

Leading with intelligence Al's role in digital futures and sustainability

A call to action by the IET led by its 2023-2024 President, Dr Gopichand Katragadda



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Executive summary

The IET's 2024 global webinar series provided a welcome opportunity for the engineering and technology community to discuss developments in AI and their potential impact on humanity. Nine webinars took place between May and July 2024, attracting participants from 18 countries.

This document summarises the webinar discussions. It serves as a reflection on the present and a roadmap for the future.

E Foreword

Every IET volunteer brings their own unique technical capabilities to their role, working to better the engineering and technology community. During my year as IET President, with the world poised for an AI revolution I decided to use my expertise to sharpen the IET's focus on Digital Futures and Sustainability.



Al has become a central driver of progress across industry, providing new ways to solve old problems. As the leader of an Al company, I focus on delivering intelligence precisely where and when it is needed – by creating real-time, context-aware Al solutions that

empower industries to make faster, smarter decisions at the point of action.

This approach lies at the heart of what was discussed at the IET's 2024 global webinar series, which provided the perfect opportunity to explore how AI can be used ethically, responsibly and effectively across diverse applications.

I was delighted to be on the panel for all nine webinars. I found the discussions with panellists and participants from around the world fascinating and insightful in equal measure, and I am incredibly grateful to all contributors.

I encourage you to read this document with a curious and open mind, ready to explore new possibilities and challenge established assumptions. It provides a rich array of insights and actionable recommendations to help guide your work, whether in industry, academia or policy making. I hope it will inspire you to help shape the future of technology by ensuring that AI is used in ways that are ethical, inclusive and impactful.

Thank you for participating in this important conversation.

Dr. Gopichand Katragadda President 2023-24, IET

Meet the panellists



Dr Gopi Katragadda CEng FIET – IET President (2023-24)

In the 1990s, Gopi pursued his education in Electrical and Electronics Engineering at Iowa State University, where he earned both a Master's degree and a PhD. He began his career at Karta Technologies, remaining there until 2002, when he transitioned to the GE India

Technology Centre. Under Gopi's leadership as Managing Director, the centre became a global leader in intellectual property generation. After 12 years, he moved to Tata Sons, serving as Group Chief Technology Officer and Head of Innovation. In 2019, Gopi founded Myelin Foundry, an AI startup, where he now serves as CEO. Additionally, he holds Independent Director positions at Bosch India Limited, Asian Paints Limited, and ICICI Securities Limited.



Dr Graham Herries CEng FIET – Chair, IET Digital Futures Policy Centre

Graham is an engineering and technology executive with 27 years' experience in driving business transformation and delivering cutting-edge, high-tech solutions across automotive, defence, aerospace, security, built environment and industrial engineering. He has a PhD

in what we now refer to as Machine Learning and Big Data Analytics, and is a Visiting Professor for the Royal Academy of Engineering. He led OPTIMISED, a H2020 Industry 4.0 Factory of the Future project that developed and deployed IoT, digital twin, data analytics and AI techniques to optimise rail and manufacturing scheduling and performance. It also assessed energy demand response as a critical input to manufacturing planning.



Kirsten McCormick MSc (Hons) MIET – Chair, IET AI Technical Network

Artificial Intelligence Lead and Senior Systems Engineer Kirsten is an internationally recognised AI subject matter expert who leads research of AI-based solutions across multiple applications in the defence sector. She is an authority on the wider implications and

implementation of AI, including ethics and safety. Kirsten uses her STEM Ambassador role to inspire the next generation about engineering and technology careers. She also actively promotes the need for inclusion and diversity in the workplace through her position on the Women In Defence group at General Dynamics UK.



Dr Maurizio Pilu MBA PhD FIET – Member, IET DFPC and Policy Oversight Committee

Maurizio is a tech executive and leader with 30 years' experience ranging from commercial R&D and innovation, government, consulting and deep tech VC. He is an IET Fellow, AI PhD and Exec MBA. Maurizio has 50 patents, 35 academic publications and secured over \$100m of investments for programmes and ventures and founded the Digital Catapult and Safetytech Accelerator. He is a respected thought leader in tech, speaker and his work featured both in trade and mainstream media.



Jon Isaacs CEng MIET – Member, IET AI Technical Network

Jon has more than 30 years' experience in engineering design, build and commissioning of industrial and special-purpose automation machinery and consumer equipment. He also set up and ran a physical and online business with sales of over £10 million. He currently has two roles – Lecturer in Engineering and Technical Manager – at Birmingham City University, where he leads a team

of engineers and technicians responsible for the delivery of high-quality teaching and research outcomes.

