps. We learnt about the

effects of using the common for tank training. And then we saw bluebells; bluebells carpeting the forest; bluebells as far as the eye could see.

We learnt the differences between Spanish, English and (hardy) Hybrid bluebells. We learnt why and where they grow. We learnt about the human effects on their territory.

The strollers returned to their cars, the slower amongst us took a short cut, but the joggers continued an additional mile to our planned destination – the top of Ivinghoe Beacon. The photographs give some idea of the views to be had.

On the walk back we viewed the Old Windmill and the newly founded wild life sanctuary. We admired Incombe Hole and discussed how it was formed. We observed the wildflowers and their dependence on farming methods.

We finished with a delicious lunch at the Greyhound pub and said our goodbyes.

Audrey Canning and Peter Chapman



The Bridgewater memorial and ramblers



At the top of Ivinghoe Beacon



The bluebell walk.

Forest of Dean Heritage Centre and Hopewell Mines: Saturday 29th July

Our 6th livery walk turned into an impromptu MOOT! It started on Friday evening, dining and staying at the Speech House.

The Verderer's Court within the Speech House, was established as early as 1338 to govern the Forest on behalf of the King. The Speech House dates to 1669, when representations to the Treasury were made to facilitate ‘*the keeping and holding of forest courts for the preservation of vert and venison*’. The Court still convenes every 40 days, though at other times (as we discovered) the Court Room houses a 1st class restaurant.

On Saturday morning some of us opted for a guided Forest walk or alternatively a self-guided sculpture tour. We joined forces lunch and afterwards visited one of the last three commercial Freeminers coal mines then continued by way of a ‘Mad Hatters Dinner Party’ back at the Speech House, before goodbyes on Sunday morning.

On the guided walk starting from the Dean Heritage Centre on Saturday we passed through some of the most industrialised parts of the Forest. We walked through landscapes formed by huge earthworks associated with quarrying sand, red ochre and iron ore, coal mining, heaps of waste from brickworks, as well as forestry and charcoal burning. We traversed abandoned railway lines,



The Speech House



The Verderer's Court



walked beside intricately engineered water conduits (preventing flooding of the underground workings) and inspected damage caused by wild boar.

We encountered sculptures of almost unimaginable depravity, showing children as beasts of burden. Thankfully in 1842 all women and children under 10 were banned from working underground.

We learnt about laws to protect the rights of miners born within the Forest boundaries, originally granted by Edward I and reaffirmed (most recently in 1838) in recognition of their service to the Crown in battle for undermining fortifications, creating earthworks and installing timber defences. Nationalisation of the coal industry in 1946 specifically exempted the Forest in recognition of its unique history and land holding arrangements. Statutory regulations in 2010 recognised that women too may hold freemining rights.

At the Hopewell Mines we learnt about the unique ‘bowl shaped’ geology of the



Sculpture of a boy as a ‘beast of burden’

Forest, thus allowing each strata to be accessed from the surface and removing the need for deep mining. This geological feature is also responsible for the lack of methane – ensuring that





the smallest member of our team (the Middle Warden's lady) was not in the unenviable position of the "sacrificial canary". However, we remained at risk from "black damp" – the result of atmospheric changes flooding the floor of the mine with carbon dioxide.

We learnt that timber is the preferred support material, due to the early warning given by its visible deformation before failure. At the coal face we were shown how to "work" a coal seam in no more than a 2 x 4 ft. cavern, lying on one's side whilst wielding heavy tools. First an undercut is made to remove pressure, followed by use of a

mattock (a short handled pick with two very sharp pointed ends) to dislodge high quality coal. As the seam is progressed, the importance of backfill was emphasised, never leaving more than a 6ft unsupported surface. Finally, the golden rule....never obstruct the retreat of a working miner.

We had a truly educational, energetic and epicurean weekend. Our thanks go to Sue Hewerdine and Windsor Coles for introducing us to our industrial heritage in a remarkable 'natural' landscape.

Audrey Canning and Sue Hewerdine



Windsor Coles very much at home underground!

CARDIFF WITH WELSH LIVERY COMPANY - 'MINI' OUT OF TOWN



23-25 June 2017

The Master Engineer created an eclectic programme of events for The Mini-Out of Town Visit to Cardiff, 23 – 25 July 2017.

The event attracted a score of Company Engineers, accompanying persons and guests.

We were privileged to partake of a Livery Supper (with a Welsh theme) in the Great Hall of Howell's School. The evening was in the company of members and guests of The Worshipful Company of Wales and Howells School. This shared evening was a most enjoyable experience.

The Great Hall had recently been restored to its former glory and the work was explained by the Conservator Architect – Mr Richard Davies. At dinner we were entertained by the Cambrian Choir (renowned for its innovative and varied repertoire), *The Singer* (who sang a wide range of songs from arias to folk) and Sejal Bhatt (who performed some amazing classical Indian Dance). Jessica Robinson had been due to sing to us but was taken ill on the morning and *The Singer* was called at short notice to take her place.



Saturday morning was lecture time. But what a lecture! It was given by Professor Roger Falconer of Cardiff University, known locally as "The Barrage Man". He spoke about Tidal Energy in the Seven Estuary with great enthusiasm. He drew our attention to another footprint other than the well-known Carbon Footprint – the Water Footprint. Did you know it takes some 200 litres of water for you

to enjoy one cup of coffee? And 2000 litres for a pound of beef.

Then we went to prison and escaped! Lunch was in "The Clink" a restaurant run by the local prison, where some inmates are studying for NVQs in hospitality. A super repast and an excellent project to support.



Then to the Opera – no time to rest. This was *Die Federmaus* by Johann Strauss. The event was held at the Welsh Millennium Centre. An extra pleasure for us was the presence of HRH Prince Charles (Honorary Royal Freeman of The Worshipful Livery Company of Wales), who was making an informal attendance.

A short YouTube video of the highlights can be seen at:

https://www.youtube.com/watch?v=Q_4VDEnlxE0

Gina Barney





The following article was written by Windsor Coles on behalf of the Welsh Livery Guild.

A WELL ENGINEERED WELSH LIVERY EXPERIENCE IN THE GREAT HALL OF HOWELL'S SCHOOL, LLANDAFF, CARDIFF

To mark the occasion of the re-opening of the Great Hall at Howell's School, the Worshipful Livery Company of Wales welcomed the Master and Liverymen of the Engineers' Company, the Past

Master Draper, Past Master Haberdasher and the Junior Warden of the Arbitrators Company to a splendid Concert and Supper on 23 June 2017.

We were privileged to welcome the Lord Lieutenant of South Glamorgan, Mrs Morfydd Meredith, the High Sheriff Mr Gilbert Lloyd and the Principal and Governors of Howell's School to see the results of many months of extensive restoration works.



Following the welcome by the Master, Wing Commander Graeme Morgan DL and Wing Commander Richard Read OBE, the Conservator Architect Mr Michael Davies took the gathered Liverymen and guests through the detailed works in large part funded by the Drapers' Company,

including the restoration of the pictures of scenes from a number of Shakespeare plays.

Over 100 Liverymen and guests were treated to a splendid Supper prepared and served by the staff of Howell's School, (matching if not bettering any in



the splendid Livery Halls in London). Following the supper they were treated to a concert of music and dance. Opening the concert, the Cambrian Male Voice Choir under its Musical Director Fred Nicholas, sang the wonderful hymn, Myfanwy composed by James Parry to the lyrics of Richard Davies followed by Calon Lan and many favourite traditional and new songs. The company were then entertained by Ms Ffion Edwards, a third year student at the Royal Welsh College and Drama studying music accompanied by another student Ms Angharad Thomas. To complete the entertainment, Dr Sejal Bhatt the recipient of the Gold Award for 2015 –2016, an eye surgeon, performed a classic Indian dance in traditional dress, which captivated and enthralled the audience.

In his response to the toast to the Guests delivered by the Junior Warden of the Worshipful Livery Company of Wales, Geoff Hughes, the Master Engineer stated that the evening was a true Livery experience, well organised, well controlled by the Beadle, Bipin Pitrola and one that will long live in the memories of all those present. The Master Wing Commander Graeme Morgan DL thanked all those present and in particular the Engineers Company, Principal Sally Davies, Wing Commander Richard Read OBE and all the team at Howell’s school for a hugely successful event.

This event was the last to be organised by the former Clerk to the Worshipful Livery Company of Wales, Richard Read OBE, the Master wished him well in his “retirement” and for all to have a safe journeyhome.



Master Wing Commander Graeme Morgan (above) and the Master Engineer (below).



MINI OUT OF TOWN VISIT TO RAF COSFORD & IRONBRIDGE

30th June – 1st July 2017



RAF Cosford is the home of the Defence College of Technical Training, as well as the No 1 School of Technical Training and the No 1 Radio School. Over 1,000 staff are based there. Together with students being trained to be engineering officers or technicians, there may be over 5,000 people on the base at any one time. There are also many aircraft used for training. One of the hangars that houses them was previously an indoor running track where Sebastian Coe and Zola Budd set indoor world records in the 1980s.

