InstMC

WILL HYDROGEN MEASUREMENT ISSUES IMPEDE THE ROLLOUT OF HYDROGEN FUEL?

QUALITY CONTROL IN COVID-19 TESTING

INTRODUCTION TO NET ZERO ENGINEERING: MEETING THE UK'S AMBITIOUS TARGETS

THE IMPACT OF INDUSTRY 4.0 ON THE AUTOMATION, CONTROL & INSTRUMENTATION ENGINEERING DISCIPLINE

JUNE 2021_ISSUE TWENTY

PRECISION

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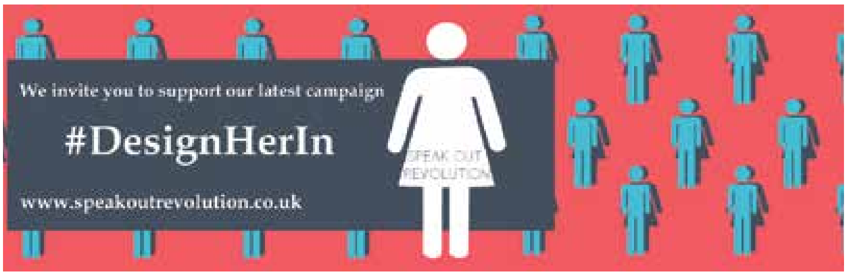
SPEAK OUT REVOLUTION: IT'S TIME TO #DESIGNHERIN

The Speak Out Revolution #DesignHerIn campaign is a call-to-action for industry to prioritise and accelerate inclusive work environments for women across the engineering sector. Our future global challenges from powering our planet with cleaner energy, creating new healthcare solutions that improve quality of life to building safe and sustainable cities will be underpinned by engineering and technology. This kind of innovation demands teams with diverse skills, experiences and backgrounds to design and deliver solutions that serve everyone in our society yet only 12.37% of UK engineers are women (Engineering UK report 2018 https://www.engineeringuk.com/research/engineering-uk-report/).

In response to increasing reports highlighting fundamental barriers for women participating in the engineering profession, Speak Out Revolution launched the #DesignHerIn campaign throughout March 2021. This is a collaborative campaign to find solutions for the fundamental barriers to women participating in the engineering profession.



The campaign

Women were invited to anonymously submit the barriers they have faced within their careers, with the campaign receiving responses from across the engineering sector.

Women from a broad range of industries including nuclear, construction, defence, energy and transportation reported fundamental barriers which included:

- No access to truly flexible or part-time working
- Unresolved sexual harassment and harassment based on sex (everyday sexism)
- No provision of basic facilities and equipment (such as toilets, safe spaces to express breast milk or PPE)
- Pregnancy and maternity discrimination
- Unfair pay, compared to their male counterparts
- Little representation on expert panels (#manels), governing bodies or in leadership teams.

Throughout March an emergency Think Tank was convened by Speak Out Revolution to discuss, document and provide solutions to the barriers identified. Around 150 men and women from across the engineering sector registered support to create the "Design Her In Playbook", a comprehensive guide to best practice solutions for the fundamental barriers faced by women working in the engineering sector.

Are you an organisation committed to improving gender equality within the engineering sector? Register your interest in a copy of the #DesignHerIn playbook, or request a talk for your institute or organisation at www.speakoutrevolution.co.uk/campaign

The Speak Out Revolution #DesignHerIn campaign is delighted to have the support of the InstMC, Women's Engineering Society and Caroline Criado Perez, author of Invisible Women.

Marie Hemingway
Founder & Director,
Speak Out Revolution

Speak Out Revolution is a Not-For-Profit with a mission to cancel the culture of silence on harassment and bullying in workplaces across the UK. Support their work by anonymously sharing your experience working in a toxic culture or with difficult people at speakoutrevolution.co.uk/the-speak-out-survey so they can drive change.

Marie is a strategy consultant helping businesses transform their people, processes and technology to drive positive business outcomes with expertise in strategic investment decision making, digital transformation and organisational change. She is a board member for the Women's Infrastructure Network focused on expanding the network outside of London, creating cross sector opportunities for women to network, exchange ideas and help shape the infrastructure agenda. Find out more at: www.speakoutrevolution.co.uk

LinkedIn: https://www.linkedin.com/company/speak-out-revolution

Follow us on Twitter @WeAreSpeakOut.

Connect with Marie on LinkedIn https://www.linkedin.com/in/marie-hemingway-she-her-271453119/

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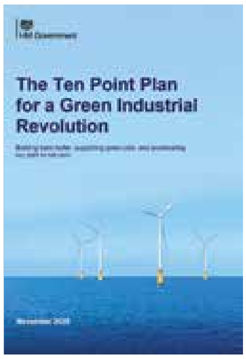

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ADVANCED MACHINERY AND PRODUCTIVITY INSTITUTE:

AN INITIATIVE TO ENSURE UK MANUFACTURING IS EQUIPPED TO LEAD THE WAY IN THE CREATION OF TOMORROW'S INTELLIGENT, INTEGRATED TECHNOLOGIES

An on-off conversation between Dr Tony Bannan OBE (CEO of Rochdale-based precision machine tool maker, PTG Holroyd) and Professor Paul Shore (Head of Engineering, National Physical Laboratory), that spanned almost 12 years, has led to what may well be one of the most significant initiatives yet to help re-establish the UK as a leader in the design, build and supply of intelligent, next generation machinery.

The result of that conversation and subsequent involvement by industry, academia, the National Physical Laboratory (NPL) and local government in Rochdale, Manchester and Yorkshire, is the Advanced Machinery and Productivity Institute (AMPI) – a proposed new centre of innovation for machine tool technologies. From a base in Rochdale, Greater Manchester, AMPI will drive the creation of new machines and technologies, and the provision of specialised training of skills that will be needed to manufacture tomorrow's products and develop advanced materials. It is anticipated that the institute will stimulate the UK's advanced machinery sector to achieve £4bn in export sales within 10 years and bring circa 30,000 high-value jobs to UK manufacturing industry. Perhaps most significantly, AMPI will also provide a stimulus to widen participation and opportunity; it will level-up areas that have the potential to release significant positive socio-economic benefit, promote private-sector investment in R&D and increase productivity to create high value, better paid careers.

"Our protracted discussions were borne out of a shared frustration regarding UK machinery manufacturers' seemingly continual struggle to compete when bidding against much better resourced and better equipped European competitors with significantly better R&D capabilities," says Tony Bannan. "Manufacturing is not only a key driver of economic growth, but also an essential part of the UK economy, contributing £192bn per annum. In short, it's vital we stay ahead of the game. The UK is the world's ninth largest manufacturer [Source: Make UK, 2019]. Our goal is to help ensure UK manufacturing is equipped to lead the way in the creation of tomorrow's intelligent, integrated manufacturing technologies – as well as the materials those machine tools will use. We believe that the creation of a new, highly accessible centre for innovation in specialised machinery and machine tool technologies and productivity will redress the balance, putting UK manufacturers of all sizes ahead of their counterparts in Europe and beyond, by focusing on the development of advanced manufacturing processes that don't exist today."

To underpin the need for the AMPI, Dr Bannan highlights the pivotal role advanced machinery has played in countries such as the US, Germany and China, and how it has provided the catalyst for significant research, innovation and industrial development. "The UK has no such national programme for machinery-based products," he adds. "The current innovation funding landscape also makes it difficult for manufacturing companies to benefit from academic support." In Britain, accessing the High Value Manufacturing Catapult (HVMC) centres is often perceived as expensive for smaller organisations with quite brilliant ideas; that is partly because Catapult initiatives tend to be focused towards larger companies. Unlike the 'future-thinking ideology' that will be the cornerstone of AMPI, the Catapult is focused on adaption and optimisation of existing processes, machines and systems, normally sourced from overseas suppliers. AMPI aims to work in cooperation with the Catapult, resulting in UK manufacturers having increased options, with the adoption of UK-made machinery being a clear growth target.

In 2017, the government-produced Made Smarter report outlined how the UK could gain a leading position in the fourth industrial revolution (Industry 4.0). A report, 'Future State Workshop', was produced by Tony Bannan and Paul Shore, following a meeting of industrialists and academics at NPL in Huddersfield. Calling on the

An artist's impression of the proposed Advanced Machinery and Productivity Institute (AMPI).
(Image courtesy of Rochdale Development Agency / Fairhursts Design Group.)

opinions of leading experts from both precision engineering and academia, the report highlighted that 'the majority of accurately manufactured goods - goods used in almost every imaginable application for everyday living - are produced by high technology, highly advanced computer numerically controlled (CNC) machinery'. In other words, machine tools and industrial robotics are advanced machinery in the form of enabling technology; they enable the production of the materials and products that we rely upon in our everyday lives, from mobile phones to medical implants, to the next-generation electric vehicles. Machinery innovation, automation and production capability is therefore vital to the future productivity, security, prosperity and well-being of our manufacturing sector and the UK economy.

To help establish a business case for the AMPI, in 2020 a partnership comprising the NPL, Rochdale Development Agency and various industry partners, secured government seed funding of £50,000 through UK Research and Innovation's 'Strength in Places' competition. The support of local government in Rochdale, Manchester and Yorkshire, colleges and universities, manufacturers and machine tool associations, was also secured. Even more significantly, to really get the AMPI project moving - and in a far-sighted move to bring greater opportunity to the region - earlier this year Rochdale announced plans to support AMPI with the lion's share of its successful multi-million pound Towns Fund bid.

"We're not only trying to establish an environment for the creation of technologies and manufacturing processes that exist today." adds Bannan. "Far from it. The remit of AMPI will also be to think about and develop future manufacturing technologies, engineering and control systems. There will also be a particular focus on metrology, an area in which the NPL will play a central role, and control systems, digitisation and software. AMPI will lead the way in the creation of intelligent, self-learning systems that embrace future networking advancements in The Industrial Internet of Things. It will pioneer the development of tomorrow's products - products that have yet to be imagined - and be a catalyst in the creation of degree-level courses for the engineers of the future, individuals who will spearhead the design of new, sustainable manufacturing methods and materials. As far as we are aware, there is no single body in the UK that is wholly dedicated to the creation of tomorrow's intelligent, connected machine tools. AMPI will fill that gap and become a hub for industry and academia alike.

"We've had tremendous support and engagement from our partner organisations, including NPL, Rochdale Development Agency and the universities, together with local and regional businesses that are forward-thinking and clearly recognise the need for an organisation like AMPI."