How can we co-create an IET Digital Futures position?

In our three co-creation webinars on 1 May 2024 we aimed to shape our Digital Futures position.

The discussions covered a wide range of topics, including emerging AI technologies, the societal challenges around data and AI, and the vital role of robust engineering governance and ethics in protecting privacy, safety and truth.

Below we summarise some of the key points made by the panellists and the global engineering and technology audience during these sessions.

Technological development continuum – exciting AI developments are taking place across all fields of science and engineering. Virtual reality in particular has moved on in leaps and bounds in the last couple of years, driven by improvements to large language models and diffusion models. All this development is a continuum: many of the technologies we routinely use today were unthinkable 30 years ago. They have become possible because of the convergence of several key factors, including increased computational power, the internet and people's willingness to use it, and the colossal amount of data that's now available.

Opportunities and threats – for engineers, understanding and using AI is fast becoming as essential as using the internet. By liberating them from the tedium of data crunching, AI can free up valuable time to focus on creativity, critical thinking and decision-making. But just like the dark web, AI does have a dark side. The lack of transparency regarding the algorithms and methods used in developing AI models is raising concerns about ethics and increasing the risk of opening doors to malicious actors. **Digital vs analogue** – it's widely accepted that digital is for convenience and analogue is for accuracy. Digital numbers are easier to store and transmit, but analogue is better for accuracy, wired speed and live music shows. Don't be fooled into thinking that digital is the only valid option. We need both.

Engineers as digitalists – the digital future is not just for computer scientists. All engineers in 2024 and beyond also need to be digitalists [people who actively use digital technologies and recognise their potential for making positive changes and progress]. An engineering mindset will of course remain a prerequisite, along with the ability to leverage knowledge of the fundamentals of engineering theory. But we can no longer rely on that expertise alone. Current and future engineers, regardless of their discipline, must willingly embrace new technologies and continuous learning. Importantly, in order to thrive they must also apply systems-level thinking and an execution focus to their role. A great augmenting tool – you can use an AI model to crunch through a database of 1.5 million research records and narrow them all down to just nine key records in a matter of seconds. But how do we know that the nine selected are the best examples? That will depend on the criteria the model has used to separate "the gems from the garbage". AI is a great augmenting tool for engineers, but it's not a replacement tool; its outputs need to be checked and validated. And there's no getting away from the fact that AI is an imprecise tool – even the best of the best AI systems are at most 98% accurate (and therefore at least 2% inaccurate). Users and decision-maker still need to exercise their own judgement.

Regulations – just like any other technology, AI can be misused. Countries the world over are moving at different speeds and in different directions to develop regulations around the use of data and AI. For example, whereas Europe has gone "full throttle" in introducing regulations to protect the right to privacy, the US is taking a more collaborative stance, inviting the industry to help define what ethics and regulations should look like. The AI policies that do exist are very young and have not yet been fully tested in practice.

Creativity and innovation – a straitjacket of regulations risks stifling creativity and innovation in Al. What's more, regulations sometimes don't change for 50 years. Who knows what technologies will be available, 50 years from now – so should technology regulations include an automatic refresh mechanism?

Optimisation – Al is often most effective when used for fast optimisation in multi-dimensional spaces where human brains simply cannot encompass all the variables and complexities involved. The development of Al models, coupled with the application of a new, systems engineering approach, is having a phenomenal impact – digital twins provide an excellent example. In optimisation there is no perfect answer. That's why it's called optimisation.

Responsibility and accountability – imagine that a car driver had to make a split-second decision: whether to knock down a young child or two elderly ladies. This is an ethical dilemma, even without the involvement of AI. How would the driver respond? Would their decision be driven by logic, or would it be random?

Now imagine that the car was autonomous. The fate of the three humans in question would be determined

by an algorithm. But who made that decision in the algorithm? Does anyone really know how the algorithm would decide? Would the process be random or driven by logic? Who would be accountable, from a legal, insurance or moral perspective? The car manufacturer? The developer of the algorithm?

These accountability questions burrow deep beneath the skin of engineering ethics. They also highlight that AI is held to a higher standard of trust and ethics than humans.