Our group of 24 saw aircraft and equipment used in training of basic engineering including airframes; engines; hydraulics; avionics; oxygen systems; ejector seats; armaments; traffic collision avoidance; also how trainees learn to maintain aircraft and how they can be put under stress to simulate operational conditions, and the importance of cyber security. There was a demonstration, for which we had to

make paper aircraft from instructions by a colleague, of the need for training messages and instructions to be by both spoken word and by visual diagrams.

There was also a demonstration of how computer games and collaborative learning are used to check that training messages have been understood. Typically, 70% of training time is spent on presenting training information and 30% is spent reviewing that the training message has got through. Many engineering personnel now acquire degrees after training as technicians. Officers need to have an engineering degree and now need CEng for promotion. Also some engineers with BEng degrees now join the RAF as technicians.

Later we visited 238 Squadron which has simulators including a Synthetic Environment Procedure Trainer for training ground crew how to marshall aircraft on the ground.



After lunch we visited the RAF museum at Cosford with exhibits from the Cold War, including the use of aerial reconnaissance and other means of gathering intelligence, cargo aircraft used for the Berlin airlift and aircraft such as the TSR2 which did not go into production.

On the Friday evening, there was a pleasant dinner at Drapers Hall at Shrewsbury. The present hall was built in 1576 on the site of an earlier guildhall built in 1485.



On the Saturday morning we visited two of the Ironbridge museums in Coalbrookdale. We were welcomed by Anna Brennand, chief executive of the Ironbridge Gorge Trust, who summarised the history of iron making at Coalbrookdale including the construction of the Iron Bridge itself in 1779-1781 and an acknowledgement of the work done by Liveryman Sir William Francis, who was present on the MOOT, to secure the foundations of the bridge. We visited the recently refurbished Museum of Iron, and the various displays in Enginuity which had some updates since our OOT meeting at

Ironbridge in 2008. After lunch several of us tried to visit the Victorian Village at Blists Hill where there is now a passenger train to a coal mine pulled by a small diesel engine, part-funded by The Engineers' Company, and named, 'Sir Peter Gadsden', our Founder Master. Alas the car parks were full so we left that attraction for another day. Altogether it was a good short weekend, for which we are most grateful to the Master Richard Groome and to Court Assistant Air Commodore Mark Hunt.

Peter Blair-Fish



A paper aeroplane, carefully made in response to spoken instructions

The prototype TSR2 at Cosford



Drapers Hall built in 1576



Half a mini – built ~ 1960

OUT OF TOWN IN MANCHESTER WITH THE MASTER AND HIS LADY



Thursday 21 to Sunday 24 September 2017

Welcome to Manchester!

When I heard those words I was immediately transported back in time – not just to that afternoon when The Master and his Lady so warmly welcomed us – but 52 years ago when I first heard those same words. I was also transported a few hundred metres from the splendid surroundings of Manchester's Midland Hotel, where we were dining, to the more austere but equally magnificent Mechanics' Institute, my *alma mater* UMIST. Why, I could give this talk! But no, as Anne Beswick expertly introduced us to her city I soon realised that I could not.

We were taken from the beginnings when the Romans established a *caster* on the mam shaped hill to well beyond the late middle ages when Manchester was still a small wool-making town. It was only at the turn of the 19th century that things started to change as the wool-makers first added cotton to their fabric and then abandoned wool all together. Did cotton drive the industrial revolution or was it the other way round? Whichever, Manchester became the boom-town of the day as people were attracted in from the countryside to work the machines that were being created and to share the economic miracle. Cotton fabrics were – and still are – known as 'Manchester Goods' throughout the Empire / Commonwealth.



Preparing for the quiz before dinner was served!

Manchester had some very clever people and also attracted others : Joule, Dalton (a founder of the Mechanics' Institute), Arkwright, Rutherford,

Turing, Geim and Novoselov – to name but a few – all worked here. The last two, both from Russia, were awarded the 2010 Nobel Prize for Physics for the 2004 discovery of graphene.

As you see, Manchester has always been a welcoming city and now it was welcoming, with a warm heart, the Liverymen of the WCE and their partners.

Mike Inkson

Visit to the National Graphene Institute, Manchester University, 22 September 2017

The National Graphene Institute (NGI) has been set up in Manchester University, following the isolation of graphene in 2004. Graphene is a remarkable material that consists of a single layer of carbon atoms, arranged in a two-dimensional hexagonal grid. It is now known to have many extraordinary properties, which include being the thinnest and strongest material ever measured.

James Baker, the Business Director of the NGI, gave us an overview of its aims. Funded by the UK government and the EU, the NGI hosts over 250 researchers, from over 30 different academic groups. It supports research up to TRL 5, at which point the technology has been validated in a relevant industrial environment. In order to help take the technology to a level where it can be demonstrated and prototyped in products, the Graphene Engineering Innovation Centre (GEIC) is currently being developed, with industrial and government investment, on an adjacent site.

Dr Liam Britnell described the properties of graphene and the methods used to produce it. Applications that he believed could be close to market included membranes (to be used, for example, for water desalination), composite materials (with high strength and light weight) and energy storage (“super capacitors”).



There is huge investment in graphene around the world (especially in China), but there have yet to be any significant mass-market applications. There was discussion with our hosts on the business models needed to attract industrial investment and collaboration. The NGI takes the view that historically many new materials have taken 25 to 30 years of research and development before their commercial potential is fully achieved and graphene has only been available for the last 13 years.



Back to the classroom to learn about graphene!

We had an interesting morning and a stimulating introduction to an extraordinary new material whose commercial potential is still to be realised, but which holds great promise.

Simon Watts

A visit to Chetham’s Library

Humphrey Chetham (1580-1653) was a wealthy Textile merchant, landowner and Banker. He founded Chetham’s Hospital School for the maintenance and education of poor boys, which is now the famous music school.

In his will he appointed 24 governors to set up a library for public study and they bought the Medieval sandstone building (built in 1421 to house the priests of Manchester’s Collegiate church) and where the library is still housed today.

We were met by our guide Fergus Wilde, who is an expert on the history of the building and Chetham’s legacy. The building is very well preserved and we visited the Baronial Hall with a beautiful oak ceiling, and Cloister Court, which houses the original well and walked along the double storeyed enclosed courtyard before proceeding upstairs to the library.

Wow! The corridors are lined with oak shelves with glass fronts on one side and gated enclosures with shelves at right angles on the other. The number of volumes of leather bound books on one subject was amazing; I counted 49 on one subject. The volumes looked untouched and Fergus said they were not handled unless requested as they thrived on neglect. There was also an original book press on show. We then proceeded to the beautiful reading room. Above the fireplace there is a decorative heraldic display commemorating Chetham and a rare painting of him. We also saw the last of the 5 Chained Libraries that contained 51 books, which were set up in the parish churches of Manchester. The alcove has the original table where Karl Marx studied with his friend Friedrich Engels. We were then allowed to handle some books that Fergus had selected for us on science and engineering. What a treat. Would have loved to spend longer there!

Dixie Bayly

The Victoria Baths

In the 1890’s the local Baths and Wash House Committee recommended the building of Turkish Baths and Bathing Pools **not** for leisure but to keep Mancunians clean. Thousands of their houses still lacked bathrooms. There might be truth that ‘muck made money’ but it didn’t promote good health! For an original cost of £57,000 the magnificent Manchester Water Palace opened in 1906. Three pools, 25 yards long and 8 lanes wide’ with their own segregated entrances, admitted First class males, Second class males, and Females. Clean water, with minimal filtering, passed down the system with the women getting the worst of the bargain. There were slipper baths, footbaths, rest rooms and the superb Turkish Baths, the latter



pampering those who could afford it. In 1952 an Aerotone was added, an amazing pummelling machine which beat many physical ailments into submission! Apparently very popular, three more were acquired although were never used.



Linda Elston going for a spin in the Aerotone.



Chris Elston getting excited at the controls!

Sadly as the local demographic changed, the baths ceased to be profitable and in the late twentieth century the Water Palace closed and fell into disrepair. This century has brought a change of heart and local passions have led to the setting up of



Lunch in the baths.

programme ‘Restoration’ resulting in a much wider support base. Lottery funding, match funding, money raising events, eg weddings in the emptied pools, have all resulted in the means to progress a full restoration. The first aim is to reinstate the Turkish Baths and the pools will follow. The amazing changing cubicles, stained glass windows and Pilkington tiled rooms will be appreciated again. We were proudly shown the water storage tanks, boilers, chemical tanks, glass tiled walkways, the laundry and the Edwardian red brick frontage. We hope they’re successful.

