THE MAGAZINE OF THE INSTITUTE OF MEASUREMENT AND CONTROL INSTMC.ORG

# THE DAWN OF SCIENTIFIC MEASUREMENT: MEASURING THE LENGTH OF THE YEAR AND THE ANTIKYTHERA MECHANISM C. 2500 BCE – 70 BCE

THE FUTURE OF MEASUREMENT AND CONTROL IN THE WATER INDUSTRY

NOVEL SELF-LEARNING OPTIMISER GIVES HIGHER ROI

CLAMP-ON ULTRASONIC FLOW METERS – THE KEY TO SMARTER WATER MANAGEMENT

SEPTEMBER 2024 ISSUE 33

# PRECISION

# WHAT DO I GET?

# INSTMC MEMBERSHIP

## Internationally recognised professional qualifications including:

CEng Chartered Engineer

IEng Incorporated Engineer

EngTech Engineering Technician

- Recognition of your professional status through use of post-nominal letters, MInstMC (Corporate Member), FInstMC (Fellow) and TInstMC (Technician Member)
- Opportunity for qualified employees to apply for specialist engineer status; Registered Functional Safety Engineer (RFSE) and Registered Explosive Atmospheres Engineer (RExE)
- Career and Professional Development guidance and support including mentoring, accreditation of employers training and development programmes
- Participation in a Local Section and Special Interest Groups to network, attend events and share expertise and knowledge
- Opportunities to participate in the proceedings of an influential Institution through mentoring, accreditation, technical panels, seminars and conferences
- Free copy of our quarterly PRECISION magazine and The Wire monthly digital newsletter, plus access to the members only section of our website and technical online library

**Scan QR Code to apply for membership**

InstMC

For further details and application forms, please visit www.instmc.org/membership or contact the Director of Membership & Registration: membership@instmc.org

IMC/MEMFYR03-260124

# ENGINEERING ROLE MODELS - NATIONAL ENGINEERING DAY 2024

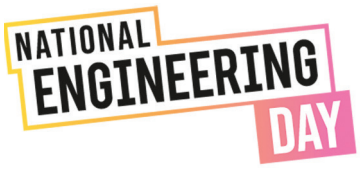
13 November 2024 is National Engineering Day (formerly This is Engineering Day), a day that aims to make the UK's engineers and engineering more visible and celebrate how they improve everyday lives and shape the world around us.

Who do you look up to? Who inspired you to be who you are today? Who should be an inspiration to the next generation of engineers?

These are some of the questions we'll be discussing on National Engineering Day, 13 November 2024, in a bid to recruit a new, more diverse generation of engineers.

**Why does diversity matter? In a word, seatbelts.**

The three-point car seatbelt has saved countless lives (>1m) since Swedish engineer Nils Bohlin invented it for Volvo in 1959.




Wearing a seat belt has been a legal requirement in the UK since 1983. But not one study has been conducted on how breast tissue affects seat belt placement. Or that the seatbelt hasn't been redesigned to make it more comfortable for women.

The inclusion deficit is not limited just to seatbelts. Other examples include automatic soap dispensers that are unable to detect dark skin, cars that are less safe for women because they were tested using male crash test dummies, public transport systems and digital services that are not accessible for disabled people.

If we are to engineer a more inclusive, accessible-to-all future, it's imperative that the engineering profession recruits from and draws on the experience and input from all sections of society.

Of today's engineering workforce only 16% are women and 10% are black, Asian, minority ethnic. That statistic has to change if we are to engineer a more inclusive, accessible-to-all future. To meet that ambition, the engineering profession needs to recruit from and draw on the experience and input from all sections of society.

This is why for National Engineering Day 2024 we'll be celebrating engineering role models by creating a series of statues of engineers whose stories and engineering achievements meet the criteria that makes someone an aspirational role model for the next, more diverse generation of engineers.

How many people who walk past the statues of engineering greats like Isambard Kingdom Brunel, George Stephenson or Joseph Bazalgette think engineering is for people other than those who've been immortalised in stone and bronze? How many white, black, and Asian women, members of the LGBTQ+ and disabled communities, for example, have observed these engineering greats and felt inspired to be like them?

People can't be what they can't see, so by publicly honouring and making visible inspiring engineers from different sections of society we hope to inspire and encourage the next generation into an engineering future.