IET Digital Futures Policy Centre

This centre supports the IET's role and ambitions in advancing science, engineering and technology by focusing on evidence-based thought leadership and policy reports. It aims to:

- Bring the engineering and technology community together to influence digital policy by governments, industries and organisations
- Ensure that the development of policy and laws is guided by learned engineers and not by ill-informed fears that certain quarters are trying to propagate
- Facilitate cross-sector working with key industry stakeholders (engineers and academics) to gather evidence and insight, including identifying AI opportunities and threats
- Exploit the breadth of expertise and knowledge shared by the IET and its members and technical networks, including codes and guidance, strategy and planning, publishing and journals – engage with members and the wider engineering community to maximise our impact
- Identify and address the challenges around bias and ethics – users want good-quality data and good architecture that allows them to access, use and leverage the data
- Communicate accurate, informative messages about AI to the engineering community and to the general public
- Secure an engineering future, not just a digital future.

How can we promote equality, diversity and inclusion?



Our three webinar sessions on 6 June provided an excellent opportunity to explore how best to raise awareness of EDI across our sector. Also how to build robust ethical principles into the methods, processes and strategies used to manage, analyse and use data throughout its lifecycle, including AI development.

The thought-provoking discussion prompted the expression of a wide range of views by panellists and members of the online audience on the guardrails that will be needed to guide the future development of AI and its impact on society. We have summarised them below.

Diverse representation in data – this is important, to help mitigate biases that can influence data analysis. For example, diverse training data is needed to enable Al to recognise people from different ethnicities. This premise extends to the people working on Al design, development, testing and implementation too. Why? Because teams that include people from diverse backgrounds (race, ethnicity, gender, economics, disabilities and more) will bring new perspectives and fresh, innovative and creative approaches to data modelling. This approach drives inclusivity, while also helping to remove biases and produce more accurate findings.

Cultural sensitivities – language models should extend beyond English and European languages, to become more inclusive. Content moderation policies should focus on cultural sensitivities and continuous improvement, to make sure AI technologies are (and continue to be) accessible and beneficial to all demographics.

Accessibility – paradoxically, it seems that the more sophisticated our technology becomes and the more it

can do for us, the less accessible it is for people who are elderly or have impaired hearing, sight, cognition or memory. It's thought that 50% of the world is still on the wrong side of the digital divide. How do we bring the benefits of AI and data science to rural India, for example?

Bias mitigation in AI – typically, around 80% of the time spent developing an AI programme is focused on getting the right kind of data, annotating it and using it to train the networks so that everything under the data 'umbrella' is fair. Rigour is essential throughout the data lifecycle because if bias is allowed to creep into AI at any point, it could result in incorrect decisions. There are many techniques available to counteract this, including:

- involving diverse groups of people in the design process, to ensure their perspective is heard and incorporated – the IET could champion inclusive design principles from the get-go
- using diverse datasets in the design, testing and training of AI models – especially deep learning, large language models and diffusion models

- applying fairness metrics, statistical analysis and regular auditing of data and algorithms to detect and mitigate biases
- implementing robust feedback mechanisms for continuous improvement
- ensuring the development of user-friendly ethical AI guidelines for all.

Applications of AI - there's a definite buzz in the air about the use of AI across industry in a wide range of applications. Al is already helping engineers to optimise the efficiency of wind farms, agricultural processes and multi-modal transport systems. It's aiding researchers by processing significant volumes of information with high levels of accuracy and speed. In healthcare it's enabling the exploration of inflammatory trends at a cellular level using non-invasive measures - in the future, health insurance providers could possibly use this type of information when calculating premiums. Al is even defying the ageing process and attempts by criminals to disguise themselves, because based on a single image, AI can recognise a person forever, even if they change their hairstyle, wear glasses or grow a beard.

Fake news – ethical and inclusive practices have an important role to play in ensuring that inputs to and outputs from AI models are representative and fair. However, we now live in a world of 'fake news' where the destabilisation and distortion of facts, truth and even history is increasing. A prime example is the growing concern about the proliferation of convincing 'deep fake' videos, where an individual's face or body is digitally altered and voice matching applied to spread false and sometimes malicious information. The IET is an evidence-based organisation – should we take a leap in promoting a fact-trained AI model?

Fairness – new ethical data laws are needed, to make sure that people can monetise their data (for a fair price) or prevent it from being used without their consent; and to safeguard people who are unaware that their data is being exploited or unable to speak up for themselves. We all need to start reading the terms and conditions more closely when we agree to give away our data.

Challenge and probe – in a meeting with a human, you wouldn't automatically assume that what they are saying is correct; you would ask probing questions before drawing your own conclusions. You should apply the same principle to Al outputs. Don't just take the first answer from a large language model. Challenge it, just as you would in a conversation with a human. You can even push further, venturing into areas that would possibly feel very uncomfortable if the interaction were with a human. It's healthy to learn mechanisms for more detailed prompt engineering and challenging of AI models.