Val Howse

Robot Orchestra

It was a gig like no other and, as a former primary school teacher, the robot orchestra at the University School of Electronic Engineering would have undoubtedly inspired me to encourage my pupils to engage in wholehearted STEM action.

It was clear from our afternoon session that the outstanding personality of Professor Danielle George, who had given the 2014 Royal Institute Christmas lectures, was the catalyst to develop what we saw of the 'DIY-recycled-robotic -music making mechanisms' that hit all the boxes for young people's interest - trendy, noisy, unpredictable, green! This



had all began while Danielle had been on maternity leave when, with financial backing from the Granada Foundation and the Engineering Council to support teachers and schools, she challenged Manchester's primary school children to produce a robot orchestra that would take others out of their comfort zones with musical outputs from designs and deadlines that were open-ended and imaginative.



Inspecting the instruments of the Robot Orchestra

Danielle explained that the whole project then took on a life of its own, with children at the heart of it proving to be smarter than any machine. The result included musical harmony from redundant floppy disc drives, Pringle cans and chop sticks, plant pots and spoons, all powered sequentially by anything technological with a motor, processor, circuit etc. We were only shown a representative portion including one drummer- robot actually looking like one but most were devices linked together variously to produce a sophisticated musical outcome that had at some stage featured alongside Manchester's Hallé Orchestra and used Ed Sheeran's hit song, 'The Power of You' as a theme.

We were treated to Grieg's, 'Hall of The Mountain King' on the disc drives and, though it may not have been engineering as we normally know it, this would

ignite the imagination and talents of any young person with a glimmer of scientific interest. It was abundantly evident that Danielle had put the right ingredients together to not only win the 2016 Royal Academy of Engineering Rooke Award for the public promotion of engineering but to employ the love of music and junk-modelling to spark the future technologists that we so urgently need.



The Master with Professor Danielle George FIET

At the end of the demonstration, Middle Warden Cdre Barry Brooks, as a Past President of the IET, presented Danielle with her Fellowship scroll of that Institution and announced she had been elected to be a Vice-President of the IET Board of Trustees - clearly, a well-deserved accolade that was warmly applauded.

Margaret Skinner



The Swordsman Number 39



Gorton Monastery - Manchester's Taj Mahal



Engineering at Manchester University who briefly described her work and her commitment to enthusing new students about the challenges faced regarding Climate Science and Energy Policy.

This was another wonderful evening, and if you have time when you are next in Manchester, this Pugin masterpiece is well worth a visit.

Jennifer Liddell

We always dine in very special places on our Out of Town Meetings and Gorton Monastery was no exception. The Monastery is a restored Pugin masterpiece and is often referred to as Manchester's Taj Mahal because, after years of neglect and vandalism, it was placed on the List of 100 Most Endangered Sites in the World, alongside Pompeii and the Taj Mahal.



Built by Franciscans in the 1860s, the Monastery was at the centre of the Community for about 100 years until slum clearance changed the area and the church was deconsecrated. Redevelopment plans fell through and the building was left unprotected for many years. Paul Griffiths DL, who welcomed us and gave us the history of the building, had been an altar server here as a boy, and it was he and his wife who set up a Trust to restore the building. What they have achieved has been phenomenal and the 'Monastery' opened again in 2007 to host conferences, events, concerts and community celebrations. Not surprisingly, they have been showered with awards.



The nave set for dinner

We ate in the nave, overlooked by the 40ft reredos and beneath what must be one of the highest ceilings in a Parish Church. We had two guest speakers: Kevin Gillham, Manager of Citywide Highways, Manchester City Council who discussed current infrastructure projects; and Professor Alice Larkin from the School of Mechanical, Aerospace and Civil



Exploring Manchester

Bright and early on the Saturday morning of the OOT weekend in Manchester, we were the first group off for a walking tour with our guide, Suzanne. Straight to the pub. The Britons Protection pub. The engineers noticed in a nano-second the missing apostrophe, but it is clearly named the Britons Protection Pub, although its entry in Wikipedia is **The Briton's Protection**. There are two reasons for the name: one with the press gangs who operated here who tricked men into service with the King's Shilling dropped in their pint when they were not looking. The second reason is the set of murals commemorating the Peterloo Massacre, so called because it took place in St Peter's Field and the Battle of Waterloo had taken place 4 years earlier.

Nearly 100,000 people demonstrated that day for parliamentary reform but were brutally charged by the cavalry. 16 people died including women, a truly shocking event at that time. We later visited the town hall extension where the names of the dead are represented in red lights in the floor mural.

A sight that interested me was the network of viaducts (there are four) all around central Manchester. They dominated the walk, being visible for nearly every street. Some of the viaducts are 200 spans long and each one is a beautiful structure: well worth a dedicated walk! The guide could not explain why there are so many. I could not find an answer online but have pieced together a

theory which is that Manchester was industrialised early on. When the railways came in the 1830s they had to find a route through all the established poor housing and factories and keep the road and canal networks intact. Easiest way was to build viaducts! But then Birmingham is similar in industrial history and does not have so many viaducts?

Suzanne Flynn

An elemental walk around Manchester with no precipitation in sight!

Our "Blue Badge" official City guide (Peter) was a knowledgeable, enthusiastic and expansive promoter of Manchester. He energetically led us away from the front of the Hilton hotel only to stop after a few steps and exclaim the first of many densely packed "sites".

The City coat of arms is embedded on the building opposite which was one of Manchester's first libraries and is now the Spanish Institute. The coat of arms comprises a royal lion and antelope supporting a shield upon which are three diagonal stripes representing the rivers Medlock, Irwell and the, now culverted, Irk. The globe atop the shield is adorned with eight bees who represent the mill workers as the co-ordinated industrious life of the hive. The bee has been adopted by Manchester as its symbol and is widely visible in many places including Town Hall floor mosaic, bollards, t-shirts and shopping bags.



Turning back to view the 43 storey building which contained our hotel for the lower 23 floors, we were invited to observe the residential accommodation above (prices available from any leading estate agent). Mild jealousy and indignation ensued when it was advised that the architect's terms of engagement incorporates ownership of the penthouse of any building he designs whilst there was no mention of the engineering involved. Peter highlighted the fins projecting above the building. These are designed to reduce the building sway created by "vortex shedding". An unfortunate side effect is that the fins create a whistle in high winds which can be heard over two miles away in Hulme but not in the building. Should have employed an Engineer!



Castlefield Basin

Castlefield basin is the terminus of the Bridgewater canal and its link to Liverpool at its port. A thriving area with many warehouses and much infrastructure to prevent flooding by the River Medlock in its heyday, it is now undergoing a renaissance for city

dwelling and outdoor entertainment. However its history as a significant staging post dates back to Roman times with *Mancuniam Castra*, one days march from Chester on the route to York. Commercialism over-rode history and the only reference to the fort is on the heritage boards. Once built, the basin was quickly joined by the Rochdale canal which, whilst constructed from the Manchester end, has the locks numbered from its destination. Well, it was built by a Yorkshireman. The final lock is entitled Duke's No 92 in deference to the Duke of Bridgewater on whose land it all stands.

Manchester is famously proud of the historic pairing of Engels and Marx although they would appear to have had significantly different backgrounds and upbringing. Engels was from a capitalist family and in charge of the family mill in Manchester. When he enquired of his father if he could return home he was asked "How will you eat?"

Engels remained in Manchester, and the rest is history. The Director of the V&A museum, Tristram Hunts' biography of Engels "The frock-coated Communist" was recommended as a good read.

Jane and Colin Newsome



The ubiquitous bee and the Engels statue, complete with authentic Russian inscription which was erected last year having been liberated from the Ukraine in 2015.



Quarry Bank Mill, Styal

The founder of the mill complex, Samuel Greg, created a community free from the inhuman working conditions of cotton mill towns emerging at the end of the 18th century. His objective was to industrialise the whole process of making cotton fabric from the raw material, which previously had been a cottage industry. Profit, however, was still the driving factor but it was achieved by ensuring the health and loyalty of his workforce.

Following an excellent lunch, we were expertly guided by National Trust volunteers to get an understanding of three aspects of this industrial property. Space limitations meant that only a small group could investigate the social welfare and life experiences of the young apprentices. These were a small part of the workforce of some 2,000 during peak production until the plant's demise in 1959. The remainder of the tour party was shown the mill complex. Greg could not have realised his ambitions without seeking the best civil and mechanical

engineering expertise. Substantial power was required to run the large banks of machinery associated with the various production processes. We were shown the power plant that was constructed, comprising the 50-ton breast-shot water wheel and the restored working steam engine installed in 1836. The guide then took us through the processing of the cotton.