Find out more by visiting https://thisisengineering.org.uk/ https://raeng.org.uk/national-engineering-day

# CONTENTS

## ARTICLES

# PRECISION

The magazine of the Institute of Measurement and Control
Published by: Institute of Measurement and Control
297 Euston Road, London NW1 3AD T: +44 (0) 20 7387 4949
www.instmc.org
www.twitter.com/instmc
https://www.linkedin.com/company/institute-of-measurement-and-control-the-/

Chief Executive Steff Smith
E: steff.smith@instmc.org

Design, print & mail fulfilment
by HMCA Services Ltd
Tel: 01423 866985
E: enquiries@hmca.co.uk

Cover price, where sold, £20

BY PAUL QUINCEY, RETIRED PRINCIPAL RESEARCH SCIENTIST, NPL

# THE DAWN OF SCIENTIFIC MEASUREMENT: MEASURING THE LENGTH OF THE YEAR AND THE ANTIKYTHERA MECHANISM C. 2500 BCE – 70 BCE

Statements about early history are always speculative, but we can be fairly certain that the first measurement of a scientific nature was one of time. It did not need a clock, just observation, patience, and the ability to count.

From any specific location, the place where the Sun crosses the horizon at sunrise or sunset moves in a steady cycle that matches the yearly changing of the seasons. Counting the number of days in the cycle gives a period for the year of about 365 days.

Choosing the time unit to be the period of the Earth's rotation, or, as they would have seen it, the average time between sunsets, was both natural and sensible. Indeed, the day and its subdivisions, with 86,400 seconds being defined as one day, was the standard basis for time measurements until 1956.

The figure of 365 is remarkably accurate, good to within about 0.07 %. Better estimates were made over time – we know the true period is now close to 365.2422 days – and, arguably, the length of the year remained the most accurately measured physical quantity of any kind until high precision measuring instruments were developed in the 18th century.

Records are patchy, and we don't know where, when or how the length of a year was first measured, though it is a safe bet that it was done independently on several continents. A special mention should go to the ancient Egyptians, who seem to have used a calendar based on 365 days from around 2500 BCE.

## Angle

Right angles would need to be checked when building important structures, but this can be done in simple ways. The measurement of arbitrary angles probably also started in early historic times, determining the position of the Sun, to tell the time of day, and of the Moon and planets, out of curiosity.

Finding a suitable measurement unit for angles is even easier than finding a time unit, because it can be based on a full turn. It was the Babylonians, in present day Iraq, who chose to subdivide the turn into 360 equal angles, which we call degrees, in one of the later centuries BCE.

The early devices that measured angles, such as sundials and astrolabes (multipurpose devices that incorporated protractors with sights) were useful but not particularly accurate, perhaps good to within half a degree.

## The Antikythera Mechanism (made between 200 BCE and 70 BCE)

In the world of science, the ancient

Greeks have a reputation as great thinkers and mathematicians, but less great experimenters or makers of scientific instruments. The measurements made for Eratosthenes's estimate of the size of the Earth were crude, though very effective.

However, this is not the whole story. The Antikythera mechanism, as reconstructed from corroded remains found in a shipwreck in 1901, includes a mechanical distillation of the observed movements – angles and times – of the Sun, Moon and then-known planets as they move along the ecliptic. It had an astonishingly precise, complex and ingenious gearing system that incorporated the variable speed of the moon in its orbit and the retrograde movements of the planets.

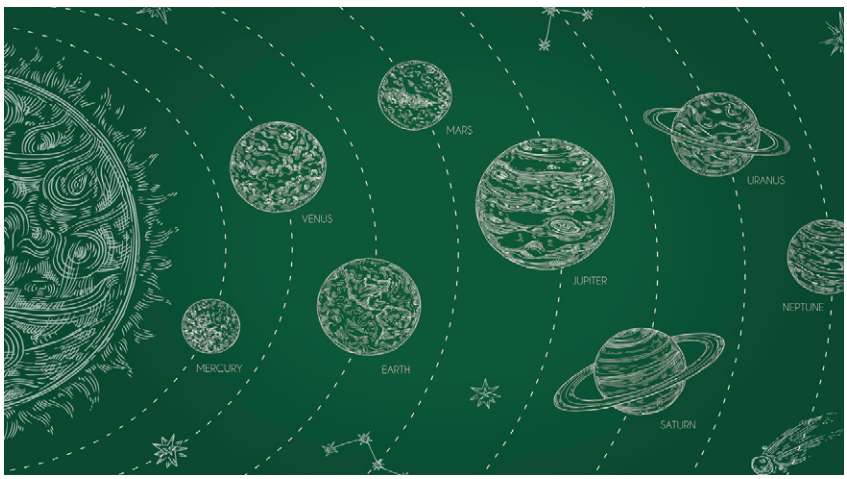
Although not a measuring instrument, the use of accurate measurements of cycle times, epicycle times and angles within its design, and the precision engineering, puts it in a similar category. As if to highlight the point that two of our familiar measurement units were already established by that time, the inner dial on the front face is marked with a full circle of 360 degrees, while the outer one shows a year marked out as 365 days.

## The long interlude

One of the many remarkable features of the Antikythera mechanism is its uniqueness – we have no comparable examples of the technology from the time, or for many centuries afterwards, perhaps until mechanical (but pre-pendulum) clocks were developed in Europe in the 14th century. Accurate time keeping did not arrive until the first pendulum clock was made by Christiaan Huygens in 1656.