The Advanced Machinery and Productivity Institute at a glance

- AMPI is the result of a collaboration between a number of leading UK advanced machinery and manufacturing companies, together with the Institution of Mechanical Engineers, the National Physical Laboratory and the UK's Manufacturing Technologies Association.
- AMPI will stimulate the UK's advanced machinery sector to achieve £4bn in export sales within 10 years, adding in the region of 30,000 high-value manufacturing sector jobs.
- AMPI's purpose will be to create a lasting mechanism which will promote innovation and collaboration in machinery design, while developing the next generation of skills needed for sustained economic growth.
- AMPI seeks to propel UK industry into the next generation of manufacturing technology and enable it to take a lead internationally.
- AMPI has the support of the Universities of Huddersfield, Salford, Manchester and Leeds, and is proposed to be located in Rochdale, at the heart of a recognised cluster of advanced machinery manufacturers.
- AMPI has received funding from the Strength in Places Fund programme to develop its business model. Rochdale Council has allocated significant capital towards the project from its Towns Fund.

To learn more about AMPI, its aims and objectives, visit: http://ampi.org.uk/

INTRODUCTION TO NET ZERO ENGINEERING: MEETING THE UK'S AMBITIOUS TARGETS

BY PETER NORMAN, IENG, MINSTMC, MIET

InstMC members living in the UK are likely to be aware of the Government's 'Ten Point Plan for a Green Industrial Revolution' published in November 2020. Not surprisingly, the InstMC is taking an active interest in all the necessary engineering concepts for future technical education, training and skills transfers as well as looking to expand the diversity and repertoire of Special Interest Groups (SIGs).

When it comes to considering strategies for technical safety, we often remember layers within the 'safety model' to help keep the role of instrumented systems in broader perspective. When it comes to energy sustainability, it's worth remembering the Energy Hierarchy published by the Institution of Mechanical Engineers (IMechE) back in 2009/10. Extracting from their set of five tiers, in order of sustainability, Tier 1 was Energy Demand Reduction; Tier 2 was Energy Efficiency; Tier 3 was Utilisation of Renewable, Sustainable Resources. As has been observed through Covid pandemic restrictions, change in human activities and behaviours will be of great assistance. The engineering technologies to now help achieve the Tier 3 have, of course, advanced and evolved enormously over a further decade.

Engineers at the highest professional level already understand that the success of utilising renewable energy sources will only be met by a combination of green energy technologies and resources combining into the new energy ecosystem.

The following list of key carbon reduction target areas has been compiled from recent engineering news and numerous technical webinars and is not a direct reiteration of the aforementioned Ten Point Plan.

1. Energy System:

- Hydrogen gas via UK pipe-grid networks and distribution areas;
- Green Electricity needing Smart control systems for distributed electricity micro-grids to meet increased demand input and output management.

2. Industrial Energy:

- Green electricity generated by wind, solar, water and nuclear power.
- Hydrogen combustion heating being explored by some Scottish whisky distilleries.

3. Energy Storage Systems & Battery Technologies:

- Energy storage systems to support electrical micro-grids supply equipment
- Battery technologies particularly to improve range and safety of electric transport.

4. Oil and Gas:

- Emissions reduction and safe offshore platform decommissioning implementation
- IIoT for process plants under development such as Ethernet-APL
- Carbon capture usage and storage (CCUS) projects essential to support Blue Hydrogen production for the initial phase of low carbon energy transition.

5. Buildings:

- Building management systems for better energy management of heating, ventilation and air conditioning systems (HVAC)
- Smart buildings measurement and control systems.

6. Digital Infrastructure:

- Smart connectivity for IoT and IIoT including 5G (ISA 95) & Ethernet-APL-
- Smart connectivity and control of the distributed, electricity micro-grids system.

7. **Decarbonisation of Transport:**

- Decarbonisation of UK's railways – mainly by Electrification but also Hydrogen power. Electric locomotives to replace diesel locomotives for heavy freight trains; more package logistics operations using electric trains for longer-distance delivery journeys to help reduce lorry and large van road traffic
- Hydrogen-powered passenger commuter trains for some shorter branch-line journeys at relatively low running speeds
- Increase in Electric Vehicles and use of Hydrogen Fuel sources/ resources for road vehicles.

8. **Aircraft electrification and electric airport plans. A variety of small aircraft types exist with potential for larger types to become hybrid-fuelled.**

9. **Biogas / bio fuels from food waste and bio fertilisers for agriculture.**

10. **Low Carbon Agriculture using renewable heating systems and use of Bio-fertilisers.**

Already, UK electricity generation and supply has become increasingly renewable through the deployment of alternative sources such as wind, water, solar and nuclear as coal-fired power stations are phased out. These cleaner forms of electricity generation could also be used to create green hydrogen, by electrolysis, when the generating facilities have surplus capacity during times of lower consumer demand.

The mix of electricity generation and increased demand for electric power, will inevitably lead to complex, flexible supply and demand management systems. Smart grids employing wireless devices will be necessary to enable constant monitoring and control of power distribution networks within UK regions. The fact that the smart grid will incorporate wireless devices for control of circuit-breakers naturally creates vulnerability to cyber threats leading to denial of service attacks. Protective devices that were once electromagnetic relays have now become miniature computers with sophisticated control software. Electrical equipment giants, however, produce these items.

The Prosumer Electrical Installation (PEI) concept has been internationally developed to take advantage of renewable sources of energy and enhance the needs of the end-user. By utilising active energy management, the end-user should be able to permanently monitor and control own electricity consumption and production to help advance the decentralisation of electricity generation.

Domestic home installations will no longer be simple. Already UK homes have smart energy metering. Electric vehicle (EV) ownership is increasing and home-owners can have EV charge points installed. Solar PV panels can be installed on roofs. The UK's consumer population will be further encouraged to embrace these technologies to assist the ambitious net zero targets. Hydrogen, as the future piped gas supply, is being actively investigated as a replacement for natural gas for heating. Ground source and air source heat pumps are a possibility. There could also be biomass boilers.

Clearly, if UK manufacturing could develop to embrace more home-soil production of the necessary engineering equipment this would improve the engineering employment outlook. However, these renewable technology projects are not cheap and the necessary investments must progress rapidly and with the necessary co-ordination and collaborations to enable the whole infrastructure to be put in place.

The UK does have the Catapult Network of not-for-profit, private organisations bringing together nine leading technology and innovation centres spanning over 40 locations. These should be transforming the UK's capability for innovation in sectors of strength. There should now be opportunities for the InstMC to engage with the knowledgeable people and younger engineers studying the emerging engineering technologies at universities. The UK also has the Faraday Institution as an independent institute for electrochemical energy storage research, skills development, market analysis and early-stage commercialisation.

The intention of this introductory article is to pave the way for further articles dealing with the key engineering aspects that need to be embraced by the UK's future energy infrastructure.

Q&A

Aidan O'Connell

In the Q&A hot seat is **Aidan O'Connell,** Assistant Lecturer of Instrumentation & Automation at Munster Technological University and Chair of the newly formed InstMC Ireland Local Section

What was the root of your interest in Engineering?

I grew up in West Cork, Ireland as I am a member of a well sought after, but ever diminishing resource, a farmer's son. It was a medium size cattle and sheep farm, but we did also for a time cultivate winter feed for our animals. As farming is not one job but a wide variety of skills, which can range from animal husbandry to electrical and mechanical servicing and repair of equipment, and everything in between, this was an early chance to learn, based on interest and pure necessity.

My father managed his own construction firm, but farming was his real passion.

Since a young age, I have always had an interest in tinkering with things (not always successfully). During my early adolescence, I was given the responsibility of operating mechanical farm equipment and assisting with repairs. I was forever seeking ways to create or modify tools to get tasks completed faster or easier.

During my mid-teens to earlier 20's, breaks from studies were spent farming and/or honing my construction skills (plumbing, roofing, groundworks, etc). These turned out very useful when I fully refurbished my house a few years back.

Although there were more immediate opportunities to select the trade route, instead, I decided to attend the local Institute of Technology (formerly Cork Institute of Technology, now Munster Technological University) to study a certificate in Applied Physics & Instrumentation. I would stay on for four years to complete my Honours degree. In my third year, as part of my course there was a 6-month placement, mine was at Pfizer Little Island Pharmaceuticals, working on a control system upgrade. The experience gained during the placement was invaluable and it shaped my decision making in terms of the route I wished to pursue in my career. After graduation, I sought travel/work experience/adventure, so I took a position with SA Kentz in Saudi Arabia. This choice resulted with most of my career working in the area of oil & gas.

What is your vision of Engineering in Britain for the next ten years?

I foresee here, in Ireland and across the world, things will evolve in a similar way to Britain. I can only see the requirement for more dynamic and less rigid personnel - just have a look at the list of skills requested in typical current job specifications. More people will have diversions in their career path and, obviously, longer working lives. People will be expected to be more capable in non-technical "soft" skills and work more closely with different disciplines and people from great distances.

There is a present trend, and a strong market demand, for specialised short technical courses to enable people to move into different but related fields. I expect this to grow in the future.

What should the UK government do to address the shortage of UK engineers?

This seems to be a global issue. I do not feel confident commenting specifically about the UK but suspect there is some common ground with Ireland. While the question asks about government's role, I would wish to extend it to society and stakeholders. I believe that my recent move into academia has given me another perspective to this challenge.

Like most things in life, there is a spectrum of interest in STEM, it is strongly innate in some whilst others just need a little support and direction. The optimum place to ignite interest in science is at home but we all have had influencers outside home, too, such as teachers and relatives.

I fear that financial decisions are forcing schools to make tough choices regarding funding and reducing the availability of lab-based subjects such as physics and chemistry that are more expensive per student to deliver. Schools are key to fostering an interest in a technical career but the lack of emphasis on teaching of these less popular subjects has also created a negative feedback loop with the lack of teaching staff in certain areas.

I believe all stakeholders (including PEIs) ought to lobby government to increase funding for STEM subjects. In addition, at a local level, those invested should form partnerships (educators, PEIs, companies, etc) to provide resources (human & capital) and STEM champions to promote the positive life and work opportunities such a career path offers.

I am a strong advocate of craft to engineer, some of my best mentors have followed that route but at times I fear that we are robbing Peter to pay Paul. I believe we must ensure that we are producing enough skilled personnel to guarantee this natural progression is taken account of and possibly there is a prospect for all involved to establish streamlined paths from day one of trade training for all.

In some quarters in Ireland, there has existed some snobbery towards craft studies. Lately, I have noticed that the tide has changed, especially when you consider the cost of third level and the opportunities such qualification offers. The recent reinvigoration of apprenticeships, some now being delivered to degree level, is a welcome development driven by the government of Ireland.

What do you do in your free time to relax?

My family and I live in Cork City. I still enjoy helping on the family farm, assisting with construction activities, DIY, growing vegetables in my garden, walking, hiking and reading; I'm particularly interested in history & politics. Although these activities are less frequent with young children, one still endeavours! Post Covid, we would like to spend more time in Spain with family. I am a founding member and Chair of the InstMC Ireland Local Section and the Student Advisor committee member of ISA Ireland.