It was remarkable to contemplate how the client explained his brief for the demanding requirements to the machine designers. Equally the skill to create such complex and durable mechanisms was amazing. The horrors of people operating these unguarded machines which had so much inertia that they couldn't be quickly stopped are almost beyond imagination. Static from belt drives could draw in hair and loose clothing, children were trapped darting between moving machines. Health and Safety regulations of today would deny any of the installations. Finally there was a chance to wander in the beautiful grounds and garden.

Henri Pageot



A gathering at the Engineering Heritage Award for Quarry Bank Mill awarded by the Institution of Mechanical Engineers 11 March 2011

Saturday night dinner at Manchester Town Hall

Dinner was served in the Great Hall of the Town Hall, a magnificent, Grade 1, neo-Gothic, building just a short distance from our hotel. We were very lucky as it is just about to close for a £300 million restoration.

As we left the Hilton, we had to walk past a crowd of on-lookers behind a barrier and accompanied by two policemen. Were they there to view us? In fact the crowd was there to see some of the stars from 'Corrie' who were coming to the hotel for a charity ball.

In the foyer to the main hall and sipping our 'bubbly', we were entertained by a wind quintet from the Royal Northern College of Music, playing their own selection of favourites, including the March of the Toreadors from Carmen and many Beethoven's classics.

We walked into the awe-inspiring Main Hall under the watchful, and perhaps disapproving, eye of a statue of Gladstone. The food and drink amply matched our surroundings. The quintet played a special rendition of J S Bach's 'Sleepers Wake' to celebrate the 40th Wedding Anniversary of Richard and Janet Groome. It had special significance for them, as it had been played at their wedding.

Our guest speaker was Sir John Timpson, Chairman of Timpson with its 1,935 shoe repair stores throughout the UK, renowned for his unique management style as well as fostering 90 children with his late wife, Alex.

His speech was very entertaining and thought-provoking. His management style is 'upside down', where the most important people are the retailers in the stores, with the role of all management grades being to support them. His staff selection is equally special; ignoring CVs and basing selection entirely on attitude and enthusiasm. Before any employment is offered, a short-listed applicant is given a half day



Sir John Timpson receiving a Stirling engine from the Master

trial in a shop. If subsequently, attitude turns out not to be ‘right’, the individual concerned is sent on his way quickly. Ten per cent of his work force have been recruited on leaving prison and these ex-offenders make some of his best employees. He really dislikes anyone who tries to tell him how to run his business, especially HR departments, politicians and professional advisors!

As we made our way back to the Hilton, we intermingled with the younger revellers, under the watchful eye of good natured policemen. Past Master Graham Skinner, resplendent with his CBE medal was asked, “Are you a Lord or sommat?” “Something like that”. In truth, we all felt like Lords on this splendid and memorable occasion.

Graham Owen

COMPANY NEWS

THE MASTER'S REPORT



As I write this I am halfway through a very eventful year; it is true that however much you prepare for this role, it is an amazing experience with many surprises. I have for instance been to the Royal Garden Party, the World Lego Robot championships, the lunch with the judges at the Old Bailey, several cutting edge meetings at the Royal Academy and the Sheriff's Ball, just to name a few.

I was very pleased to return to Ironbridge in June with a number of our Liverymen and guests, to see recent progress in their 50th year as a visitor attraction, and present them with one of our regular donations. We have also visited Cosford and Cardiff this summer for some unique experiences that you can read more about elsewhere in this issue, and we have just come back from the Out of Town in Manchester which appeared to be a huge success.

I would like to take the opportunity of updating you on our recent office move. After many years at Wax Chandlers Hall (WCH) our lease came to an end and the renewal terms were not very attractive; however we were in the process of discussing this and other options when there was an unfortunate fire at WCH. Although the fire was confined to the basement (where our archives, gowns and treasures were stored), there was also smoke and soot damage throughout the building and we were forced to move out at short notice. We were very kindly given a temporary home at Ironmongers Hall and we then set about the clear up. I am pleased to report that the gowns and treasures have responded to specialist cleaning and were saved. We were worried for some time about the Sword, but this has also emerged in good shape. We have lost some paperwork, but we think most of the important material is still OK.

We remained a little concerned about the general infrastructure at WCH and so when they made no move in the lease negotiations we decided to make our move to Ironmongers permanent, and hence we have begun a new chapter there with one of the Great Twelve Livery Companies. Additionally we have gained further flexibility and gained closer contacts with another Modern Company because we have also taken storage and meeting room

arrangements at the Wo. Co. Information Technologists Hall (WCIT) close by.

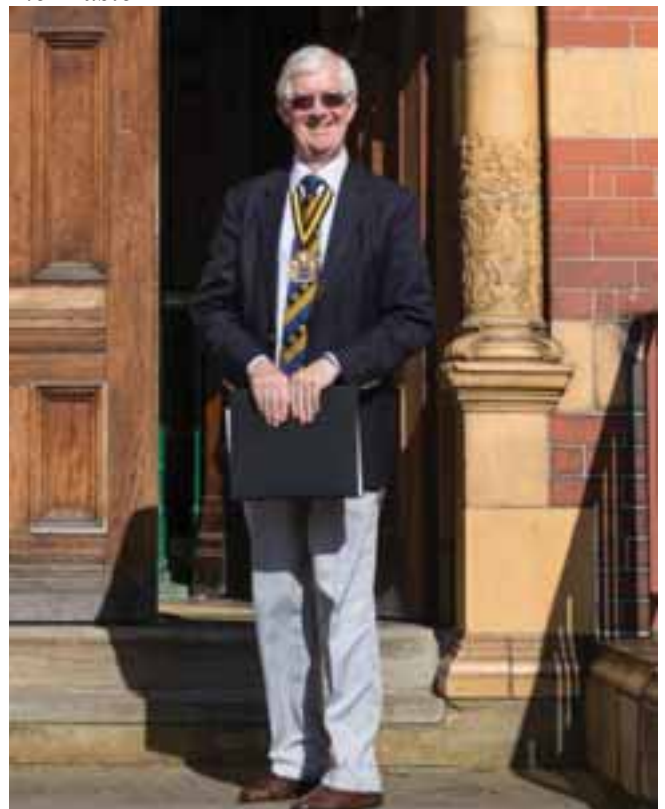
These two arrangements, Ironmongers and Information Technologists, deliver significant annual savings for the Company and give us 24 hr access for our gowns etc. For the first time in recent years, many of our treasures are also on display at the Information Technologists Hall. We have also already held functions at both WCIT and Ironmongers, and these have worked very well.

I am also starting some new joint initiatives with WCIT as a fellow Modern Company with much in common, so watch this space.

Finally, I am delighted to see the new Marketing Committee up and running, with an energetic membership and many ideas to grow our Livery.

Our challenges for the next six months are to increase our influence and contacts in the City, to promote better integration of the profession as mooted in the report by our Liveryman John Uff, and to make engineering 'cool' for younger people; no small objectives!

Richard Groome
The Master



ENGINEERS TRUST/IET HORIZON NEW ENGINEERING BURSARIES



At an Awards ceremony held on the 15 February at IET Savoy Place the first five winners of the Engineers Trust/IET Horizon Engineering Bursaries were presented with their certificates - three apprenticeships and two undergraduates.

In the face of a nationwide engineering skills shortage, the Engineering Horizons Bursary scheme aims to help more apprentices and students to become engineers by making an engineering career more accessible to those who have had to overcome personal challenges to continue an engineering education.

This new bursary scheme, developed by IET, improves access to engineering apprenticeships and undergraduate courses and the winners are people who are passionate about their work, yet restricted by hardship or personal disadvantage and ensures such circumstances are not a barrier for new talent entering the profession whether as a student or apprentice. Each Bursary is for £1,000 pa for the duration of the course of either three or four years. Winners are

expected to maintain a positive engagement with both the Trust and IET throughout their course.

The Engineering Trust was represented at the Awards ceremony by Senior Warden David Johnson, Middle Warden Barry Brooks and Trustee Malcolm Vincent who presented certificates to the Engineers Trust's five Horizon Bursary Awards winners – see photograph opposite and Award winner's details below.

The event was inspiring with our winners being such enthusiastic young people totally committed to engineering.

We are in the process of appointing two liverymen as mentors but three more volunteers are sought for this batch of winners. The extremely positive reaction of our winners to the news of being assigned a mentor reinforced the importance of mentoring for young people. It is very much hoped that the wider livery engages positively in mentoring roles as we increase our support of the Horizon Bursary Scheme.