Angle measurements continued, with the astronomical observations of Hipparchus in the 2nd century BCE and Claudius Ptolemy in the 2nd century AD, as well as Heron's worm-gear controlled theodolite (called a dioptra), from the 1st century AD. However, detailed records of their observations are scarce, and claims of high accuracy seem to have been exaggerated. This would need to wait for the large observing instruments created by Islamic astronomers in the 10th century, and especially those used by Tycho Brahe in the late 16th century, as described in my March 2024 Precision article.

Paul is the author of the blog 'Some Historical Highlights of Scientific Metrology. To read his articles or get in touch with him, visit https://metrologicalhindsight.wordpress.com/



# INSTMC 2024 AWARDS NIGHT


We had a fantastic evening celebrating our 2024 InstMC Award winners at The Royal Institution on 4th July. This was our first time hosting the event with the United Kingdom Automatic Control Council for 'InstMC 2024 Awards Night & UKACC Annual Distinguished Lecture'.

Around 85 attendees gathered to celebrate the achievements of our winners with InstMC President, Sheila Smith and Prizes & Awards Committee Chair, Ken Grattan presenting the awards.

We were honoured to have Professor Rodolphe Sepulchre, winner of the Sir Harold Hartley Award, presenting the Distinguished Lecture: 'Spiking Intelligence: Towards Reconciling Physics and Algorithmics?'.

Thank you to everyone who attended and huge congratulations to all our award winners: Professor Rodolphe Sepulchre, Dr Rosa Busquets, Professor Bajram Zeqiri, Professor Elfed Lewis, Dr William Milligan, Professor Ahmed Kovacevic, Members of BSI Committee BS6739 led by Ian Callender and Professor Graham Machin.



# THE FUTURE OF MEASUREMENT AND CONTROL IN THE WATER INDUSTRY

Every other year the water and environmental industries get together to discuss the challenges that we face in instrumentation, automation & control.

This year we meet on 9th -10th October at the NEC in Birmingham at the Water, Wastewater & Environmental Monitoring Conference & Exhibition (WWEM). As part of the show, the industry holds the Instrumentation Apprentice Competition to challenge the new entrants to the industry. Now in its tenth year, the apprentices get their skills and, more importantly, develop their knowledge of the people and technologies that are available within the industry.

With the challenges that face the industry in the next decade, the competition is vital to ensure the next generation of instrumentation specialists. The Water Industry is set to see regulatory instruments and their data increase from a few thousand ten years ago to approximately 56,000 in the next decade. When you add the non-regulatory instruments that monitor the sewer environment to detect blockages and protect the homes of customers, the industry is set to add another 250,000 monitors to monitor in a sewer network that is greater in length that the road network in the UK.

The Instrumentation Apprentice Competition isn´t the only thing to enjoy at WWEM: there are conference sessions which are free to attend. Whole days are devoted to flow and spill monitoring, the results of which we see published in the newspapers each April and which feed the “real-time” public spill platforms; an entire day devoted to monitoring the Health of the Nation, a programme of environmental monitoring that is set to see around £5 billion of customers money invested over the next 10 years; and two days on Digital Water and the various ways it is being applied across the water industry including a focus on cyber security and how the new EU NIS2 directive will be applied to the water industry.

Special thanks of course go to the InstMC which is one of the organisations that take part in WWEM and support the Instrumentation Apprentice Competition each year.


## Process improvement is like cycling.
## Everything runs more efficiently with the right partner.

Energy optimization is the key to sustainable production. As a strong partner for strategic energy management, we help you cope with rising energy costs and tighter environmental targets. We are at your side – uncovering the ways to save and be resourceful while maintaining safety, quality, reliability, and uptime.

Do you want to learn more?
**www.uk.endress.com**

Endress+Hauser
People for Process Automation


# Focus and objectives

# INSTMC STRATEGY 2024

## VISION:

To become the preferred international body for promoting the advancement of the science and application of measurement and control technology.

### Mission

To establish the Institute's pre-eminence in the UK as the professional institution for advancing the science and application of measurement and control technology

### Core values

The Institute is nothing without its members. We will encourage member engagement by excellent communications, transparency of processes and decision making. Our strength comes equally from our status as a Learned Society and our closeness to Academia and Industry. The Institute is a philanthropic organisation and will direct its energies to the good of mankind and of the measurement and control profession

**InstMC Strategy 2024**
Focus and Objectives

# THE INSTITUTE HAS CHOSEN FOUR FOCUS AREAS TO FORM THE STRATEGIC PROPRIETIES FOR OUR FUTURE STRATEGY

**Raise the profile of the Institute and grow its influence.** With more influence we can better campaign for our existing members, and this also makes us more attractive to potential members.

**Increase the number and diversity of engaged paying members.** We are first and foremost a membership organisation, and our members should be at the heart of all we do.