Test, verify and validate – don't forget the basic principles of good system engineering practice when testing your model and work, to verify and validate your model, as well as to confirm how representative it is, or whether it's over/undertrained. Above all, remember that artificial intelligence is not an intelligence; it's a computer model.

Democratisation of robots – we have no visibility of what's coming over the hill. But as humans, we need to up our game to make sure we are able to live and work in the best possible way alongside robotics and Al.

Role of professional institutions

Humanity is on the cusp of the next industrial revolution. To what extent should professional institutions like the IET guide the evolution and expansion of Al? Possible examples include:

- raising awareness about the potential for AI to displace jobs, while also highlighting the importance of upskilling the workforce to leverage AI effectively
- informing people that AI is a tool to augment humans, not to replace them
- educating developers on the vital importance of using statistical and validation techniques designed to remove accidental biases and ensure ethical AI practices are followed at every stage of the data lifecycle
- teaching people to challenge what they read and educating people to use multiple data sources (just as they used to do in the preinternet era), to 'triangulate' information
- creating a standard method to ensure the diversity of input data
- empowering members (ranging from engineers, managers and start-up owners to academics) and the wider engineering community to follow national, regional and global guidelines on ethical AI practices.

How can we strengthen the IET's global impact on AI?

The final three webinars, held on 2 July 2024, explored how to maximise the IET's global presence and influence concerning all things Al by championing ethical data and Al practices.

In our three July webinar sessions we took a deep dive into the critical role that AI now plays in all our lives. Participants explored how engineers and technologists can contribute to the development of a resilient and responsible technological future by upholding standards of ethics while designing, delivering and using AI tools.

The discussions were wide-ranging and thought-provoking. Below we summarise some of the many views expressed.

Ethics and governance – governance has a vital role to play in ensuring that data is used responsibly and safely, for human health and comfort, and for purposes which are positive for all. Governance should maximise the benefits of AI while mitigating the potential for harm – including catching 'bad actors' early and punishing them for misusing AI. The engineering sector needs to have a voice, to champion ethical data and AI practices. As the IET, we need to collaborate with policymakers and actively contribute to forging a resilient and responsible technological future.

Laws and regulations – the European Union (EU) has developed guidelines that prioritise fairness to all and the privacy of data (including an individual's facial features), accountability and transparency.

Under EU law the use of AI for emotion recognition is not permitted in workplaces or schools (let's face it, connecting an expression to an emotion is not even straightforward for humans); and the same principle applies to face recognition in public spaces. In Japan, any input to an AI model is not protected by copyright law; and the output of an AI model may infringe copyright laws if it's a close match to someone else's work.

Inclusivity – it's universally accepted that diverse representation in data is good news from an inclusivity perspective. There's also a strong argument for diversity within the teams responsible for developing and training AI models, to provide invaluable insights into the required inputs or outputs for different groups. The EU's AI Act includes many subsections on the lifecycle of AI model development, highlighting not only the importance of knowing where the data is and whether it's protected, but also whether it is representative of a broad spectrum of people (rather than a small, easily accessible subset). A particularly exciting AI development is that it's now possible to interact with many AI models in the language of your choice. A sign that AI is becoming more democratised?

Youth engagement – there is a huge amount of concern about the misuse of AI in schools, with many young people sorely tempted to use AI to complete their homework assignments instead of doing the hard graft themselves. It's important to achieve an acceptable balance, so that AI is used in a positive way in education. Teachers and parents would welcome an information pack explaining what they need to know about AI, as well as the positives and negatives associated with the large language models that young people are increasingly using. Looking ahead, perhaps greater interactivity will be introduced, with gamification playing a role in how learning will happen?

Data monetisation – data sharing is a highly complex and challenging topic. But are we paying for the data? And if yes, are we paying for it fairly? The ethics of data monetisation are a huge issue. It's worth remembering that since the advent of the iPhone and smartphones, we've all given away much more data than we were ever aware of – and for no financial return.

Bias – there's a lot of concern about statistical bias in data. The bias is present because the data has been collected with human inputs. It's actually far easier to remove bias from data than it is to remove it from humans. To develop a representative AI system, the database needs to span the complete spectrum, from neurodiversity to employment, ethnicity, age, disability and more. We can't afford bias to enter at any point in the AI development process. We need to remain vigilant because it can creep in insidiously over time as data is updated.