Given one wish what would that be?

That everyone would have the required resources to achieve their true potential and not to be limited by the lottery of life.

INCORPORATED ENGINEER

(IEng) maintain and manage applications of current and developing technology, and may undertake engineering design, development, manufacture, construction and operation.

What is professional registration?

- **Recognition** through membership of a relevant Professional Engineering Institution (PEI), that an individual's knowledge, understanding and competence have been assessed and confirmed through Professional Review.
- **Verification** that they have attained the standard required for inclusion on the national register in the appropriate category of registration.
- **Commitment** by an individual to maintaining their competence through Continuing Professional Development (CPD), professional behaviour for the benefit of society and their commitment to the engineering profession.

Registration is open to any competent practising engineer or technician, with different levels and pathways to registration available.

Why you should become professionally registered?

For yourself

- Recognition of your competence as an engineer or technician.
- Demonstrable evidence of your commitment to the profession.
- Internationally recognised status.
- Enhanced career prospects.

For your employer

- Increased technical/managerial credibility.
- Competent workforce.
- Competitive advantage.

For society

- Ensures the public is safeguarded through provision of independent and trustworthy advice, products and services and safe and reliable infrastructure.
- Assurance of ethical and sustainable behaviour.

Incorporated Engineers are able to demonstrate

- **The theoretical knowledge to solve problems in developed technologies using well proven analytical techniques**
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- **Responsibility for project and financial planning and management together with some responsibility for leading and developing other professional staff**
- **Effective interpersonal skills in communicating technical matters**
- **Commitment to professional engineering values**

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For further details and application forms, please visit our website or contact the Director of Membership & Registration on +44 (0) 20 7387 4949 Ext 3 or email: membership@instmc.org

Scan QR Code to apply for professional registration via InstMC

BY JENI LEWTHWAITE

PRIOR USE ASSESSMENT OF FUNCTIONAL SAFETY LEGACY COMPONENTS - 61511 PRIOR USE

Method Compliance Assessment are specialists in Prior Use assessment of legacy SIF components as per IEC 61511.

Why assess devices?

Each device installed in a Safety Instrumented Function (SIF) must be suitable for use at the target Safety Integrity Level (SIL) required of the SIF. The only route available to end users to demonstrate the suitability of legacy components is defined within IEC 61511 – and this is known as Prior Use (PU) Assessment.

What is Prior Use?

IEC 61511 defines requirements for selection of devices based on PU as:

"documented assessment by a user that a device is suitable for use in a SIS and can meet the required functional and safety integrity requirements, based on previous operating experience in similar operating environments".

The main focus of the PU evaluation is to provide statistically valid evidence that the rate of dangerous failures of the device is sufficiently low.

What are the key requirements for Prior Use?

61511 specifies the following evidence that should be provided within a PU assessment:

Evaluation of the manufacturers quality, management and configuration management systems

This step evaluates the capability of the manufacturer to consistently manufacture a reliable device. The following are examples of types of supporting evidence:

- An independently verified Quality Management System;
- Design and manufacture to an industry recognised product standard;
- Traceability between reported failures and modifications;

Adequate identification and specification of the devices

The desired functionality required from the device (e.g., environmental performance) should be defined. This is then compared with the device's capability and performance to confirm that it is fit for purpose.

Demonstration of the performance of the devices in similar operating environments

The following data relating to device performance is required to justify that the historical performance of the device is suitable for the SIF:

- Recorded historical evidence of device hours in use;
- Estimate of the frequency of demand of the safety function;
- Number of failures of the safety function, categorised as safe/ dangerous, detected/undetected.

To assure confidence in the completeness of the information, evidence of a formal system to collate and interrogate the data should be provided.

The volume of the operating experience

The following examples of evidence could be used to demonstrate an acceptable volume of operation:

- Unit-hours of operation achieved over the lifetime;
- Process conditions during use;
- The different applications where the component has been used.

How is PU recorded?

The evidence, calculations and conclusions for the prior use assessment should be formally documented and subject to the control of a management of change procedure. In the case of a change being made to the device, evaluation of the continued validity of the evidence must be justified.

References

IEC 61511, Functional safety – Safety instrumented systems for the process industry, 2016.

Chemical and Downstream Oil Industries Forum (CDOIF), Guideline - Demonstrating prior use of elements of a safety instrumented function in support of EN 61511, V4.

QUALITY CONTROL IN COVID-19 TESTING

BY LORRAINE TURNER, DIRECTOR OF ACCREDITATION, UKAS

Since the onset of the COVID-19 pandemic, the government has recognised the vital role that testing has in both managing the disease and supporting the move out of lockdown.

Helping laboratories deliver high quality, reliable tests remains a priority for UKAS. Given the relative novelty of the COVID-19 disease, it is vital that all aspects of any new test methods and procedures are rigorously evaluated and verified if patients, regulators, and the public are to trust them. By assessing the technical competence of laboratory staff and the facilities, equipment and testing methods used, accreditation generates confidence in the quality and reliability of test results. Accreditation of an organisation provides confidence in the fitness for purpose of its services, so it is vital that laboratories involved in COVID-19 testing gain and maintain accreditation during this time.

Owing to the high public demand generated by this national emergency, it was accepted that COVID-19 testing had to commence before accreditation was in place. However, it was also recognised that external evaluation of providers was essential to track their progress towards accreditation. In its capacity as the UK's sole National Accreditation Body, UKAS has been working closely with the Department for Health and Social Care (DHSC) to adapt assessment processes to current conditions without compromising standards. As a result, two innovative accreditation processes have been developed, specifically for COVID-19 testing providers.

Fast tracking quality processes

Each laboratory is different in terms of its personnel, equipment, facilities, testing procedures and quality management processes. Laboratories that are already accredited to the relevant standards (either ISO/IEC 17025 for general laboratories or ISO 15189 for medical laboratories) have been able to apply for a fast-tracked extension to scope to cover COVID-19 diagnostic testing. The first accreditations under this simplified process were awarded in June 2020 and UKAS has since conducted over 80 assessments of both public sector and private laboratories, with more than 30 being awarded full accreditation for COVID-19 testing.

The government's overall strategy for dealing with the disease has focused on diagnosing the number of cases in the community. It follows that the majority of the COVID-19 related accreditations awarded to date have been for antigen testing (to see if you have the disease). UKAS has also received a number of applications for COVID-19 antibody testing which are currently being processed.

Private Providers

The number of private providers offering COVID-19 tests has steadily increased throughout the pandemic and rose dramatically after the government introduced limited exemptions to the restrictions on movement. Helping all laboratories deliver high quality testing is a priority for UKAS, regardless of whether they operate in the public or private sector. In November 2020 DHSC announced that private providers of COVID-19 testing wishing to offer general population testing and/or participate in the 'Testing to Release for International Travel' scheme would have to either (a) already hold UKAS accreditation for COVID-19 testing, or (b) meet certain minimum standards[1] and be a UKAS applicant for COVID-19 testing under a new three-stage accreditation process.

The staged approach has been developed to enable progress towards accreditation to be tracked and to enable users to understand where providers are on their journey towards UKAS accreditation. 'Stage 1: UKAS Application' involves completing a self-declaration registration form which is reviewed by UKAS. Successful applicants are listed on the DHSC website[2] and move onto 'Stage 2: UKAS Appraisal', which covers the implementation of 13 key requirements[3] relating to clinical expertise, facilities and equipment, test methods and validation, and governance and documentation. Stage 2 is designed to ensure providers are capable of reaching the required standards of performance and competence, as well as prepare them for a full UKAS accreditation assessment under 'Stage 3: UKAS Accreditation'. UKAS feedbacks to DHSC at all stages of the process, and any laboratory failing to meet the standards required will be removed from DHSC's lists. In March 2021, this scheme was extended to support the list of providers performing the compulsory testing for international arrivals 'day 2&8'.

Remote control

To protect the health and safety of all its staff, assessors and customers, UKAS has been conducting the majority of its assessments remotely. Although the actual assessment process has altered slightly, its objectives, standards of performance and assessment criteria have remained the same. Test providers and laboratories still have to prove they have the same level of competence across the same aspects as they would if an assessment was being conducted on site. The witnessing of the relevant testing activity remains an important part of the accreditation assessment process. Although this would normally be done in person by the UKAS assessment team, the testing can be witnessed remotely in several ways, including live streaming and narrated video.

Once the documents and records have been collated, they are reviewed remotely and discussed with the provider's relevant clinical and technical staff.

To date, UKAS has received over 450 applications from private providers performing swab sampling and/or testing. Testing includes 'point of care' tests, that provide almost immediate results and the laboratory based 'PCR' tests. Many stage 2 assessments have been completed, and stage 3 assessments have commenced. These assessments are providing vital information about the providers' competence and quality improvement processes that enable them to remain on the DHSC list(s).

> By assessing the technical competence of laboratory staff and the facilities, equipment and testing methods used, accreditation generates confidence in the quality and reliability of test results.

[1] https://www.gov.uk/government/publications/testing-to-release-for-international-travel-minimum-standards-for-testing/minimum-standards-for-private-sector-providers-of-covid-19-testing-for-testing-to-release-for-international-travel

[2] https://www.gov.uk/government/publications/testing-to-release-for-international-travel-minimum-standards-for-testing/minimum-standards-for-private-sector-providers-of-covid-19-testing-for-testing-to-release-for-international-travel

[3] https://www.ukas.com/c19-stage2-ukas-appraisal/

InstMC

CEng Chartered Engineer

CHARTERED ENGINEER (CEng)

develop solutions to engineering problems using new or existing technologies, through innovation, creativity and change and/or they may have technical accountability for complex systems with significant levels of risk.

What is professional registration?

- **Recognition** through membership of a relevant Professional Engineering Institution (PEI), that an individual's knowledge, understanding and competence have been assessed and confirmed through Professional Review.
- **Verification** that they have attained the standard required for inclusion on the national register in the appropriate category of registration.
- **Commitment** by an individual to maintaining their competence through Continuing Professional Development (CPD), professional behaviour for the benefit of society and their commitment to the engineering profession.

Registration is open to any competent practising engineer or technician, with different levels and pathways to registration available.

Why you should become professionally registered?

For yourself

- Recognition of your competence as an engineer or technician.
- Demonstrable evidence of your commitment to the profession.
- Internationally recognised status.
- Enhanced career prospects.

For your employer

- Increased technical/managerial credibility.
- Competent workforce.
- Competitive advantage.

For society

- Ensures the public is safeguarded through provision of independent and trustworthy advice, products and services and safe and reliable infrastructure.
- Assurance of ethical and sustainable behaviour.