**Improve and strengthen relationships with Academia and students.** The Institute is a learned society, and we should be engaged with academia to stay up to date on advances in the field, while supporting our future engineers.

**Develop and implement other Income streams.** We need to generate enough income to operate and provide benefits to our members. To be future proof we need to develop income outside of membership subscriptions.


# INSTMC ATTENDS TOMORROW'S ENGINEERS LIVE 2024

For the second year running, InstMC attended Tomorrow's Engineers Live 2024 on 5th February, hosted this year by the Institution of Civil Engineers (ICE).

Now in its third year, the event supports those delivering engineering and technology outreach programmes to get the most out of their activities. There were practical sessions, collaborative discussions and opportunities to share ideas. More than 100 delegates heard from industry experts, STEM outreach providers and engineering role models. Together, we learnt more about how to inspire the next generation of engineers, reach underrepresented groups in engineering and technology, promote technical and other pathways into the sector… and much more.

Keynote speaker, Yewande Akinola, an engineer and innovator who has worked on the design and construction of projects in the UK, Middle East, Africa and East Asia, emphasised creativity as a constant and recurring theme within engineering. As a speaker and social entrepreneur, she believes engineering should be open to everyone and spoke about challenging the perceptions of women in engineering. Improving the perception of engineering – and who can be an engineer – was a theme echoed throughout the day during various sessions and personal stories.


The panel session 'Opening Doors' featured organisations including STEMAZING, Mabey Hire and Tech She Can, highlighting the importance of relatable role models who can inspire the next generation of innovators and problem solvers. The standout message was 'You can't be what you can't see'.

Afternoon breakout sessions enabled attendees to choose the subject or topic they wanted to focus more on. 'Getting buy-in from senior leadership' encouraged us to think about brand values and alignment. Key themes from the speakers included: knowing your audience to get buy-in as early as possible; using data to support your case, as well as a cost-effective plan, which will show you're thinking about, and measuring ROI and the bottom line. Think building a skilled future workforce and fostering a positive public image.

'Lightning Talks' from four organisations addressed various aspects of promoting STEM education and engagement including initiatives targeting underrepresented groups; integrating ethics into engineering education; and leveraging senior leadership support and community collaboration. We heard from Stewart Edmondson, CEO & Executive Director, UK Electronics Skills Foundation on their highly successful 'Girls into Electronics' initiative, Grace Benham (RNLI) talked about targeting schools and communities and their use of social media in STEM engagement.

Sir Julian Young, Chair of The Tomorrow's Engineers Code, highlighted the role that senior leaders play in engaging young people and supporting STEM initiatives – asking the audience 'can you be doing more to engage young people?' The Code is a community of more than 300 like-minded organisations (including the InstMC) promoting collaboration and best practices. The Code offers resources, events and networking opportunities to support organisations in their STEM engagement efforts.

The final keynote speaker was James Dornor, founder of Driven by Us, an organisation empowering ethnic minorities and underrepresented groups within the workplace as well as the motorsport community. James, a previous interview subject in Precision magazine (Issue 30 - Blazing a Trail: Equality, Diversity, Inclusion & Motorsports) talked about the group's focus on schools with high levels of deprivation and lower educational attainment. He openly shared his personal journey, detailing challenges he faced growing up including health struggles and the loss of his father at a young age. He believes that sharing personal experiences and failures makes STEM outreach more relatable. The audience was given top tips for effective STEM outreach which included encouraging volunteering, implementing mentoring programmes post-outreach and sponsoring STEM events or organisations focused on increasing opportunities for disadvantaged groups.

Tomorrow's Engineers Live is helping to build a brilliant, sharing community which comes together to collaborate, discuss challenges and celebrate good practice. We continue to need impactful engagement that highlights the wealth and breadth of engineering and technology opportunities to appeal to all young people: not doing this in isolation but building and delivering activities together.

# NOVEL SELF-LEARNING OPTIMISER GIVES HIGHER ROI

DR PAUL ORAM AND ANDREW OGDEN-SWIFT

Operating companies in some sectors in the process industries have been using closed loop, real-time optimisation (RTO) for over 30 years to improve manufacturing performance.

Improvements have been achieved in throughput, energy and chemicals use, quality, yield and emissions. Typical levels of improvement are 2-5% but in some cases improvements have been as high as 10%. Payback times are often measured in months, weeks or even days.

Despite these contributions to performance and return on investment, closed loop optimisation solutions have only made inroads where high economic returns justify its implementation, for example within oil refining and petrochemicals.

### Why is optimisation not used everywhere?

The challenge with existing commercially available closed loop optimisation solutions is that some type of model is needed.