Malcolm Vincent

Undergraduate/ Apprentice	Name	Company/ University	Discipline/ Subject	Liveryman mentor
Undergraduate	Matthew Curtis	University of Hertfordshire	Mechanical engineering	Steve Yianni
Apprentice	Daniel Swain	Rolls Royce PLC (Aerospace)	Aero engineering	Paul Wood
Undergraduate	Emily Ellwood	Queen Mary College University London	Electrical engineering & Electronics	Sydney Chin-You
Apprentice	Thomas Linaker	Siemens Rail Automation Communication and Information Systems	Rail Technology and Electronic engineering	Victor Mantey
Apprentice	James Gibbons	Arup	Civil engineering	Andrew Walker

NEW ARRIVALS

Welcome to our new liverymen

Welcome to four new liverymen clothed at the Court Meeting on 25 April 2017

Professor John Garry Hawley

BSc PhD CEng FIMechE



Professor Gary Hawley is the Dean of the Faculty of Engineering & Design at the University of Bath, a position he has held since 2008. He is the Director of the Powertrain & Vehicle Research Centre and holds the prestigious Medlock Chair of Engineering in recognition of, “*excellent academic research and its application to industry*”. Over the next three years he will establish a new national research facility – the Institute of Advanced Automotive Propulsion Systems (IAPPS) after recently securing £60m from various funding bodies.

Away from work he has spent many years studying Egyptology, a topic he finds fascinating and mysterious as well as unearthing the history of the early coal mines in his native Barnsley where he worked as an underground mechanical engineering for 10 years.

After the miners strike he literally jumped onboard ship having secured a commission in the Royal Navy as an Instructor Officer spending most of his time at the now defunct Royal Naval Engineering College where he completed a PhD. The final two years were spent on exchange with the United States Navy at the United States Naval Academy before joining the University of Bath.



Rodney McClelland

CEng FICE FCIHT



Rod spent most of his career with Alfred McAlpine civil engineering. This included the management of a temporary works team producing schemes and providing technical advice on construction methods for all types of projects in the UK and overseas.

Notable projects he was involved with included the Dinorwic pumped storage scheme in North Wales, bridge works on the Scammonden Dam section of the M62 and Chek Lap Kok airport in Hong Kong.

This was followed by a period in bid management, leading multidiscipline teams tendering for major road schemes in the UK.

He has made a significant contribution to the Construction Industry, having chaired many committees. Produced best practice reports for the Construction Industry Research and Information Association (CIRIA), served on the Standing Committee on Structural Safety (SCOSS) and chaired the Council of the Concrete Bridge Development Group (CBDG).

He was the first recipient of the CIRIA 2000 award for: “*The most outstanding contribution to sharing knowledge and building best practice*”.

Leisure activities include; golf, clay pigeon shooting, Tai Chi and music. He is also a member of a local golf club and vice captain of a golf society which raises money to buy wheelchairs for disabled children.



Professor David Howard

BSc PhD CEng FIET FIOA Senior MIEEE



Welcome to three new liverymen clothed at the Court Meeting on 11 July 2017

Andrew Ward

MA(Cantab) PhD CEng FICE



David Howard is the Founding Head of the new Department of Electronic Engineering at Royal Holloway, University of London where his mission is to get greater than average female participation in the subject, in keeping with the College's Founders mission.

Out side of work, David conducts Feltham Choral (a local amateur choir) and is the organist at the 12 century St Mary's Thorpe. He lives on the banks of the river Thames where he has a Mirror dinghy with a small outboard and kayaks. "Nothing like gentle time on the river o calm the mood and appreciate nature."

Steve Yianni

MA(Cantab) MBA FEng CEng FIMechE



Frank Onians

BSc CEng FIEE FIET





Calvin Blacker

CEng FICE



Calvin has represented Great Britain in Formation Skydiving enjoys indoor climbing and has also competed in Ballroom and Latin dancing. Calvin has a 5yr old daughter

Calvin was educated in Engineering at Nottingham Trent University where he studied Civil Engineering following his BTEC HND at Burton-on-Trent.

Following Graduation Calvin has been lucky enough to work on a number of high profile Civil Engineering projects including Manchester Second Runway, Bollin tunnel 280m long, Manchester railway improvements (34 miles), M6 Toll, Ferrybridge new junction between M62 and A1M including 33 miles of new motorway, A453 buildability advice and project management to bring the proposed dualling of the A453 between Nottingham and M1 through Public Inquiry, Design manager for the M25 widening to 4 lanes between J27 and J30 where he delivered some significant project improvements and cost savings.

As Engineering Manager he delivered the design and then managed the Engineering Team for the first Smart Motorway to open between M25 J5 and J7.

Currently in the role of regional Chief Engineer he gives advice and mentorship on around 60 projects in the SE of England. He is also a Reviewer for the Institution of Civil Engineers.

ADDENDUM

AWARDS 2017



THE ENGINEERING AWARDS PART 1

ROYAL ACADEMY OF ENGINEERING ENGINEERS TRUST

YOUNG ENGINEER OF THE YEAR

The RAEng Engineers Trust Young Engineer of the Year competition, awarded by the Royal Academy of Engineering with support from the Worshipful Company of Engineers, offers five prizes of £3,000 to early career engineers in full time higher education, research or industrial employment whose achievements are recognised as outstanding.

Winners 2017 (£3,000 Prize):

Dr Ruth Misener - Lecturer in Computational Optimisation, Imperial College London – for her innovative research vision that integrates research software development, optimisation algorithms, biomedical engineering, and process systems engineering.

Frank O’Leary – Chartered Geotechnical Engineer, Arup – for working on numerous high profile projects in London City and is currently working on the design and construction of five-storey basement beneath a Grade-II hotel in Mayfair.

Anna Ploszajski - Engineering Doctorate Candidate, University College London – not only for her patented research into hydrogen storage for an industrial partner, but also for being a truly outstanding public communicator of engineering.

Chris Shaw - Lead Engineer, Sensible Object Ltd – for his work as a founding member and Lead Engineer of a company called Sensible Object, which set up to manufacture the game *Beasts of Balance*.

Dr Jenni Sidey - Lecturer in Combustion, University of Cambridge – for her work as a combustion scientist who studies a wide range of complex phenomena, ranging from fundamental turbulent flame physics to pollutant reduction in gas turbine engines.

ARKWRIGHT SCHOLARSHIPS

The Worshipful Company of Engineers currently supports 4 Arkwright Scholars undertaking their Sixth Form studies at schools in Greater London as a potential lead-in to higher engineering studies.

They are:

2015-17 **Miss Tasnim Begum** – St Marylebone School 6th Form, London W1

2015-17 **Mr Andrew Hughes** – Eltham College, Mottingham, London SE9

2016-18 **Miss Saskia Bustrode** – Putney High School, London SW15 6BH

2016-18 **Mr Nicholas Roberts** – Highgate School, London N6 4AY

ENGINEERING HORIZONS BURSARIES WINNERS

The Engineers Trust currently supports 5 Horizons Bursaries through the IET, aimed at students or apprentices who may face, or have faced, challenges or personal obstacles and are UK residents. An annual award of £1000 per year for the duration of the degree up to 4 years is awarded.

They are:

Mr Daniel Swain - an apprentice in aero engineering at Rolls Royce Plc (Aerospace)

Mr Thomas Linaker - an apprentice in rail technology/electronic engineering at Siemens Rail Systems

Mr James Gibbons - an apprentice in civil engineering at Arup

Miss Emily Ellwood - studying electrical engineering and electronics at Queen Mary University, London



Mr Matthew Curtis - studying mechanical engineering at the University of Hertfordshire



THE SERVICES ENGINEERING AWARDS

THE SERVICES ENGINEERING UNDERGRADUATE AWARD

Awarded to an officer graduating from the Defence Technical Undergraduate Scheme (DTUS) who has achieved outstanding academic performance and demonstrated clear leadership and commitment to a professional engineering career in the Armed Forces.

Officer Cadet Hannah Williams RAF. Currently on Initial Office Training, Officer Cadet Hannah Williams is an exceptionally gifted future Royal Air Force engineer officer and a very competitive sportsperson. Very highly regarded by the Academic staff, including the Vice Chancellor, at Loughborough University she consistently demonstrated astonishing commitment toward her personal and academic development for future Service in the Royal Air Force.

A person with great promise in the engineering profession, she naturally displays tremendous selflessness, takes genuine responsibility for the development of others and possesses the very clear potential to develop into a truly talented leader.

THE SERVICES ENGINEERING POSTGRADUATE AWARD

Awarded to an officer completing a postgraduate technical degree who has achieved overall academic excellence and contributed most to the advancement of technical knowledge or its application through a research project.

Captain Damian Warren graduated from the Royal Engineers' Professional Engineer Training (Civils) course in July 2016 gaining not only the top student award but also being considered the best student for a generation.

Captain Warren has delivered a consistently outstanding performance. He achieved unprecedented results during the academic phase of his course while providing essential mentoring to the other students. His MSc technical report submissions throughout the course were of an intellectual depth never seen before, including a thesis of the very highest calibre.