Chartered Engineers are able to demonstrate

- **The theoretical knowledge to solve problems in new technologies and develop new analytical techniques**
- **Successful application of the knowledge to deliver innovative products and services and/or take technical responsibility for complex engineering systems**
- **Accountability for project, finance and personnel management and managing trade-offs between technical and socio-economic factors**
- **Skill sets necessary to develop other technical staff**
- **Effective interpersonal skills in communicating technical matters**

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For further details and application forms, please visit our website or contact the Director of Membership & Registration on +44 (0) 20 7387 4949 Ext 3 or email: membership@instmc.org

Scan QR Code to apply for professional registration via InstMC

INSTMC SPECIAL INTEREST GROUPS

InstMC SIGs provide an opportunity for like-minded engineers to network, share ideas and expertise, collaborate and learn, and keep updated on industry news and developments.

We currently have 7 Special Interest Groups covering the following technical topics within the measurement and control fields: Cyber Security, Digital Transformation, Explosive Atmospheres, Flow Measurement, Functional Safety, Measurement and Standards. Driven by groups of volunteers who work, or have expertise, within the relevant topic area, SIGs promote the sharing and advancement of knowledge through a range of activities. These include producing white papers and briefing notes, as well as hosting and attending conferences, seminars and exhibitions.

How to Join

Members can join any SIG through the members only area of the InstMC website. Click 'MyInstMC' on the homepage and login to your account. Select 'Manage Personal Details' and under Special Interest Groups, click the 'Edit Special Interest Groups' button. Click 'Join' for any SIG you wish to become a member of.

If you are interested in finding out more about a particular Special Interest Group visit https://www.instmc.org/Special-Interest-Groups or email the relevant contact below.

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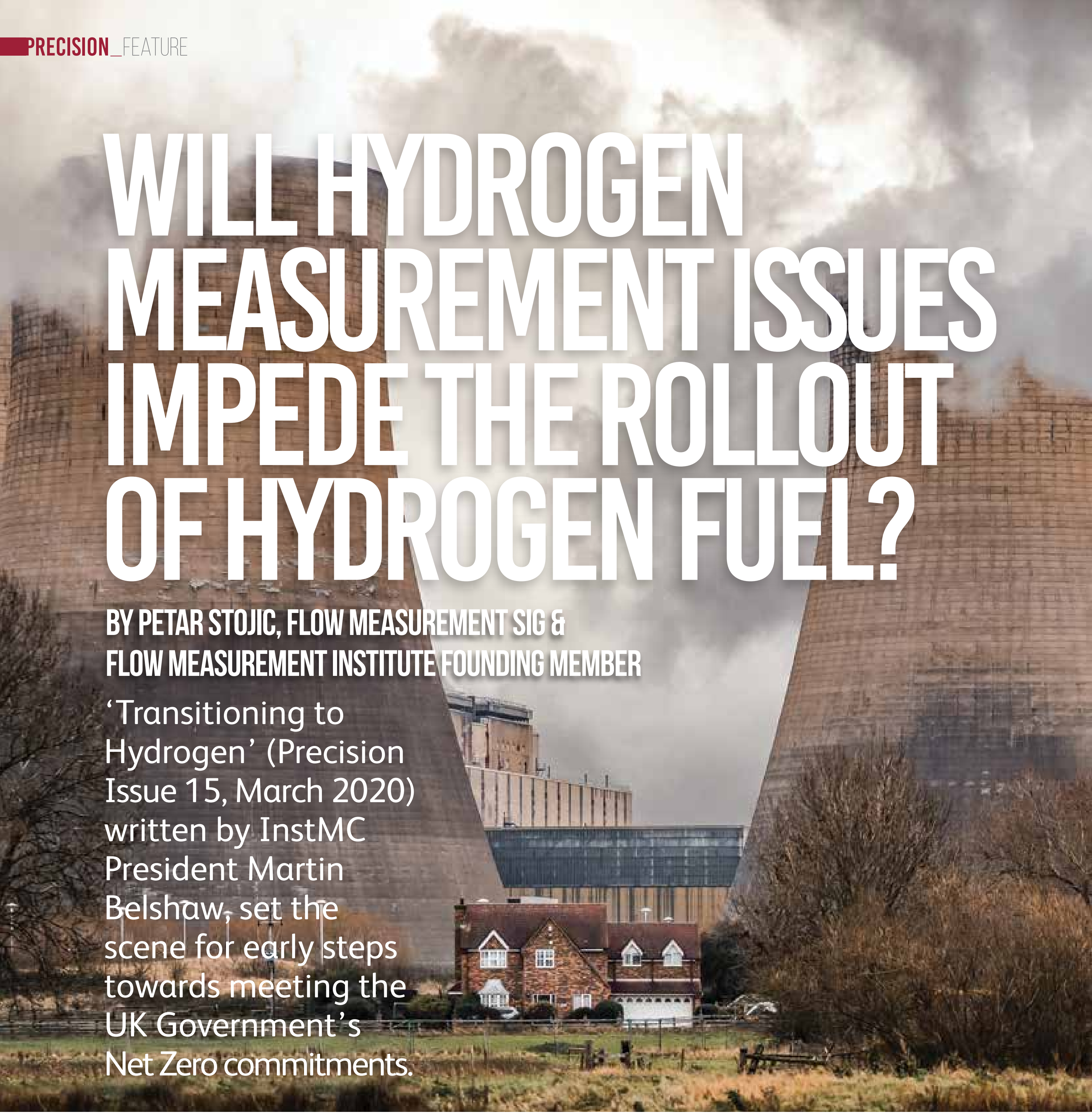

WILL HYDROGEN MEASUREMENT ISSUES IMPEDE THE ROLLOUT OF HYDROGEN FUEL?

BY PETAR STOJIC, FLOW MEASUREMENT SIG & FLOW MEASUREMENT INSTITUTE FOUNDING MEMBER

‘Transitioning to Hydrogen’ (Precision Issue 15, March 2020) written by InstMC President Martin Belshaw, set the scene for early steps towards meeting the UK Government’s Net Zero commitments.

Mention of Net Zero is more frequent, almost daily, in the national press and this month another pilot was announced: two show homes are being built in Gateshead with heating boilers and cooking hobs entirely powered by hydrogen. This follows an earlier announcement of a larger scheme to run 300 homes in Fife on green hydrogen, which should be in operation by the end of next year. Both these pilots address user acceptance issues – demonstrating that normal households can carry on heating their homes and cooking their meals using hydrogen as an alternative to natural gas. It is one step up from proving that arrays of novel equipment work in a laboratory environment.

Suitable Sustainable Alternative

So, if these user trials are a success, does this mean that the widespread use of hydrogen is inevitable? Surely at that point there will be clear evidence that the hydrogen appliances work in a domestic setting and that the households that used them are happy and encountered no discernible difficulty? Well, not quite. Demonstrator projects are not entirely real world – for example, the Gateshead homes will be fed by tanks of hydrogen. The use of hydrogen on a much wider scale, through the current gas network infrastructure (pipes and pumps of varying diameter, orientation and pressure) exposes us to a number of unknowns. The behaviour of North Sea gas (natural gas) is well characterised, but is the same true of hydrogen, either in pure form, or when blended with natural gas? These questions were posed by the Institute's Flow Measurement Special Interest Group (FMSIG). "We'd read several authoritative external reports, saying that hydrogen was the most suitable sustainable alternative to conventional hydrocarbons", said FMSIG Chair Bill Priddy. "Our own informal soundings suggested that there were likely to be considerable measurement issues and we were concerned that these would result in measurement uncertainties that were very different to what consumers have come to expect with natural gas and other conventional fuels. We were also of the view that there were no suitable Flow Measurement Standards in place to underpin widespread adoption of hydrogen as a domestic or industrial fuel. With that in mind we instigated a review to determine whether or not this was the case. The review was conducted by PA Consulting, a Technology Consultancy experienced in conducting such reviews for both Government and corporate clients. Their findings were unambiguous. There are no suitable flow measurement standards for hydrogen and, unless this is addressed it is likely to be a major barrier to the widespread deployment of hydrogen."

Why are flow measurement standards important?

Measurement standards do the following:

- Underpin confidence in the fair exchange of goods for domestic and international trade
- Validate equipment performance claims made by manufacturers
- Help the government to frame effective regulations (e.g. environmental protection, safety, etc.)
- Underpin consumer protection legislation and enforcement
- Underpin those documentary standards (e.g. BSI, ISO, etc.) which require specific accurate measurements

But recognising and proving that a problem exists is not an end in itself. We wanted to ensure that the report's findings and recommendations would make a timely and positive contribution to the deployment of hydrogen as a fuel. In our view the most effective action was putting the facts in front of the key influencers with the greatest stake in making the transition to Net Zero. In this case, the Government Ministers with direct responsibility for Energy Policy, COP 26 under the UK's Presidency, and the National Measurement System (specifically the element that prioritises the development of new measurement standards). InstMC President Martin Belshaw accordingly wrote to Kwasi Kwarteng, MP Secretary of State for Business Energy and Industrial Strategy; Alok Sharma MP, COP 26 President; and others, highlighting the report's findings and recommendations. Martin said: "It is important for the Institute to be at the forefront of identifying where there are critical shortfalls in measurement knowledge and capability, and to bring that to the attention of those who can address such problems. This is, after all, why the Institute was originally founded."

"We've also used the evidence in the Report to contribute to a submission by the Royal Academy of Engineering to the All-Party Parliamentary Group on Net Zero" said Institute Chief Executive, Steff Smith.

"Their findings were unambiguous. There are no suitable flow measurement standards for hydrogen and, unless this is addressed it is likely to be a major barrier to the widespread deployment of hydrogen."

Continued on page 21.

AN INTRODUCTION

The Institute of Measurement and Control is committed to promoting the professional excellence and standing of engineers and technologists at all levels in the automation, instrumentation, control and related industries. Our aims are to serve the public by advancing the science and practice of measurement and control technologies and their various applications, to foster the exchange of views and the communication of knowledge and ideas in these activities, and to promote the professional development and qualification of our members.

In 2017 the Institute launched a new quarterly magazine which is a high quality journal with technical features related to measurement and control. This coffee table type magazine is circulated to the InstMC 3002 individual and 100 company members. It is also aimed at anyone interested in the various uses of measurement and control.
It is a positioning and marketing tool for the Institute as well as raising awareness to a wider audience of the use of measurement and control in the world today.

ADVERTISING RATES

Discounts can be given if 3 or more adverts are taken. POA.

Full Page	£1,375
Half Page	£825
IFC	£2,200
IBC	£2,200
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INSERTS

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Inserts are accepted into Precision magazine and must go to the entire UK circulation.

CIRCULATION BREAKDOWN:

2376 UK Engineers / 626 Overseas Engineers
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PRECISION MAGAZINE

Continued....