**Model types include:**

| Type of Closed Loop Optimiser | Nature of Model |
|---|---|
| Model-predictive controller (MPC) | Originally models were linear, but over recent years newer technologies have added non-linearity in process gain |
| Steady state RTO | Non-linear steady state model |
| Non-linear MPC | Non-linear model is gain and dynamic aspects of model |

Models are typically developed empirically e.g. by plant test or using fundamental chemical engineering equations (also referred to as first principal models). Models then need to be validated by comparison with operating data.

The issues with this model dependency are:

- Expertise is needed to select the right technology for specific problems and justify investment and develop the model.
- Developing models from plant tests requires plant operation knowledge, and experience in process identification tools provided by suppliers to fit the models.
- Developing chemical engineering models requires good modelling/ flowsheeting tools specialised for closed loop optimisation along with strong expertise in thermodynamics, physical properties and modelling.
- Expertise to apply model-based optimiser solutions to a process plant. Examples of this include defining the optimisation problem (e.g. what variable to optimise, what to adjust, what limits need to be honoured), setting up steady state detection and parameter updating for steady state optimisers, operator training and support, and approaches to safe commissioning etc.
- The time needed and disruption to operations to carry out plant tests.
- The cost to develop the models in engineering hours.

Moreover, as the process changes due to equipment modification, operating changes, changes in feedstocks, fouling and wear etc., the model requires maintenance. Without this maintenance, optimiser performance will quickly degrade.

Consequently there is an ongoing need for expertise, which is often difficult to source, with costs therefore remaining high to keep optimisers on-line. This has meant that these technologies have not been very widely applied, even

though suppliers have added capabilities and tools to ease their maintenance burden.

## A Model-Free Approach

Clearly requiring a model makes closed loop optimisation hard for many companies to justify. An alternative is to use a model-free or self-learning approach where the solution learns how adjustments to the process influence the cost effectiveness of the operation and the value of any limiting variables.

This can be further improved by using autonomous agents, where each agent is paired with one manipulated variable in much the same way as traditional PID cascades. All the autonomous agents must have the same measure of operating cost, or profit, but each agent can manage one or multiple constraints.

A further refinement is to make tuning as simple as possible so that the user can readily understand how to set up the optimiser based onan understanding of process economics and which variables impact it together with the knowledge of limits on the unit and a simple estimate of unit response time.

The results of these simplifications are significantly lower costs and much faster projects with shorter time to value as shown in figure 1.

Figure 1 – Project Timeline

## Additional Benefits

Clearly this is a much lower cost approach that gives higher payback or ROI and justifies applying optimisation to smaller process units

It is also not constrained by the need to have specialist engineers or contractors. A self-learning solution can be designed so that anyone, familiar with the economics and operation of a unit, can implement the optimiser. For example, resident process or control engineers.

In addition, existing optimiser technologies which use linear models only find an optimum at a constraint boundary. The self-learning approach will find constrained, partly constrained and unconstrained optima.

## Enabling Better Overall Operations

By having closed loop optimisers at the heart of plant operations, analytics and monitoring can be added to understand what causes reduction in plant profitability allowing faster action to reduce or eliminate the causes.

## Summary

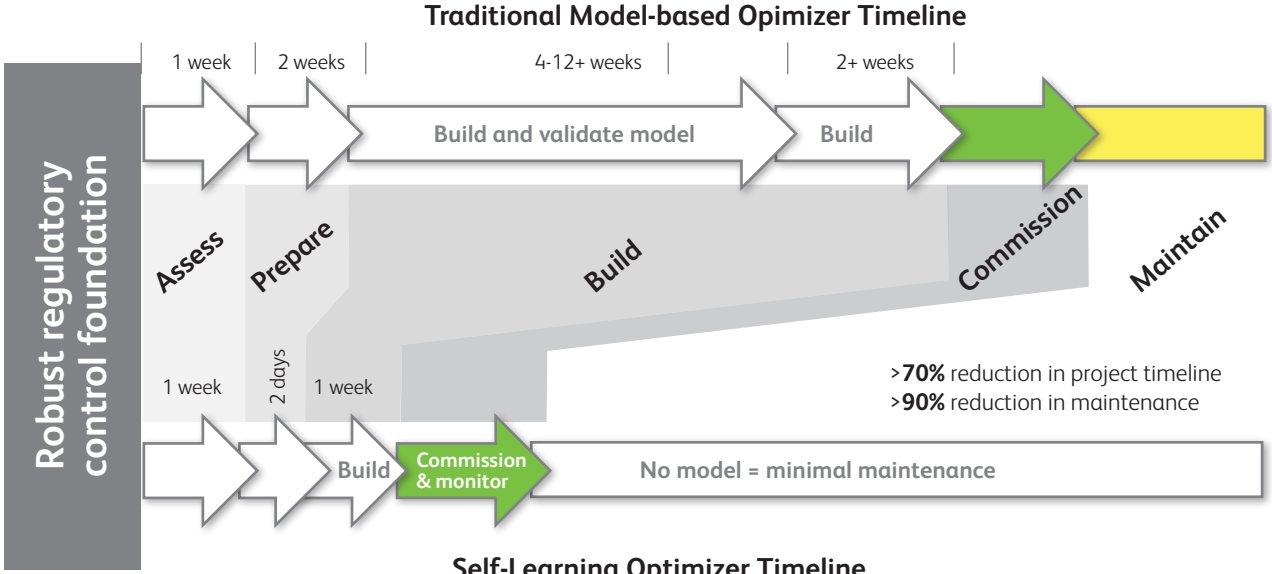
Closed loop optimisation has made a significant contribution to the economic performance of some sectors of the process industries. The use of these technologies has been limited by the availability of expertise needed and the significant cost to build and maintain models underpinning the solutions.