On a 9-month attachment as a Senior Engineer on a £120M high-risk tower construction in Central London, he was quickly given additional responsibility and dealt with a constant stream of complex problems to keep the project on track. Working on the £4bn Thames Tideway project in Arup's London office, he was able to hold his own with world-leading geotechnical experts. Alongside all this, he found time to champion engineering to schoolchildren as a STEM ambassador.

For his unprecedented technical ability, phenomenal capacity for work and utter dedication to engineering and for being an inspirational ambassador for the Corps of Royal Engineers, Captain Warren receives this award.

Both the Awards above were made on the recommendation of the Operations Director of the Defence Academy of the United Kingdom at Shrivenham, Wiltshire.



THE SERVICES OPERATIONAL ENGINEERING AWARDS

Awarded to an officer, from various Service and Corps areas, who has best made the application of professional engineering judgement or technical innovation to contribute significantly to the maintenance or enhancement of operational capability or effectiveness in any theatre of operations, including the UK. Recommendations for the Operational Awards are made by the Senior Specialist Services Authority appropriate.



ROYAL NAVY OPERATIONAL ENGINEERING AWARD

Lieutenant Commander Victoria Shirvill Royal Navy has delivered an exceptional level of operational and exercise success throughout her tenure on 814 Naval Air Squadron and has delivered the highest effectiveness on no fewer than 6 separate operations, 4 multinational exercises and protracted split operations, including OP LITTEN, COUGAR, ALVIN, COPPERFIST and Maritime Security Operations in Oman. It is due solely to her impressive personal intellect, ability to deftly balance a hugely diverse administrative workload and determination to maintain an unparalleled standard of aviation safety that she has delivered the most efficient Fleet Air Arm Squadron this year; producing the most hours per aircraft. This has been an inspiring performance from a remarkable individual, whom I think is most deserving of the Royal Navy Operational Engineering Award 2017.

ROYAL ENGINEERS OPERATIONAL ENGINEERING AWARD

In 2016, it became clear that the Corps of Royal Engineers was failing to provide sufficient work-based learning opportunities for its artisan soldiers to complete their Government apprenticeships. **Staff Sergeant Aaron Hickman**, the Military Plant Foreman of 22 Engineer Regiment, had the vision to identify a completely new and innovative approach to solving this problem, as well as the fortitude to see it introduced and implemented against considerable bureaucratic resistance.

SSgt Aaron Hickman recognised that, to complete their apprenticeships soldiers, instead of deploying abroad for several weeks, would be better attached to a civilian contractor for the minimum period of time required to achieve the work-based learning outcome. This had never been done before and needed an entirely new approach to be developed, agreed and introduced.

This was easier said than done and required Hickman to clear several bureaucratic hurdles. The first was buy-in from local construction companies which he

achieved with help from the firm working on local barracks construction. The next was acquiring a Construction Skills Certification Scheme (CSCS) card for all participants, something completely new for the military but which he quickly identified and achieved. Finally, he needed an indemnity policy. Hickman tracked down a MoD Placement Policy Guide from which he created a draft indemnity contract which he got agreed by the Army Legal Services and contractor.

Maintaining artisan skills through industrial placements offers not only a solution to completing apprenticeship but also a new way of conducting continued professional development for artisan tradesmen and women. This not something the Corps has always done well in the past and poor trade training has been a constant source of frustration to artisan soldiers, contributing to some deciding to leave the Army.

The process that Hickman has negotiated has not been easy. There were significant bureaucratic hurdles in his path and he was acting almost entirely on his own. Hickman's foresight, perseverance and sheer bloody mindedness have together given the Corps and Army a novel, effective and efficient way of training that should not only enhance the quality of our soldiers' but also provide a recruiting and retention incentive as well.

ROYAL SIGNALS OPERATIONAL ENGINEERING AWARD

Major Graeme Endean deployed as Officer Commanding Kabul Communications Unit and the communications lead for the multinational Kabul Security Force from June to November 2016.

With great effect, Major Endean delivered and evolved a plethora of operational and tactical communication and information systems in a complex and dangerous environment supporting UK and multinational forces. Through detailed engineering knowledge, dedication, and strong leadership, Major Endean identified new requirements and processes, investigated and resolved engineering problems and educated commanders on the complexity of communications engineering. Through personal endeavour, the operational and tactical information



and communication services he delivered were a vital force multiplier.

ROYAL ELECTRICAL & MECHANICAL ENGINEERS OPERATIONAL ENGINEERING AWARD

Captain Hannah Winterbourne has been employed as the Officer Commanding of the Light Aid Detachment of the King's Royal Hussars, and commanded one of the largest detachments in the Army, where at its peak she has been responsible for over 100 platforms including 42 Challenger 2 tanks and many other armoured vehicles. During her tenure, she led the unit through 2 regimental firing packages, multiple training exercises and delivered equipment support to over 30 discrete tasks, including a divisional level exercise. Her ability to manage such a challenging workload whilst consistently meeting readiness targets is testament to her commitment, flexibility and innovation.

However, Capt Winterbourne is not afraid to show her engineering intelligence away from her leadership role, and over the last year has been key in articulating and presenting solutions to equipment issues. This has included thermal imaging and fixed fire extinguisher maintenance, commander's control handle failures as well as briefing on Challenger 2 equipment support to a wide range of stakeholders across the 3rd UK Division.

Having taken over at a unit that had previously been graded as unsatisfactory for its equipment care, Capt Winterbourne has been key in changing the mind-set of the King's Royal Hussars, and where Engineering Standards have previously been considered as common sense, she has driven them to become common practice. This shift has resulted in demonstrably high levels of equipment availability and has been integral to maintaining the operational readiness of the British Army.

Having proven her engineering knowledge, skills and experience, Capt Winterbourne has been highly sought after and she volunteered on several occasions to contribute to various external projects. This has seen her consult on new policy such as maintenance

standards, fleet management and information systems as well as briefing the senior leadership team at DE&S on engineering at a unit level. In each case, Capt Winterbourne has shown herself to be knowledgeable and articulate, earning her the highest praise from all that have worked with her.

In command at one of the Army's most busy and technically demanding units, Capt Winterbourne has excelled at delivering engineering effect and should be commended for her dedication, her sharp application of engineering principles and her leadership. Capt Winterbourne is the epitome of what it means to be a REME officer, is a true ambassador for the Corps and is wholly deserving of the WCE operational engineering award.

ROYAL AIR FORCE OPERATIONAL ENGINEERING AWARD

From Jun 16, **Flight Lieutenant Dale Hornsby** set out to improve both the articulation and assurance of Tornado CAW management activities in order to develop a continually improving model of assurance. Hornsby quickly assimilated the complex regulatory frameworks and related them to the existing Tornado engineering management practices. He incorporated the regulations as part of a root and branch review and created detailed process maps which could then support thorough audit and assurance. He identified which organisation undertakes what CAW activity, and created revised agreements with the heads of each. Prior to Flt Lt Hornsby's rejuvenation of CAW assurance, the Tornado Mil CAM was unable to make any realistic assessment of the effectiveness of the CAW management, nor provide any evidential assurance to the Duty Holder chain. The changes Hornsby has made have had a significant and far-reaching impact on the quality of CAW assurance activities across the Tornado fleet.

When improved monitoring identified a concerning degradation in reliability of the Tornado Environmental Conditioning System (ECS) in Op SHADER, Flt Lt Hornsby facilitated the rapid deployment of a contractor On-Call Support (OCS) team to carry out an in-depth diagnostic procedure. This procedure was not authorised for use on RAF aircraft; Flt Lt Hornsby orchestrated discussions between the CAE,



DO and TAA representatives and helped expedite a pragmatic and legal method of allowing the work to be undertaken.

He also established arrangements for future ac preparing to deploy to have the ECS comprehensively reviewed by the OCS. The ability to identify a trend and react accordingly is as a result of the improved mechanisms that Flt Lt Hornsby has developed to monitor engineering Quality Assurance and Airworthiness. His eye for detail, evangelistic approach and pragmatism have advanced a revolution in attitude across the whole force. His achievements are testament to a deep understanding of CAW regulation and assurance as well as determination to involve multiple and disparate organisations. He has driven substantial improvements to CAW Management, which has the consequence of improving operational availability and the airworthiness of the Tornado overall.

THE DEFENCE ENGINEERING EQUIPMENT & SUPPORT AWARD

Awarded to the person who has contributed most, through application of professional engineering judgement including the use of leadership, management and technical acumen, in the acquisition of new capability or to meet materiel availability targets for any of the Armed Forces. The recipient can be an individual of any rank or a team from the regular or reserve Armed Forces, the Royal Fleet Auxiliary, or the MOD civil service serving in the Defence Equipment & Support Organisation with a recommendation by Chief of Defence Materiel.