"I'd strongly advise people to read the report" said Bill Priddy. "You will get a fuller appreciation of the types of issues that are likely to be encountered. And this isn't just about hydrogen. Moving forward, the Government's 'The Green Industrial Revolution' promotes a number of technology approaches towards achieving Net Zero. Carbon Capture and Storage (CCS) is flagged as a key contributor to Net Zero. We in FMSIG consider it likely that there are no suitable flow measurement standards for Carbon Dioxide either, and that is likely to be our next line of enquiry. But our role is much broader than evidencing key problems; we've also offered our support to the Government in an advisory capacity when they begin to explore options to remedy the flow measurement standards capability gap".

To view the report, visit the InstMC website: www.instmc.org/Special-Interest-Groups/Flow-Measurement/REQUIREMENTS-FOR-LOW-CARBON-FUELS

An illustration of the difference in dispensing Hydrogen and conventional vehicle fuel

Hydrogen Refuelling Stations (HRS) for vehicles come under regulation OIML R-139. New HRS must meet class 2 (+/- 2% when initially certified, +/- 3% once in-service). Old and existing HRS must meet class 4 (+/- 4% when initially certified or +/-5% once in-service).

By comparison, the existing regulatory requirements for petrol and diesel is an 'at the nozzle uncertainty' of -0.5% to +1.0% (at the minimum measured quantity of 5 litres as set out in

OIML R-117). On a £50 fill the maximum the customer could lose out by is just 50p.

However, when filling up a Fuel Cell Electric Vehicle (i.e. Hydrogen vehicle) for the same £50 fill, the customer could lose out by £1.50 - £2.50 depending on the age of the HRS.

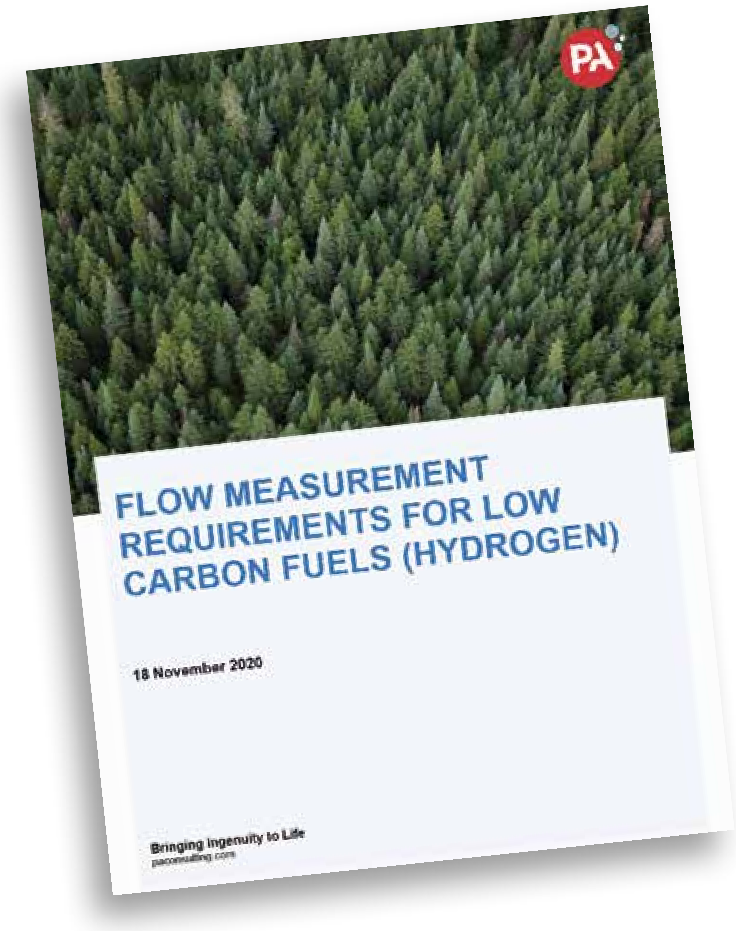
The reason for the discrepancy lies not in any fault in the documentary standards, it is because there are no underpinning flow measurement standards.

Why is hydrogen difficult to measure?

Consider the operating conditions during a typical hydrogen vehicle tank fill.

- The pressure is extremely high (300 – 900 bar depending on the system and components)
- The fluid temperature will swing significantly (from -40 °c to +40 °C)
- The flow rate is unsteady, with major transients throughout

Taken in combination these factors pose very significant challenges to achieving low uncertainty in the mass measurement of dispensed hydrogen.



I'd strongly advise people to read the report" said Bill Priddy. "You will get a fuller appreciation of the types of issues that are likely to be encountered. And this isn't just about hydrogen.

BY FRED MCCLINTOCK CENG MINSTMC MIMECHE MIET, WORLD FUTURE SOCIETY MEMBER

FAR FUTURE TECHNOLOGY: OPTIMISTIC PART 1

This is the first of two articles addressing far future technology from the measurement and control engineers' perspective.

I contend that this era is the best ever for most humans to be alive because our advancing technology continues to improve life.

Since my university days in the mid 1960's, I have been a keen technology futurist and a member of the World Future Society (WFS). I have always been impatient to know about technology that will emerge in 10 years, 100 years and indeed a million years ahead.

When describing the future, it has to be remembered that the history of the future teaches us that everything we think we know now is just an approximation of something we haven't yet found out, so expect the unexpected.

The increasing pace of technological advancement is accelerating all the time. This has come about, in large part, by the birth of the World Wide Web some 32 years ago and has since become humanity's first global information system. Fasten your seatbelts and be ready for an explosion of change.

Each of the technologies described below is categorised as A, B, or C, defined as follows:

A – from 50 to 100 years
B – from 100 to 1,000 years
C – from 1,000 to 1 million years

A
Measuring Future Civilisations – The Kardashev Measurement Scale is a method of measuring a civilisation's level of technological advancement, based on the amount of energy it is able to use. The measure was proposed by celebrated Soviet astronomer Nikolai Kardashev in 1964.

Civilisations are categorised as follows:

Type I - utilises all the energy of the sunlight that falls on the planet.
Type II - utilises all the energy its sun produces.
Type III - utilises the energy of an entire galaxy.

Using this measurement scale, in the year 2021, our human civilisation is not yet sufficiently advanced to register on the scale. For instance, we still get most of our energy from burning dead plants and the dead bodies of our ancestors in the form of coal and oil. However, we may consider ourselves to be somewhere around 0.6 of a Type I civilisation.

It is just possible, all other things being equal, that we could reach the level of Type I within the next 100 years.

A
History of the Future – The history of future prediction teaches us a salutary lesson – some things just don't turn out as we predict. Furthermore, in the past, the future has often been hastened on by war. For instance, NASA's Apollo project of the late 1960's and early 1970's was born out of the tensions created by the Cold War.

It is a marvel that it has taken just over 100 years to go from the Wright brothers to flying a helicopter by remote control on Mars.

It might be of interest for measurement and control engineers to visit once more the works of Leonardo Da Vinci to determine whether some of his inventions of 500 years ago may yet be waiting to be realised.

B
Detecting Other Dimensions – We live in more dimensions than we can see, because how we perceive nature is not how nature actually is. The human animal perceives only the familiar three spatial dimensions plus the dimension of time. However, the current version of string theory (M-theory) requires 11 dimensions.

Using future high fidelity measuring instruments, probably successors to the Large Hadron Collider (LHC), centuries in the future it ought to be possible to sense and quantify these other dimensions. It will then be interesting to find out whether life, but not as we know it, has found a way of inhabiting one or more of these other dimensions.

A, B
Atomically Precise Manufacture – Imagine we were much better at making things, such that we could produce radically more of what people want and at much lower cost.

Modern day manufacturing processes, including 3D printing, are 'clunky', wasteful and inefficient. Also, they cannot be used to create products that require an extreme degree of precision due to their large-scale nature.

Atomically precise manufacturing will have the precision to create extremely sensitive products. These will include much more efficient photovoltaic systems for electricity generation and room-temperature superconductors for greatly increased energy transmission efficiency. We can also expect web-enabled artificial retinas, brain augmentation prostheses and devices for the direct removal of carbon in the atmosphere (artificial trees) on a grand scale.

The ultra-high-fidelity instruments required to achieve atomically precise manufacturing will be designed and developed by future measurement and control engineers and will in the future be covered by undergraduate engineering courses.

B

Artificial Consciousness – A full understanding of animal/human consciousness (not intelligence) is required for humans to truly take charge of their evolution. Currently, we have a number of rather primitive theories, the foremost two of which are (1) Integrated Information Theory (IIT) and (2) Global Workspace Theory (GWT).

To what extent are human beings conscious? I suggest that human consciousness is quite limited. Once we have a complete understanding, we will be able to create machines that have a significantly higher level of consciousness than humans currently possess. We are perhaps one hundred to five hundred years away from having a full understanding. But when we do reach that point, we can expect to be able to create artificial sentient life forms, cyborgs if you will, with the ability to travel to and explore other worlds in the Milky Way.

B

Constructing Space Elevators – The design, construction and maintenance of space elevators offers a veritable paradise for measurement and control engineers.

At present we use rocket technology (as originally developed by the ancient Chinese) to get into space. A better way could be by means of the space elevator.

A space elevator is essentially a long cable probably made of carbon nanotube composite ribbon extending from the planet's surface into space with its centre of mass at geostationary earth orbit (GEO), 35,786 km in altitude. Electromagnetic vehicles travelling along the cable will serve as a mass transportation system for moving people, payloads, and power between Earth and space.

B

Whole Brain Emulation – In the next century it will be possible for measurement and control engineers to scan human brains at a fine enough (submicron) spatial and chemical resolution, to create cell-by-cell dynamically executable models.

These model brains would be built using computer hardware of the future, perhaps nano-scale quantum dot hardware. The signal input-output behaviour would be indistinguishable to that of the original brains.

It can be anticipated that this technology will be covered in future measurement and control undergraduate courses.

C

Speed of Light Travel - There is one way in which it will be possible to travel at the speed of light and that is to create your 'connectome' (a comprehensive map of all neural connections in the brain) so that all your memories, feelings and thoughts are captured digitally, including the essence of your consciousness.

You will then become a pure energy being, free from all material constraints. Your connectome could be beamed (laser ported) at the speed of light wherever you want to go in the universe and beyond.

C

Constructing a Dyson Sphere - The Dyson sphere concept was popularised by the British born theoretical physicist and mathematician, Freeman Dyson, in a 1960 paper. Commonly envisaged as an engineered spherical shell around our Sun, or some other sun in the galaxy, the shell would collect and deploy the full power of the Sun's output. This is equivalent to around 30 trillion times the power consumption of humanity today.

It is certainly an engineering project for the far future. The scale is so large that it is difficult to imagine the measurement and control engineer's role, other than to say they will definitely have one.