Self-learning approaches overcome many of the hurdles which presently limit the widespread use of RTO, thus making the benefits of optimisation much more attainable for a wider range of plants.

**Dr Paul Oram** is CEO of ORTOmation.io. Prior to starting up ORTOmation.io (https://ortomation.io/) Paul worked for BP in multiple roles in control and optimisation. His final role was Chief Instrument, Control and Electrical Engineer. Paul is also a visiting Professor at Imperial College, London.

**Andrew Ogden-Swift** has worked with ORTOmation for the last 18 months, Prior to that he spent over 40 years in advanced software applications working for a variety of companies

The self-learning approach will find constrained, partly constrained and unconstrained optima.



# FOCUS ON A SIG

## CYBER SECURITY

I was fortunate enough to moderate a Panel at "Future Oil and Gas" seminar recently, the topic being "AI and its part in protecting Legacy Industrial Control Systems [ICS]". The panel was diverse in backgrounds, and the members all had a great depth of knowledge in their field. It occurred to me that the title might be a bit "niche"? However, soon into the conversation it was very apparent that it was not. There are so many topics within ICS Cyber and they often overlap, which got me thinking about our Cyber Security SIG.

In common with other SIG's the Cyber SIG's aim is to provide information at hand to its members. The topic of Cyber Security is gaining momentum at a rate that most of us could not have anticipated five years ago. However, where to gain useful insight and connections with regards to Cyber Security remains a little "hit and miss".

To this end, starting last month, we are organising a bi-monthly Subject Matter Expert presentation. Each presentation will cover a topic within Cyber Security, and the presenter will issue us a paper highlighting the topic and provide some useful pointers, further reading and contacts where applicable. The sessions should provide an opportunity for attendees to use within their CPD – details of August Presentation to follow along with the October and December titles for this year. Overall, the aim is to foster an "Exchange Network", where SIG members can garner and share their insights.

A little early for making New Years resolutions, but in the next year we will be holding a "Masters Session" where we have a panel of Subject Matter Experts who will be presented with issues/problems from SIG members. The Subject Matter Experts would then put forward some ideas to resolve these issues. There will not be any direct advice or a hard sell, rather some pointers for the SIG Member on how to plan, where to research and what to consider with regards to the problem/issue presented to the "Masters Session".

These will be the initial steps we take in 2024 to generate a depth of SIG knowledge available to our members, so we can call on an understanding of a broad set of topics in our area and understand how they overlap.

Members may join the SIG through the InstMC website https://www.instmc.org/sigs/cyber_security

**David Fisher-Holt,**
Chair, Cyber Security SIG

# FOCUS ON A SIG

## FUNCTIONAL SAFETY


Although functional safety has been around for decades, there are still many aspects of it with which the industry is striving to achieve compliance. This stems from a variety of causes including lower profit margins, cost cutting leading to decreased investment in developing people, emergence of new technologies (hydrogen, CCS, AI, cybersecurity), obsolescence, and generational changes. I think that we are at a crucial moment in time where we need to work together more than ever to ensure knowledge is passed on and the high standards of engineering, that the UK is globally renowned for, are maintained.

As one of the main successors of the InstMC Safety Panel, the FS-SIG aims to do exactly that. We will continue to put out briefing notes on hot topics and try to improve the way we connect to our wider member audience.

Additionally, Covid-19 and the subsequent lockdowns have evidently affected all of us and have changed the workplace forever. Software packages for online conference calls are now, often, the preferred option for bringing people together. I say that almost ironically, as bring us together they most certainly do not: at least not in the literal sense. I am sure we all agree that the benefits of meeting your peers in person can never be outshone by any webinar or online workshop however well put together. This is where the magic happens.

Hence, we are currently in the process of organising a functional safety conference in Q4 2025, with participation from other SIGs as well, held in the North West. Exact details of the programme, format, date and location are yet to be finalised, however we will advertise the event as soon as everything is firmed up, so to everyone who is keen to learn more and reconnect with likeminded professionals, watch this space.