This award recognises the role of **Warrant Officer Paul Sykes Royal Navy** in recovering a Spey gas turbine on HMS Kent in September 2016 that had been put out of action following an attempted combustion can change. He identified a serious engine misalignment issue that the OEM advised could not be rectified in situ. Using his service experience and engineering acumen he diagnosed that the root cause of the fault related to incorrect engine installation years before. He then developed a repair plan and directed the team that successfully put the engine back into service over a three-day period. The operational

and financial impacts of his work were recognised across the Service and allowed HMS Kent to continue with her tasking.



THE ENGINEERING AWARDS PART 2

WATER ENGINEERING AWARD

The Water Engineering award is made jointly with the International Water Association (IWA) for the best presentation and paper at the annual IWA UK Young Water Professionals Conference.

Winner 2017 (Medal) – Julia Terlet

Julia Terlet graduated from the University of Nantes, France with a Bachelor’s degree in Law and Political Science followed by a double Master of Law Degree, including the study of Environmental and Climate Change Law, from Nantes and Cardiff Universities. She is now studying for a PhD in Water Conservation at Cardiff University School of Engineering conducted in the context of the European framework 7 project WISDOM. Her PhD project is entitled ‘Water behaviour modelling for efficient ICT-based water management in urban environments’.

Julia won the prize for the best paper presented at the International Water Association’s UK Young Water Professionals conference 2017, where she described her research which aims to reduce water consumption in the UK using Information and Communication technologies (ICTs) such as smart meters, in-home displays and web and mobile applications.

Julia is clearly passionate about her subject and is also actively engaged with the Cardiff Water Research Institute managing and coordinating early-career members and with communications and marketing.



MERCIA AWARD

The Award is made annually to a student under 30 for a postgraduate paper describing how engineering techniques are being used for the advancement of medical treatment and provides a medal and bursary towards the cost of a taught or research programme of postgraduate studies in Medical Engineering.

Winner 2017 (Medal and £500 Bursary) – Aisling Barry

Aisling Barry graduated in Mechanical Engineering from Edinburgh University in 2013, where she showed a strong interest in Engineering in Medicine. This led onto her being selected, as one of eleven from some 2000 candidates, to join the new NHS-related MSc Programme in Clinical Sciences (Clinical Engineering) at King's College, London both as a part-time student and a trainee at the Royal Liverpool University Hospital. She specialised in Rehabilitation Engineering and Medical Equipment Design and graduated with a 1st class Master's degree in 2016, having completed a project about the development of a specific medical engineering approach to help the resuscitation of babies in low income countries, the subject of her excellent Mercia award winning paper.

Aisling, as well as being an excellent student, has participated in a wide variety of voluntary work including teaching engineering and supporting neighbourhood projects. She is continuing her studies for a degree in Medicine and Surgery at the University of Warwick and is very interested in the use of innovative technology in healthcare, specifically in increasing early adoption of new medical devices into routine practice.

STEPHENSON AWARD

The Award is for those who have been particularly successful in encouraging young people to study engineering with an emphasis, but not exclusively, on mechanical engineering. In 1997, members of the

Institution of Mechanical Engineers made donations to fund a Worshipful Company of Engineers Loving Cup to mark the Institution's 150th Anniversary. Donations in excess of those needed for the Loving Cup were used to establish the Stephenson Award and further donations were received from members in later years, supplemented by a substantial grant from Rolls-Royce plc. The Engineers' Company acknowledges the assistance of the Institution of Mechanical Engineers and the Engineering Development Trust (EDT) with nominations for this Award.

Winner 2017 (Medal & £1000 Prize) – Jessica Rogers

Jessica has almost 15 years of experience in promoting STEM to young girls and boys. She is a passionate engineer, diversity consultant and STEM Ambassador who has promoted her profession both across Europe and in the United States.

At her university as a member of the Society of Women Engineers collegiate section, Jessica started an event called WOW! That's Engineering! for over 100 8-12 years' old girls with the Charlotte, NC Hornet's Nest Council for the girls to learn about STEM careers through fun experiments and activities. Jessica devised many of the activities herself including the Lifesaver Wind-powered Car and the Recycled Paper Design Challenge. The girls received their science badge and a special Society of Women Engineers patch for participating in the event.

In 2009, Jessica moved overseas to Germany where she developed a relationship with the Girl Scout Troop on the US military base in Weisbaden. Just like the program at her university, Jessica ran a WOW! That's Engineering! event for 27 girls allowing them to get their science badge and Society of Women Engineers patch. This event too is still running today with the help of the local Society of Women Engineers group. Jessica moved to the UK in 2014 and joined Atkins where she started the year long Young Engineers & Scientists (YES) Programme in the Epsom office. The students enrol and come to Atkins after school, once a month for eight months of the academic year. Sixty year 8 and 9 students sign up from six local schools



around Epsom to learn about different types of STEM careers through interactive activities and experiments.

Jessica spends the summer engaging with local schools to enrol students with the goal of achieving equal numbers of girls and boys across the programme. The programme covers a range of STEM disciplines and sets two new disciplines every year to keep the activities exciting. She coordinates over 80 members of staff and volunteers for the eight sessions.

BARONESS PLATT OF WRITTLE AWARD

Originally established to recognise engineering excellence amongst those pursuing final year studies leading to academic qualifications for entry to the Engineering Council's Incorporated Engineer grade, this Award was refocused in 2013 to those who achieved registration as Incorporated Engineer in the preceding calendar year. Named for the Late Honorary Liveryman and Court Assistant Emeritus, The Baroness Platt of Writtle CBE FEng in recognition of her work in support of the Engineering profession in general and Incorporated Engineers in particular, the Award was first made in 2002. The Engineers' Company acknowledges the assistance of the Engineering Council and its partner Professional Engineering Institutions in selecting the winner.

Winner 2017 (Medal & £1000 Prize) – Sam Williams

Sam Williams worked for engineering consultancies for several years before joining EDF Energy at Sizewell B power station as a project engineer. For a radioactive waste processing project for long term storage of spent ion exchange resins, he made technical judgements and set design requirements for a dedicated radioactive waste processing cell.

He reviewed the contractor's design for constructability and adherence to the specified requirements. He devised functional tests and oversaw the commissioning of the waste processing cell including setting to work the multidisciplinary commissioning team. The novel technology used to

process the radioactive intermediate level waste resins had not been used before anywhere in the UK.

He has demonstrated strong leadership qualities when initiating and supervising work during reactor refuelling outages. He is well aware of relevant health and safety legislation and is committed to promoting safety in the workplace through coaching and field supervision.

Sam has a recognised ability to deliver projects in the Nuclear Industry through effective stakeholder management and a proven ability to lead and motivate his project team. He is currently managing fixed price contracts of up to the value of £14 million for the replacement Turbine Governor and Supervisory systems on both 600 MW turbine generators at Sizewell B.

He also mentors younger engineers and actively promotes professional membership. The judges were particularly impressed by his clear, confident and well-illustrated presentation.

CADZOW SMITH AWARD

Established in 1996, the Cadzow Smith Engineering Awards were endowed by the Eastern Group plc in recognition of the outstanding services to engineering of its former Chairman, Dr James C Smith CBE FEng FRSE now a Past Master Engineer. The Awards are for excellence on an accredited undergraduate engineering course conducted at one of eleven universities within London and the Home Counties. Besides academic excellence, the recipients of the Awards must have demonstrated self-confidence, professional awareness, leadership and sound common sense.

Winner 2017 (Medal & £2500 Prize) – Kirsty Greener

Kirsty is a well-rounded candidate with exceptional communication skills. As well as demonstrating an impressive technical ability, the panel were impressed by her awareness of the commercial and financial implications of her work.



Kirsty came to engineering having done economics A Level (as well as physics and maths) and coming to an understanding of the importance of engineering for economic development.

She described her work in the Palace of Westminster, during her placement year, and, in particular, the refurbishment of the “bomb door” staircase after a safety hazard had been identified when a Peeress fell down them.

She also makes a large contribution outside her academic studies. She has organised events for the University Civil Engineering Society. Through the Institution of Civil Engineers (ICE), Graduates and Students section she has initiated a competition for school students called Brunel Young Civil Engineer which attracted approximately 60 participants. She also brings her experience of the Crown Estate to work on the Civil Engineers headquarters a One Great George Street through her membership of the ICE’s Building Committee.

The panel sees her as someone who, overwhelmingly, has the skills and ambition to succeed in her career.

HAWLEY AWARD FOR ENGINEERING INNOVATION

The Hawley Award, established in 2006, is awarded annually for the most outstanding engineering innovation that delivers demonstrable benefit to the environment, by a resident of the UK who is at an early career stage, holds a graduate or post-graduate degree in engineering or science from a recognised UK university and is a graduate or more senior member of an engineering institution.