A

The Future of Measurement – The textbook interpretation of quantum mechanics states that the conscious measurer affects the quantity being measured, through the very act of making that measurement. Therefore, there must always be measurement uncertainty. Yet after a century of spirited debate, there is still no consensus on exactly why this comes about and how to think of the quantum measurer. This was the reason Einstein in his theory of general relativity, considered the measurer to be a disembodied, fictitious, massless entity having no effect whatsoever on that which is measured.

This state of affairs ought to be intolerable for all measurement engineers. Over the next 100 years say, measurement engineers must therefore work towards making the quantum world more fully understood, and therefore explainable to school children, as opposed to the current ideas which are difficult to comprehend, even by the finest scientific minds of today.

C

Seeding Life Throughout the Universe – If human beings are alone in the universe, it surely must be our destiny to seed life throughout it. From this standpoint some scientists believe that humankind has a narrow window of opportunity. We have no way of knowing how long it will last. One hundred years? One million years?

Whatever the case is, now is the time to do the necessary scientific and engineering experiments; to take the risks; to explore the universe and seed life (in humanity's image) throughout it.

Part 2 will feature in the September 2021 issue, sounding a more cautious note and considering major threats such as human extinction.

LOCAL SECTION NEWS

LONDON

'Digitalization in Vehicle Manufacturing' presented by Rockwell Automation 9th February

Rockwell Automation advised that the growing consumer demand for electric vehicles is pressuring brand owners and suppliers to shift processes and technology to serve these changing market needs. For most automakers, a race is on to accelerate electric vehicle production with smart, flexible operations and integrated automation solutions.

It was suggested an integrated automation architecture would be the foundation to bring the vehicle manufacturing industry concepts to life. To access the right information at the right time is required to make important operational decisions. It also enables easy integration of equipment into a manufacturer's plant and very quick reactions to various vehicle market demands.

An integrated architecture uses control and information systems that share a common network, control platform, data structures and design environment. A single network can seamlessly connect plant systems to each other and to the rest of the plant's equipment. While common, standardised data structures can more easily help pull data from across plant operations and turn it into actionable information for all production employees.

Scalable Infrastructure: These offerings would converge plant networks, connect production plant and business systems, and give production employees access to information to make quality decisions.

Rockwell stated that their Infrastructure-as-a-service (IaaS) system, could reduce the problems and issues in designing, deploying, and maintaining a network infrastructure. IaaS combines pre-engineered network solutions, on-site configuration and 24/7 remote monitoring into a single contract. It can use technologies and architectures which can optimize the performance, efficiency, and uptime of companies' network architectures.

Independent Cart Technology (ICT): Systems built with this technology will advance electric-vehicle production, offering the potential of higher line speeds and reduced downtime. It allows companies to move small components, or even full car bodies, around a plant faster and more precisely than conventional mechanical solutions. This will speed up production in a traditional body shop or in areas such as battery cell and pack production, where high-speed conveyance has proven to be a challenge.

These foundations allow any company to deploy smart technologies and capabilities that can help EV operations run faster and with more flexibility.

Rockwell advised the solutions to be considered should include:

ICT systems will achieve with the push of a button fast changeovers. These systems also have fewer moving parts, which should reduce maintenance needs and improving uptime.

Scalable Manufacturing Execution System (MES): Individual MES applications can help companies to understand and manage production, without investing in a full MES software package.

These applications address specific challenges, such as quality, machine performance or genealogy and track and trace. You can start at the machine or work-area level with a single application and minimal infrastructure requirements. Companies can add other applications or scale up to an integrated-MES solution as plants grow production and realise return on investment (ROI).

Automation's simulation software is designed to prototype and test machines before they are built. Rockwell's 'Teamtechnik' performs functional testing to confirm performance before building the drive into the electric vehicle.

The challenge for EV and battery manufacturers is to accelerate production at a sufficient rate to meet demand in the short term. They also need to future-proof their production operations for further inevitable innovations.

Automakers require a shift to data-driven manufacturing in a highly flexible and connected environment. Manufacturers need to connect the plant floor with business systems to deliver information to drive business analytics and better business decisions. The seamless supply chain connectivity and operation will improve cost efficiency and product quality, together with built in flexibility and scalability, to leverage emerging technologies.

Barry O'Regan
Hon. Sec, London Section

IRELAND

Webinar: TeV Gamma Ray Astronomy – from Dustbins to Dark Matter

The newly formed Ireland section held its first online technical event on the 9th February, that was attended by a cohort of section members and guests.

Dr. Josh Reynolds of Munster Technological University (MTU) provided an engaging presentation entitled "TeV Gamma Ray Astronomy – from Dustbins to Dark Matter". Ranging from topics on the science behind Gamma Ray Astronomy to the instrumentation involved, Dr. Reynolds detailed his own interest in the field that stemmed from his time spent as firstly a graduate student, and later a Post Doc, in the Whipple Mountain observatory in Arizona, USA.

Cosmic rays, discovered in 1912 by Victor Hess, occur at altitudes of up to 5.3km. During a flight to study the effects of ionizing radiation during a solar eclipse, Hess discovered the source was not the Sun. Mostly composed of charged particles, some cosmic rays can have extraordinarily high energies, some reaching macroscopic energies of ~30 joules.

It proved difficult to track the source of these cosmic rays, as charged particles are deflected by magnetic fields. However, as gamma rays are uncharged, they travel in a straight line. Very-high-energy gamma ray photons that are detected by ground-based telescopes are in the TeV range, ~1012 eV. This is 12 orders of magnitude in energy difference to the energy contained in a single photon, (1 eV).

The majority of gamma rays never make it to ground level due to their interaction with the atmosphere.

Early and continuing efforts to detect cosmic gamma rays relied on satellites, however these were limited by the flux of the gamma ray photons. The solution was found in the properties of Cherenkov light.

First noted by Marie Curie, all radioactive sources exhibit a radioactive glow when submerged in water. Cherenkov explained this phenomenon in his PhD thesis of 1934, as particles travelling faster than the speed of light in the medium, similar to a sonic boom in sound.

The first atmospheric Cherenkov detector, "The Dustbin" was literally a repurposed dustbin, containing a simple phototube and pulse counting electronics. There were many attempts at capturing data which ended with no discernible results, until in 1983, when a group of Irish scientists decided to investigate the use of Cherenkov flash shape as a discriminant between gamma rays and a nucleonic background. A 37-pixel camera with customised electronics was placed at the focal point of the Whipple 10m reflector. This was able to discriminate between gamma ray flashes and background flashes on the basis of shape.

After extensive observations of a number of galactic and extragalactic sources, gamma rays were conclusively observed in the Crab Nebula, and the findings were published in the 1989 Astrophysical Journal.

TeV Gamma Ray Astronomy has now been accepted into the mainstream and continues to develop. Future plans include the development of a Cherenkov Telescope Array, which will improve sensitivity over current arrays by up to a factor of 10. This will produce significant data rates of approximately 370TB/day.

Frank Hallissey,
Ireland Section.

"Early and continuing efforts to detect cosmic gamma rays relied on satellites, however these were limited by the flux of the gamma ray photons. The solution was found in the properties of Cherenkov light."

VIRTUAL

InstMC

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27th October 2021

Institute of Measurement and Control

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LOCAL SECTION NEWS

CENTRAL SCOTLAND

Central Scotland has held two online seminars via Microsoft Teams this year. These presentations were hosted by Rob Stockham (Gantner Instruments), Stephen Tomlinson and Dayna Seay (SGN).

'Optical Sensor Measurements' presented by Rob Stockham on 8th February

There are some applications where optical sensors can perhaps offer some advantages over conventional 'electrical physics' measurements. Optical sensors can provide better data quality against traditional electrical sensing technologies such as thermocouples, foil strain gauges and piezoelectric elements.

This online seminar covered Fibre Bragg Gratings (FBGs) and optical sensor products including: temperature, strain, pressure, vibration, tilt and displacement. Other custom sensors covered included isolation from electrical interference (EMI, RFI), high voltage isolation, resilience to ionising radiation, wide temperature ranges and hazardous area applications.

'Project Hydrogen 100 (H100 Fife)' presented by Stephen Tomlinson & Dayna Seay on 19th April.

The H100 project is the first of its kind to employ a direct supply of clean power to produce hydrogen for domestic heating. This lecture focused on explaining the clean energy combination design of the project. This will be a purpose-built generation and storage solution, supplying a distribution network, comprising of a 7MW offshore wind turbine supplying power to electrolyser units for green hydrogen production. The hydrogen will be stored in above-ground 30bar storage tanks and flow through pressure reduction, metering and gas odorisation before reaching the low-pressure polyethylene distribution network.

The project aims to deliver a first-of-a-kind 100 % hydrogen distribution network, supplying around 300 domestic properties initially. The demonstration of an end-to-end hydrogen solution for heat, and potential future phases across the whole system is an essential step towards energy system transformation and a key step on the pathway to net-zero emissions.

We are continuing technical lectures for the rest of the year on topics related to engineering and instrumentation that might be of interest. Thanks to all those who have attended so far. Please, check the Events page on the InstMC website for details of the online seminars scheduled in the following months.

Carolina De la Cruz
Events Coordinator
Central Scotland Local Section

CENTRAL NORTHWEST

Our 2021 technical lecture series commenced in February this year. The committee decided to try a new time slot of 12 noon to run the sessions as a 'lunch and learn' style (without the lunch of course!) whilst we are still running these sessions virtually via MS Teams.

In February, HTS Group presented on the use of technology for conducting ATEX inspections. The presentation shared the advantages and disadvantages of paper-based and cloud-based ATEX inspection asset management systems. Exploring the array of different cloud-based options available on the market and how they can improve the management of existing ATEX inspection systems.