Another area of focus for us at the moment is the Registered Functional Safety Engineer (RFSE) qualification and the target audience we aim to reach. We will be putting out online material to present this in detail towards the end of the year.

In the meantime, if you have any questions related to the activity of the FS-SIG, please feel free to email Tudor Balan at chair.fs-sig@instmc.org.

**Tudor Balan,**
Chair, Functional Safety SIG

# Q&A

## Steven Biggs

**Steven Biggs,** Director at Fluidic Ltd and Chair InstMC Central Scotland, shares his thoughts on addressing the shortage of UK engineers.

**What was the root of your interest in Engineering?**

I studied Mechanical Engineering at Glasgow Caledonian University from 1999, graduating in 2003. During the summer breaks, I worked placements with two small engineering companies: Integrated Sensor Systems in East Kilbride and subsequently, Fluidic Ltd, who continued my employment full-time after graduation.

Fluidic really ignited my passion in engineering. At that point we were a small business with only a few engineers working in a wide variety of industries – power generation, refineries, pharmaceutical, food and beverage to name a few. The constant exposure to new and different measurement and control applications always kept my interest. By that point, Fluidic had really begun to establish ourselves in the UK nuclear market. Diligence here is paramount, and I quickly learned the importance of risk assessments, SIL applications, instrument testing and quality procedures.

At Fluidic I was lucky to work under a very experienced and approachable boss in David Cairney. Far from the old fashioned "do as I say" boss, Davie had a very progressive management style that encouraged initiative, self learning, and personal development. Working in safety critical industries such as nuclear and oil and gas, it is important to have processes to catch errors. Individual responsibilities are important, but humans make mistakes. Where this happened at Fluidic, you never felt the need to cover up out of fear. It was important that we installed robust systems that caught mistakes and that we installed a culture that would ask what happened, how did it happen and what can be learned from it."

After Fluidic I spent a few years as a design engineer in the medical device sector – learning more on quality processes, particularly ISO 13485 systems – and then with a manufacturer of industrial heating devices. Having a long fondness for my roots with Fluidic though, it was an easy choice when the chance to return happened in 2010. Now as part of the management team, I try to ensure that the progressive culture Davie instilled remains and Fluidic continue to grow from strength to strength.

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

We are already in the age of information. I am incredibly lucky to be in such a growing sector as measurement and control. Everything is measured today. I read an article recently about a "WI-FI shirt" – scan the buttons with your phone and it will tell you how many times you've worn it and when!

Its great to have access to so much data, but we are getting to a stage where we need to ask what data is actually useful and what can be done with it? There's the old problem where an operator has become so acclimatised to warning lamps in his control room that they no longer hold any sense of "alarm". Perhaps the growing use of AI will help automate some non-critical process controls, freeing up more dedicated "human" focus on critical – and importantly safety critical – processes. Perhaps this automatic fine tuning of basic process control processes would also encourage energy efficiency, noting the obvious climate challenges that we face, and will only exacerbate over the next 10 years without prompt attention.

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

Undoubtedly a problem that we have all encountered. Fluidic have an application out for an apprentice engineer just now for this very reason. I was lucky to fall into full-time engineering employment in engineering, but even 20 years ago I was in the minority and that situation is getting worse. Graduates with no experience can't get a job to get experience – employers can't find experienced engineers.

Companies should be encouraged to take on young people and give them experience. Not simply a case of waiting until there is a job to fill, and then searching the recruitment marketplace to see who's available. Government incentives for employers – all employers of a corporate or SME scale – to get young people into work and train them with a trade or profession, is a no brainer. The UK has a budget deficit of £120billion this year. Even forgetting the ethical line of helping our young, how about the financial drain of unemployment. Spend a little to get the unemployed into work. Give people a chance to develop and learn. In only a few years this will pay back ten-fold in income tax and general spending.

**What do you do in your free time to relax?**

Even in my spare time I enjoy instruments – musical ones. I play guitar in a covers band The Snips and we can often be heard screeching out some Beatles or Stones numbers in the pubs around Glasgow on a Saturday night.

I also have two wonderful teenage girls. Neither look to be following their dad into engineering but both are very bright sparks and have their own path to follow. My eldest recently excelled in her history higher and seems to be following this route. My youngest is a loveable wee rogue that keeps me on my toes with revolving boyfriends and her daft camera snaps she likes to catch me off guard with.

**Given one wish what would that be?**

I am hoping that our recent change of government, to a historically more liberal party, will put an emphasis on reducing unemployment and encouraging upskilling opportunities. The UK used to be a powerhouse of industry and "Made in Britain" was a badge of quality. Hopefully, with the right investment, we can resolve the blips of the last few decades and empower our young engineers to lead the new world.


> The constant exposure to new and different measurement and control applications always kept my interest.