HAWLEY AWARD SPONSORS

Allis cum Humanitate John Laing plc

AMEC plc Keir Group

AstraZeneca National Grid

BP Nuclear Decommissioning Authority

British Energy Nuclear Industry Association

BSI Royal Academy of Engineering

Carron Energy (Uskmouth power Co Ltd) Royal Society of Chemistry

Costains Rutland Fund Management Ltd

Deloitte & Touche PLC RWE npower

Dr Robert Hawley Scottish Power

EDF Energy Shell

Engineering & Technology Board Society of Environmental Eng

Engineering Council UK Thames Water

Engineers’ Company Liverymen The Go-Ahead Group Plc

Fidelity The Weir Group PLC

Hammonds UKAEA

HSBC VT Group

IAC Water Conservators’ Company

IET World Nuclear Association

Institute of Marine Engineering

Winner 2017 (Medal & £5000 Prize) – Dr Amrit Chandan

Dr Amrit Chandan is a graduate from the University of Birmingham. He is an experienced Chemical Engineer with a special interest in fuel cell and energy storage technology. In addition to his technical skill, Amrit is an entrepreneur and was named Business Quarterly Magazine’s Entrepreneur of the Year 2014.



He and his team have developed the NuCycle process which is an innovative method for quickly assessing if perceived “end-of-life” Lithium batteries are suitable for reuse.

This is vital for enabling batteries to enter the circular economy, extracting all possible value from battery cells before they need to be recycled for material recovery.

They have developed an innovative, quick and non-destructive process to test the reuse potential for perceived end-of-life lithium batteries. The algorithms for testing and the key parameters they use are key to their competitive advantage as they are able to conduct their process 3x faster than their competitors.

The direct environmental impact is in the extension of the use-phase of Lithium batteries. Currently, the batteries are sent for recycling before they are truly at end-of-life. If the use-phase of the batteries is increased, more carbon emissions can be offset from those used to produce and to eventually recycle the batteries. Indirectly, the repurposed batteries also reduce emissions when they are used in conjunction with renewable energy, for example as domestic energy storage for solar power.

Furthermore, they have calculated that such a battery pack should cost about 50% of the cost of a brand-new Li-ion pack which means they are viable for use in developing regions like Central America. This is important in mitigating emissions as renewable energy uptake has seen large uptake but lack of access to low cost battery energy storage means that polluting diesel generators/gas engines are used when the grid is down. By providing these regions with low cost battery energy storage, it is possible to further mitigate harmful emissions.

LEETE PREMIUM AWARD

Established in 2012 under the Will of Liveryman Dr David Leete for the purpose of making awards in what Dr Leete called Production Engineering Research but defined sufficiently broadly to encompass the whole field of what is now known as Manufacturing Research, an agreement was made with the Institute for Manufacturing (IfM), University of Cambridge, to provide a “premium” above normal Departmental

Training Awards to be awarded to their best new PhD research student in 2013 and in each of the following two years. Eligibility is restricted to UK Nationals whose prospective projects do not benefit from CASE awards and the £18,000 total award is staged over 3 years of PhD study subject to sustainment of satisfactory performance.

Winner (£6000pa for 3 years) – Christopher Valentine

The Leete Premium Award, endowed by the late Liveryman David Leete’s half million-pound legacy to the Trust, has now provided 3-year awards of £6000 per annum to three production engineering doctoral research students at Cambridge University’s Institute for Manufacturing. This evening we welcome the winner of the award Christopher Valentine, who is just beginning his research.

The aim of Chris’ research is to develop sensor platforms to improve the sensing of toxic gases and chemicals. Air pollution and related illnesses kill 40,000 people every year within the UK and there is an increasing demand to provide devices with a greater level of sensitivity to better monitor pollution and toxicity.

Chris’ work will involve developing 3D Carbon Nanotube electrode structures for use within the sensors. Carbon nanotubes can provide a high aspect ratio structure to act as a scaffold onto which chemically active species can be attached. The manufacturing processes involved will allow for the facile development of a variety of functionalised electrodes enabling a wide number of chemicals and gases to be detected.

In addition to this, Chris is working on a paper-based sensor for the detection of blood glucose. Paper is a useful substrate to manufacture sensors on as it has the innate properties of being flexible, porous, readily available and low cost. The porosity of the paper allows a 3D Carbon nanotube conductive network to form, providing an electrode with a high surface area to interact with the sample and increase sensitivity.

Chris will be present during the reception, with his poster presentation to show much more detail to those who would like to know more about the research.



ROYAL ACADEMY OF ENGINEERING MACROBERT AWARD

The Royal Academy of Engineering MacRobert Award is the premier prize for UK innovation in engineering. It seeks to demonstrate the importance of engineering and the role of engineers and scientists in contributing to national prosperity and international prestige. It is awarded annually for an outstanding example of innovation and benefit to the community, which has also achieved commercial success. The award honours the winning company with a gold medal and the team members with a prize of £50,000. The Engineers Trust is supporting the Award with £20,000 annually for 10 years.

Winner 2017 (£50,000 Prize) – Raspberry Pi

Raspberry Pi received the award for its inexpensive credit card-sized microcomputers, which are redefining how people engage with computing, inspiring students to learn coding and computer science and providing innovative control solutions for industry.

With a team of engineers numbering in the tens, not hundreds or thousands, Raspberry Pi has redefined home computing for many thousands of people across the world, even taking 1 per cent of the global PC market.

From initially setting out to help increase the number of computer science applicants to the University of Cambridge, the Raspberry Pi team has put the power of computing into the hands of people all over the world. They provide low-cost, high-performance computers that people use to learn, solve problems and have fun. By doing so, they are helping to ensure future generations are capable of understanding and shaping our increasingly digital world, able to solve the problems that matter to them, and equipped for the jobs of the future.

The team members are:

Dr Eben Upton CBE - CEO, Raspberry Pi

James Adams - COO, Raspberry Pi

Pete Lomas - Director of Engineering, Norcott Technologies

Dom Cobley - Senior Principal Software Engineer, Raspberry Pi

Liz Upton - Director of Communications, Raspberry Pi

Gordon Hollingworth - Director of Engineering, Norcott Technologies

Forthcoming Events

Date	Event	Location	Booking
11-Nov-17	Lord Mayor's Show, Breakfast, Lunch & Informal Fireworks Dinner	Breakfast and Lunch Ironmongers' Hall The Wharf for Dinner	Direct with Ironmongers' and Web Office
14-Nov-17	MacRobert Award Seminar	Royal Academy of Engineering	RAEng website
13-Dec-17	Carol Service & Dinner	Chapel Royal, Tower of London & Clothworkers Hall	Web Office
<i>09-Jan-18</i>	<i>Court (& Partners Dinner)</i>	<i>Saddlers Hall</i>	<i>Web Office</i>
<i>13-Feb-18</i>	<i>Committees & Board of Trustees</i>	TBA	
<i>06-Mar-18</i>	<i>Election Court & Dinner with partners</i>	Ironmongers' Hall & St Vedas alias Foster	Web Office
14-Mar-18	Visit to Rolls Royce Derby	Derby	Ric Parker
16-Mar-18	United Guilds Service & Lunch	St Pauls Cathedral & TBA	Web Office
24 Mar-18	Informal walk	London geology, Abbey Wood-Thames Barrier	Audrey Canning
24-Apr-18	Court AGM & Installation Dinner	Merchant Taylors' Hall	Web Office
<i>25-Apr-18</i>	<i>Brooch Lunch</i>	<i>TBA</i>	
<i>08/15May-18 TBC</i>	<i>Festival of the Sons of the Clergy</i>	St Paul's Cathedral	Web Office
May 2018	Master's Lecture – Digital Engineering & Lunch	Information Technologists' Hall TBC	
19 May-18	Informal Walk	The New Forest and its industrial engineering heritage.	Audrey Canning
May 2018	Late Spring Visit	TBA	
Jun/Jul-18	Visit to Raspberry Pi Factory	Sony, Pencoed, Wales	D Johnson
20-Jun-18	Warden's Lecture Lunch	TBA	Web Office
25-Jun-18	Election of Sheriffs & Lunch	Guildhall & TBA	Web Office
27-Jun-18	RAEng Awards Dinner (MacRobert Award winner announced)	The Pavilion, Tower of London	RAEng
10-Jul-18	<i>Court Meeting, Awards Ceremony & Dinner</i>	Plasterers' Hall	Web Office
20-Jul-18	Informal Dinner	Hampton-in-Arden	P Taylor
20/23 Sep 18	Out of Town Meeting	Peak District including Bombardier Derby	D Johnson
September	Election of Lord Mayor	TBA	
09-Oct-18	<i>Court Meeting & Dinner</i>	TBA	Web Office
Oct 2018	Ladies Lunch	TBA	
26-Oct-18	Annual Banquet	Mansion House	Web Office

Booking is essential for all events. Members of the Company should use Web Office <http://wcmember.azurewebsites.net/> to book on-line for all main events. Queries for other events should be sent to the organiser.