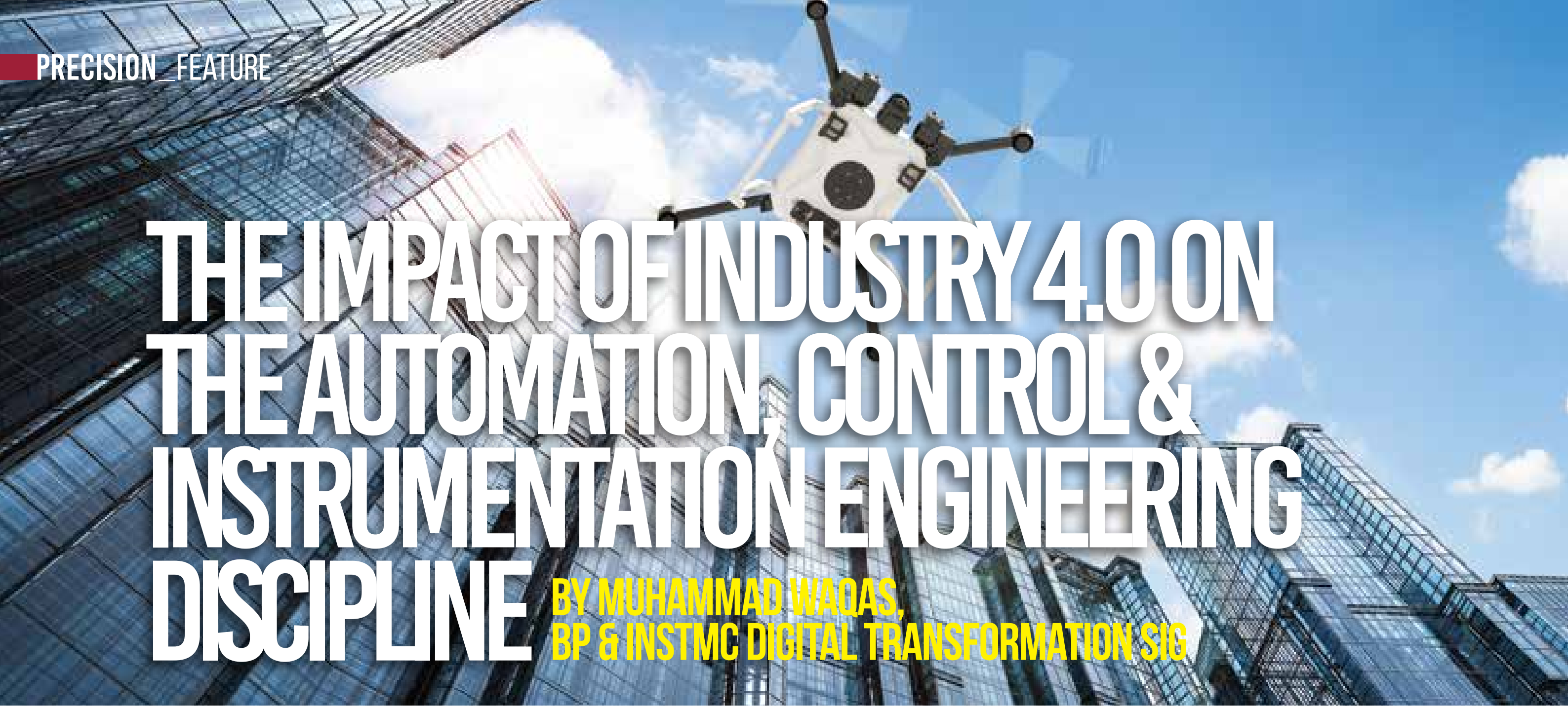
In March, RPS Group presented on the topic of 'Defining good practice for Fire and Gas Detector Mapping – an overview of the recently published British Standard BS 60080:2020'. This presentation gave an overview of what can be considered good practice with respect to fire and gas detector mapping and highlighted key points from the standard. The presentation was enlightening on the progress being made in the standards, to enable a standard approach across different companies in an area that traditionally has been reliant on company standards.

Both sessions were extremely well attended, and we will be continuing the lunchtime sessions for the remainder of 2021. We took a break from events in April due to the Easter holidays.

The session recordings are being uploaded to the InstMC You Tube channel so take a look and subscribe so you can be notified when a new video is added.

The programme for the remainder of the year is online, apart from in November, when the HSE will provide a presentation which is still being confirmed. Keep an eye on the website - https://www.instmc.org/Events for further details.

Dave Green
Local Section Chair
Central Northwest



THE IMPACT OF INDUSTRY 4.0 ON THE AUTOMATION, CONTROL & INSTRUMENTATION ENGINEERING DISCIPLINE

BY MUHAMMAD WAQAS, BP & INSTMC DIGITAL TRANSFORMATION SIG

I have worked in the Oil & Gas sector throughout my professional career as an Automation, Controls & Instrumentation Discipline Engineer. When I started my career, Distributed Control System (DCS) was very popular and well-known throughout the industry. HART-based smart instrumentation was spread across the profession and then, with time, technology improved, and I saw the transition from analogue smart instrumentation systems to fully digital smart systems with more functionalities and powerful diagnostics capabilities. This was just the beginning of the so-called 'technology evolution'. Now Industry 4.0 is here and changing the world order.

So, the key questions to consider are as follows.

1. How do we see the impact of Industry 4.0 (and beyond) on the engineering discipline with respect to workflows, the way we look into problem solving, systems performance improvement and cost-effectiveness?

2. How do we think this would impact the I&C engineering competences, knowledge and expertise? For example, would the core skills be the same but with the adoption of new technologies and applications – how would we need to consider upskilling our I&C engineering community?

3. How would we influence the community and make sure they are getting the right insights and support for their learning, development and growth – which of course links with the organisational growth?

The above questions are vital for our engineering community. Responses to those questions would help our practice community develop their mindset for success.

Let's start looking at some of the key areas under Industry 4.0 one by one.

Data Analytics: Use of data for performance analysis, incident investigation, root cause analysis, cost optimisation is not new in the industry. However, the extent of data use and the way we use the data has changed and is still changing. Nowadays data-driven decisions are allowing business to take quality and timely valued decisions. In our discipline, we have a lot of data available from ICSS (integrated control and safety system), third party control systems, smart/intelligent instrumentation, that is not being fully utilised – if this data is explored and worked out properly for creating business value then it would be a further game changer.

IoT/Cloud Computing: Although this falls under IT, there are various applications of Industrial IoT /Cloud based solutions being implemented in oil & gas. So, a better understanding would help us to not only work on such systems but develop solutions too.

AI/Machine Learning: I see huge applications for AI/machine learning in oil & gas – for example, as I mentioned above, there is a lot of unstructured data available from various data sources, however, we still don't know how to best utilise this available data to provide value for the business. If we use machine learning models, then we can probably come up with some valuable solutions.

Digital Twin/Augmented Reality: Is changing the way we work and run assets and will soon fall under the critical skills category.

Cyber Security: Due to increasing complexity in the advanced applications and technology integration with ICSS systems, cyber security has now become an essential and critical skill set for automation engineers.

Discussion with InstMC Digital Transformation SIG Panel:

I had an opportunity to present the above questions to the Institute's Digital Transformation Special Interest Group (SIG) members.

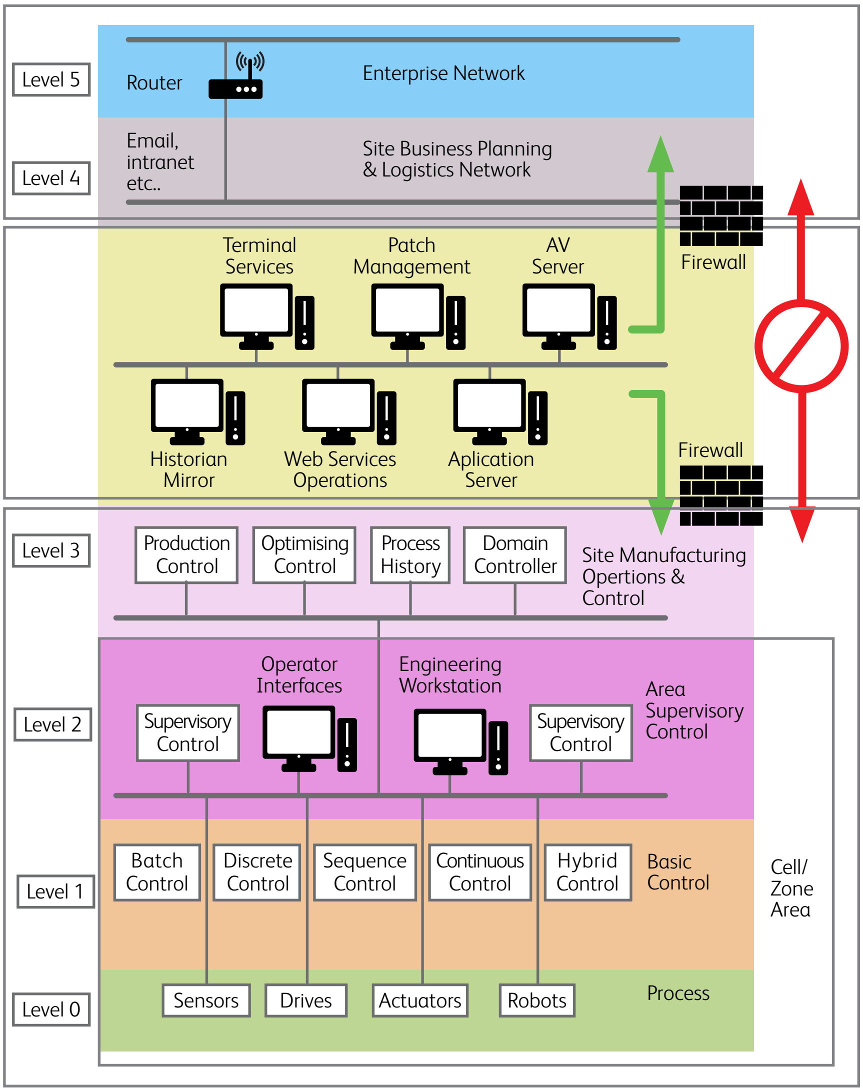
The discussion which followed came up with the following:

- There is a lot of hype and confusion, with a lack of focus. It's easy to get stuck in a swamp of terminology. DT SIG is more encompassing.
- There is no need for a change to the traditional controls & instrumentation engineering skills set. These skills are and will remain in demand for the industry. The key here is to understand the

importance of learning new skills or upskilling the I&C Engineering community in line with market trends. These will be hybridised to suit while Digital Transformation sits as a layer on top. With the technological development and adoption of digital solutions, the world is now looking for smarter digital workplaces and solutions for their business.

- On the Purdue Model, levels 0,1, 2 & 3 will always need people with basic engineering skills to set the foundations (refer to figure 1).
- Industry 4.0 has moved things forward. Again, there will always be a job for control engineers in levels 0,1,2, 3 but for the higher levels, they may want to specialise. However, there is no need to become a specialist but to be aware of the new technologies and their applications. For example, they need an appreciation of analytics, cloud structure, cyber etc. The traditional skills will still be needed for years to come.
- Industry will want to make applications faster. Some applications may be run and managed outside, but things that are critical will be close. There will be a 'skill evolution' from awareness to the need for programming skills. IT people will become more integrated with engineering. There is a role for management to prepare these people. Some will be new people some will evolve. Take away the confusion and address the concerns. Some people may find it difficult to evolve so managers need to be aware and help them adapt through conversation.

Figure 1: Purdue Model [Ref: Purdue Model for Control Hierarchy [18] | Download Scientific Diagram (researchgate.net)].