# CLAMP-ON ULTRASONIC FLOW METERS – THE KEY TO SMARTER WATER MANAGEMENT

A transformative technology in the field of water management, clamp-on ultrasonic flow meters are non-intrusive devices that measure the flow rate of a fluid by using ultrasonic transducers that attach externally to the pipe, without any need to alter the pipe itself. The meters work by sending ultrasonic pulses through the water, measuring the time it takes for the sound waves to travel with and against the flow, with the difference in these travel times correlating directly to the flow rate. This non-intrusive method offers significant advantages in terms of ease of installation, minimal maintenance, and reduced system downtime.

In the city of Wuppertal, a city recognised for its digital innovation within the Bergisches Städtedreieck region of Germany, the implementation of clamp-on ultrasonic flow meters is part of a broader initiative to enhance urban infrastructure through smart technologies. LoRaWAN, a communication protocol tailored for long-range, low power IoT (Internet of Things) applications, is central to this initiative, linking various components of the city's infrastructure into a cohesive network.

## Challenges in the water network

The Wuppertal water authorities prioritise the prevention of water loss due to the city's unique geographical and geological challenges. Spanning elevations from 130 meters to 375 meters above sea level, the drinking water network operates under pressures much higher than the national average, which can exacerbate water loss from leaks. The presence of extensive sinkhole zones further complicates these challenges, as leaks can lead to significant erosion and subsidence without timely detection.

## Advantages of clamp-on ultrasonic flow meters in leak detection

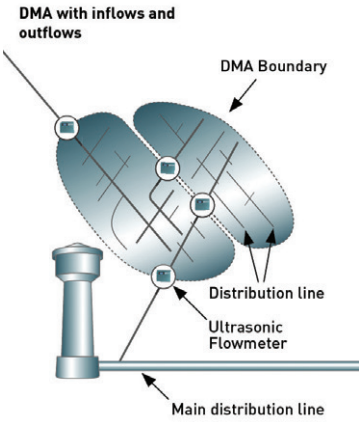

To combat the issues faced, the water provider has integrated Emerson's Flexim flow meters into their network. These clamp-on ultrasonic meters are specifically tailored for low-flow detection, critical during the minimal usage hours between 2 and 4 am. There is no minimum flow required for operation, and accurate recording of flow velocities as low as 1 cm/s is possible. This sensitivity is crucial for detecting leaks early and mitigating potential damage and water loss.

## Installation and benefits of non-intrusive metering

The installation process of these meters is streamlined, as they do not require any pipeline modification or extensive civil engineering works. This not only reduces installation costs and time, but also minimises disruption to the public and the environment. The devices come equipped with transducers that meet IP68 protection level, allowing them to operate while submerged – further simplifying installation.

## The future of water management. Expanding the network and enhancing capabilities

The initial pilot project demonstrated significant success in monitoring with Flexim meters, each equipped with a Modbus to LoRaWAN bridge. This provided swift and easy data transmission, leading to the expansion of the network over twenty additional measuring points. Such a robust integration allows for real-time data monitoring and advanced leak detection capabilities across Wuppertal's sprawling water network.




Through the deployment of clamp-on ultrasonic flow meters connected via LoRaWAN, Wuppertal is setting a benchmark in smart water management. This approach not only enhances the efficiency and sustainability of urban water services, but also showcases how cutting-edge technology can be harnessed to address complex infrastructure challenges in the most effective way possible.

To find out more about the real-world benefits of clamp-on ultrasonic flow measurement in the water industry, for permanent mains-powered installation, or battery-powered rental meters available from 1 week to longer duration options, contact Andy Hammond – www.emerson.com | flexim-uk@emerson.com | +44 (0)1606 781 420

# OUR CORE TEAM

## OFFICERS

**President**
Sheila Smith

**Honorary Secretary**
Billy Milligan

**Honorary Treasurer**
Stewart Macfarlane

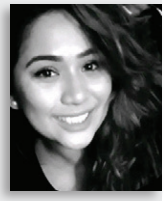
**Chief Executive**
Steff Smith
+44 (0)20 7387 4949
steff.smith@instmc.org

**Marketing Executive**
Ernest Kyei
+44 (0)20 7387 4949 Ext 4
ernest.kyei@instmc.org

**Registration & Accreditation Officer**
Jessica Currie
+44 (0)20 7387 4949
jessica.currie@instmc.org

**Marketing & Communications Manager**
Jane Seery
+44 (0) 20 7387 4949
jane.seery@instmc.org

**Registration & Accreditation Officer**
Heather Suarez
+44 (0)20 7387 4949
heather.suarez@instmc.org



**Project Manager**
Caroline Trabasas
+44 (0)20 7387 4949
caroline.trabasas@instmc.org

= Method
Functional Safety

Do It Right
Do it Once

# Functional Safety Training for Instrument Technicians

Formal Training – the cornerstone of demonstrating competence.

**www.methodfs.com/technicians**

w: www.methodfs.com e: support@methodfs.com p: +44 (0)1462 713313