Reliability and accountability – we can make AI more precise, by implementing guardrails and adding checks and balances. But don't ever expect it to be 100% accurate. AI can be very productive in healthcare settings – for example, it can be used to assist a doctor or radiologist by analysing data from clinical prediction models and detecting tumours in line with global standards. The important word to note here is 'assist', because it's the human healthcare expert who makes the final judgement call and is accountable for it.

Sustainability ethics – the race is on to build data centres around the globe. These massive, energy-intensive centres should be designed, built and operated with sustainability ethics in mind, to drive down energy consumption, curb greenhouse gas emissions and help protect our planet's future.

Education and skill development – many engineers and technologists want to gain a good understanding of AI principles and the core skills that will enable them to use AI technology effectively, ethically and safely. However, AI technology is developing at a frantic pace. This makes it difficult to identify the competencies that will be needed by future AI engineers – and of course to develop AI courses that will stand the test of time. Engineers and technologists should log the details of any AI courses they attend on their continuous professional development records.

Public awareness - misinformation and ill-founded conspiracy theories about AI continue to spread like wildfire on social media, causing mistrust and anxiety among users. But shouldn't AI be viewed as an opportunity, rather than a threat? Yes, it can be misused, just like any other technology, but that misuse must be limited by law, regulations and engineers who use AI for the good of society. To counteract the hype, the public needs to receive accurate messages about AI, to increase awareness of what it is and its positive impact on our daily lives, as well as the risks. For example, although AI will undoubtedly result in job losses, it will also lead to the creation of many new roles. At the IET we aim to inspire, inform and exert influence through our publications, events and public awareness campaigns.

Recommendations



The nine webinars provided a wealth of ideas on how to exploit AI for the good of humanity, as well as how to limit its potential to cause harm.

The broad recommendations listed here are based on a thorough review of the topics discussed in this webinar series.

Please note the information in brackets at the end of each recommendation denotes the intended audience.



Understanding AI's opportunities and global impact

Promote ethical AI development

Establish AI ethics committees to develop and promote

comprehensive ethical guidelines and standards for AI. The focus should be on maintaining high standards for data quality and AI system transparency. [IET, Industry, Government, Academia]

Education and skill development

Provide specialised AI training programmes, certifications, and resources. The programmes should be designed to upskill professionals and promote public understanding of AI. [IET, Academia, Industry]

Industry collaboration

Organise international AI conferences and forums that facilitate networking and collaboration among AI professionals. This will help to strengthen the IET's influence in setting global AI standards. [IET, Industry, Academia]

Youth engagement

Launch initiatives designed to encourage younger generations to pursue careers in AI, ensuring a continuous talent pipeline for the future. [*IET*, Academia]

Al for equality and inclusion

Bias mitigation

Ensure that AI systems are trained on diverse and representative datasets.

Regularly audit algorithms for biases and use fairness metrics to ensure equitable outcomes. [Industry, Academia, Government]

Inclusive practices

Use AI tools to support unbiased recruitment and personalised career development. Implement feedback mechanisms to foster continuous improvement. [Industry, IET, Government]

Cultural sensitivity

Develop AI systems that respect and understand different languages and cultural contexts. Incorporate this understanding within content moderation and interaction policies. [Industry, Academia, Government]



Develop AI solutions to address societal challenges

Healthcare innovations

Support the development of Al applications in healthcare. Examples include predictive

analytics for disease outbreaks, personalised medicine, and telehealth services. [IET, Industry, Government, Academia]

Sustainability initiatives

Advocate for AI solutions that address environmental sustainability, including smart energy management, climate modelling, and conservation efforts. These initiatives position the IET as a leader in using AI to solve global challenges. [IET, Industry, Government]



Regulations and compliance

Global regulatory trends

Be aware of the regulatory environment across regions. Examples include the EU's

Al Act, which governs high-risk Al applications and aims to protect the privacy of individuals;

Japan's focus on AI and copyright issues and emerging regulations in the United States and India. Maintaining this breadth of knowledge will ensure that AI developments within the IET align with international standards and legal requirements. [IET, Government, Industry]



Al risk management

Invest in emerging Al applications

Focus on sectors where Al can have a significant impact,

like healthcare, automotive, agriculture, and entertainment. Innovations in these areas include adaptive learning, legal process automation, and health and wellness applications. [Industry, Academia, IET]

Monitor AI ethics

Keep up to date on regulations that impact Al development and deployment. This includes ensuring compliance with laws on AI transparency and ethical usage, as well as removing bias and discrimination from AI applications. [IET, Government, Industry]



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