- We will need more 'tech-savvy' human resources to enable advanced workforce planning; a modern career path; rotation and secondments.
- We all agree that there is a core set of skills needed. Some will become redundant, but it's hard to know which. For example, when current older engineers started out, we needed to learn to weld. It was not needed but we could understand those who did. We spent long hours in drawing shops, which is also not needed now, but we still need to understand how to read a drawing. For today's engineers, learning Python is something they need to do. Not to program, but to understand and to be able to talk with data scientists. So, this is a 'core skill' today.
- More and more we are moving to true "just in time" production. Interdisciplinary teams are needed to support this.
- We need disciplines organised around outcomes rather than inputs. Supply chain engineers will be a big deal in the future. Another example is production engineering, which is a multi-skilled job. In the future we will draw on specialists as a service, for example, instrument engineers.

Conclusion:

Industry 4.0 has changed and will continue to change the automation, control and instrumentation industry. It will change some people's roles and responsibilities and will introduce new ones too. Some roles will need to be multi-disciplinary, but the need for traditional, core engineering skills will not disappear.

The ability to specialise in the new tools and methodologies introduced by Industry 4.0 will help engineers to get a better picture of operations. This will enable safer and more economical processes. But, as with previous generations, the skills needed for Industry 4.0 and beyond will be an evolutionary process, built on those important core skills.

COMPANION COMPANY SCHEME (CCS) SHOWCASE

The InstMC Companion Company Scheme has been running since 1992, enabling companies to raise their profile amongst our membership of 3,000 professional engineers in the measurement, automation and control sectors.

There are opportunities to network with other businesses, InstMC accredited universities and with individual members, at local and regional level, through Local Sections and Special Interest Groups. We currently have 78 CCS members and are pleased to introduce some of them to you here.

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NPL is the UK's National Metrology Institute, providing the measurement capability that underpins the UK's prosperity and quality of life.

From new antibiotics to tackle resistance and more effective cancer treatments, to secure quantum communications and superfast 5G, technological advances must be built on a foundation of reliable measurement to succeed. Building on over a century's worth of expertise, our science, engineering and technology provides this foundation. We save lives, protect the environment and enable citizens to feel safe and secure, as well as support international trade and commercial innovation. As a national laboratory, our advice is always impartial and independent, meaning consumers, investors, policymakers and entrepreneurs can always rely on the work we do. Based in Teddington, south-west London, NPL employs over 600 scientists. NPL also has regional bases across the UK, including at the University of Surrey, the University of Strathclyde, the University of Cambridge and the University of Huddersfield's 3M Buckley Innovation Centre.

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National Physical Laboratory

SILC – PUTTING THE SENSE INTO SENSING

Pete Loftus, Chair of the UK Sensing Innovation Leadership Council (SILC), reflects on the sensing landscape and what SILC is doing.

Sensing is everywhere. We see, or often don't see, sensors distributed around buildings and infrastructure, in cars, white goods, smart phones, and on the factory floor.

Given the extent of sensing, one might be forgiven for thinking that the sector is in great shape and does not need further help. However, it is interesting to consider where sensing is not. As a society, we are reluctant to trust sensing with some of the highest criticality applications - nuclear plant employs sensing very frugally compared to automotive for example, we don't want to trust sensors with life and death decisions without human input or extensive redundancy. Cyber security concerns limit their application in personal settings as well. So, there are issues with trust and data pedigree. Where we do expose sensed data to public consumption, the finite uncertainties involved often cause great confusion. An example is the widespread confusion over interpreting tests for COVID-19 infection. Beyond public consumption, the big end-user businesses in all sectors also find sensing a challenge. To the end user, the sensor performance may not be transparent, sensing systems often lack the computational

modelling that supports the design of the end use system. When designing a system, the challenge of trading options to sense different parameters using sensors which have poorly articulated and differing levels of performance, stretches the systems engineering discipline in many businesses.

> The dual impacts of a pandemic and the biggest change in trading agreements for decades has exposed supply chain weaknesses.

Diversity in sensing is obvious — in-vitro sensing in medicine looks very different from remote observation by satellite; or sensing to control manufacturing processes – and it is tempting to think that all these fields are unconnected with little opportunity to collaborate and learn between disciplines. However, there is common ground and opportunity to widen and deepen the connections to the benefit of all. If we just look to the data trust issue, the different application domains have all developed different ways to describe the performance of a sensing system. So, even the performance of lateral flow and temperature-based tests for the presence of infection are described differently making it challenging for even experts to compare their impact. These differences in practice can and should, be highlighted, and shared approaches identified. There is also common ground in cyber security, sensor digital twins, and specialised sensor manufacturing techniques to name but a few.

What of sensing innovation in the UK? Well, investment and progress in research is very strong. The research councils, and Innovate UK invest well over £60m per annum in sensing R&D. Much is hard to see and funds the development of innovative applications of sensing without being identified as such. Industry though does not reflect quite such a rosy picture. The dual impacts of a pandemic and the biggest change in trading agreements for decades has exposed supply chain weaknesses. They have also highlighted that, despite the R&D investment by the UK, relatively few sensors are made here, and bringing new ones to market is a challenge. Not only is the UK losing out on income and growth that a more active sensing industry sector might provide, but end user companies in the UK are deprived of the domestic support for innovation in applications that might enable them to build greater functionality into products and processes and better compete on the world stage.

ACCREDITATION CORNER ASK TREVOR

Trevor welcomes questions from readers of Accreditation Corner about any aspect of Metrology and Accreditation. In this issue he tackles three issues recently seen in questions:

Q: "I have an infra-red (IR) temperature measuring instrument that the manufacturer claims has an accuracy of 1 °C but when I compare it with other devices I find the readings vary by 20 °C or even 100 °C. How can this be?"

A: In many areas of metrology, the measurement you make is not of the actual variable of interest but of something else considered proportional to it. Temperature is a clear example of this. Very few temperature measuring instruments are actually measuring temperature, they measure something else that varies with temperature.

Some examples are thermistors (electrical resistance),thermocouples (voltage), liquid-in-Glass (fluid volume), pyrometer (colour temperature). Each of these has advantages and disadvantages. Thermocouples are cheap and easy to place. Liquid-in-glass are very stable once calibrated.

Some devices take heat out from a surface, others may apply heating. This is particularly troublesome on thin materials or substrates.

Non-Contact thermometers, including IR, have the impressive advantage that they, unlike most others, do not take heat or put heat into the measuring position and are easy to use. They are, however, the most complex technically and suffer from being affected by a myriad of non-temperature variables like surface emissivity, reflectivity and absorption at different temperatures and surfaces, also spot size, and focus issues, all affecting the reading in a given situation. That environment is necessarily usually different from the conditions during calibration.

So, even the most careful manufacturer will have calibration data under their conditions, not yours! Using a competent credible calibration laboratory, such as one UKAS accredited for the measurement concerned, will ensure that you have results appropriate to the conditions in that laboratory and those conditions should be shown on the certificate. Carefully written specifications, constrained to certain conditions, may be true statements from the manufacturer but these rarely pertain in practical industrial working conditions.

For many process applications it is changes in temperature that matter as you have developed your potentially successful process using whatever temperature kit you have, and it is the delta-t that you really need to monitor. With other factors constant, and reasonable linearity, many of these problems disappear. It is then that thermometers with great convenience like IR appear so attractive for non-intrusive in-process work.

The bottom line? Good temperature measurement is not easy, but an appreciation of the principles in your application helps you understand and overcome any issues!

Q: I have bought a new multimeter and it comes with a certificate that says "Fully Calibrated to Specification and traceable to NIST" how long may I delay having it recalibrated?

A: Several issues come to mind with this question.

Firstly, one has to decide how acceptable the original certificate is. A certificate containing no data or measurement uncertainty should be treated with suspicion anyway. Maybe the specification is well written and expressed in detail such that you may conclude how well the instrument performs at your measurement points. Often, however, this is not the case and the results of a point-by-point calibration with the associated uncertainty of measurement will help you establish if it meets your needs.

Secondly, a new instrument is just as worthy of calibration as much as an older one, especially if the manufacturer or importer does not provide a convincing certificate. It is after a few calibrations that one may review the frequency of calibration according to any drift seen.

Thirdly, "traceable to NIST", to NPL or to PTB for example may mean little. This is usually a claim that the calibration was made against an instrument that had been calibrated somewhere where they too use an instrument "traceable to NIST". This typically does not speak for the competence of the people using the equipment or the appropriateness of their procedures or environment. The formal definition of metrological traceability is fine as it requires a fully documented chain of competent activity.

In practice it is most advisable to use a calibration laboratory accredited by a national accreditation body for the measurements concerned. This should provide assurance that not only was the right equipment used but that also the people were competent, and that the validity of the results was assured by some form of inter-laboratory comparison or proficiency testing.

Trevor Thompson is an experienced metrologist and accreditation specialist, semi-retired from UKAS and is now independent. He will answer questions for InstMC Precision at questions@bestmeasurement.com.

SPOTLIGHT ON STAFF:

Q&A with InstMC Staff Member Steff Smith, Chief Executive

How long have you been with InstMC?

I joined in the autumn of 2017 as a Project Manager, so about 3 and half years now.

What is your background?

I could not decide between studying History or Sciences at University, so I did a BA in Archaeology followed by an MSc which I loved. I knew I wanted to continue to work in fields related to Science and Technology and having established that there are not a huge number of Archaeological Laboratory positions, I worked for the British Measurement and Testing Association and Evaluation International as Technical Executive gaining valuable experience before moving to the Institute.

What is your role at InstMC?

Chief Executive

Can you describe a typical day in the office?

There isn't one really. Pre pandemic a typical week would usually involve two or three days in the office with the rest of the Team, a day or so working at home and then often another day spent off site at an external meeting or event with existing or potential partners.

What do you bring to the team?

Having started at the Institute in a more junior role first, I got the opportunity to get to know my colleagues and how the Institute works from the bottom to the top which I feel gives me insight and a good overview of the Institute as a whole, including being able to see its strengths and weaknesses.

What do you like best about working for the InstMC?

I like problem solving and researching new things, so coming up with ways of improving the Institute and planning future strategy are some of my favourite parts. I also enjoy working directly with people, so I really enjoy managing the staff and working

with all our volunteers.

What do you do to unwind, once your working day is over?

We've got a large and energetic Labrador/Greyhound who likes a lot of exercise, so one of my favourite things to do to relax is go on long country walks that end at a nice pub.

Can you tell us a fun fact about yourself?

I can juggle and ride a unicycle (unfortunately not at the same time!)

LEAVING A LEGACY

Over the years, we have received a number of bequests from members, for which we are very grateful. As a registered charity, the Institute of Measurement and Control is fortunate to be able to use any gifts from members to help support the future of engineering through its work. If you are considering charities in your will and would like to have a confidential discussion regarding this, please get in touch with steff.smith@instmc.org.

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Method Compliance Assessment Ltd is part of the =Method group.
See our article on Prior Use inside this edition.

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