Reflections on Ada Lovelace Day



Watercolour portrait of Ada King, Countess of Lovelace

Following on from her article in the May 2023 edition in the run-up to International Women in Engineering Day (INWED), in this edition, Wendy Owen showcases Ada Lovelace Day – celebrating the achievements of women in science, technology, engineering and maths (STEM) – which this year falls on Tuesday 10th October 2023.

In this article, Wendy describes how Ada is an important part of STEM history, in particular computing, and talks about a few of the modern-day 'Adas' in our midst at SCSC.

Who Was Ada?

Ada was born Ada Gordon in 1815, the sole child of a brief and tempestuous marriage of the erratic poet Lord Byron and his mathematics-loving wife Annabella Milbanke. Fearing that Ada would inherit her father's volatile 'poetic' temperament, her mother raised her under a strict regimen of science, logic and mathematics. As a child, Ada developed a fascination with machines – she designed fanciful boats and steam flying machines, and pored over diagrams of new inventions of the Industrial Revolution that filled the scientific magazines of the time. At 19 she was married to an aristocrat, William King. When he became Earl of Lovelace in 1838 his wife became Lady Ada King, Countess of Lovelace. Hence why she is often called Ada Lovelace, which is a bit incorrect but never mind as it's a fabulous name!

In 1833, Lovelace's mentor (scientist/polymath Mary Sommerville) introduced her to Charles Babbage, a Lucasian Professor of Mathematics. At that time, Babbage had already attained considerable celebrity for his visionary and perpetually unfinished plans for gigantic clockwork calculating machines.

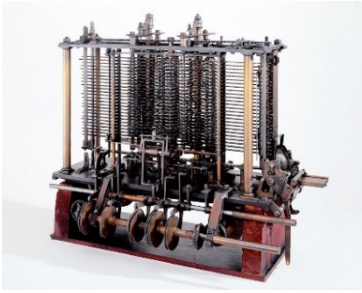
Charles and Ada both had somewhat unconventional personalities and became close and lifelong friends. Babbage described her as:

"*that Enchantress who has thrown her magical spell around the most abstract of Sciences and has grasped it with a force which few masculine intellects could have exerted over it*" and as "*The Enchantress of Numbers".*

How wonderful!

The Analytical Engine

Lovelace was deeply intrigued by Babbage's plans for a tremendously complicated device he called the Analytical Engine, which was to combine the array of adding gears of his earlier Difference Engine with an elaborate punch-card operating system. It was never built, but the design had all the essential elements of a modern computer.



Portion of the calculating machine with a printing mechanism of the analytical engine, built by Charles Babbage, as displayed at the Science Museum (London)

In 1842 Lovelace translated a short article describing the Analytical Engine by the Italian mathematician Luigi Menabrea, for publication in England. Babbage asked her to expand the article "*as she understood the machine so well*". The final article is over three times the length of the original and contains several early 'computer programs,' as well as strikingly prescient observations on the potential uses of the machine, including the manipulation of symbols and creation of music.

Although Babbage and his assistants had sketched out programs for his engine before, Lovelace's are the most elaborate and complete, and were the first to be published; thus, she is often referred to as "the first computer programmer". Babbage himself "*spoke highly of her mathematical powers, and of her peculiar capability — higher than of any one he knew, to prepare the descriptions connected with his calculating machine."*

"The Thrilling Adventures of Lovelace and Babbage: The (Mostly) True Story of the First Computer" [3] provides a wonderfully entertaining insight into Lovelace and Babbage's early exploits.

Thwarted Potential and Legacy

Unfortunately, Ada died of cancer only aged 36, a few short years after the publication of "Sketch of the Analytical Engine, with Notes from the Translator". She lies in the Byron family vault at the Church of St Mary Magdelene in Hucknall, alongside her infamous father.

You can sometimes see Ada's works and personal belongings on display at Newstead Abbey in Nottinghamshire [2]. I went there a few years back during the bicentennial anniversary of her birth and to see such items in person was a truly amazing experience.

In recent decades, Ada's thwarted potential, and her passion and vision for technology, have made her a very powerful symbol for modern women working in technology.



Newstead Abbey in the 1800s

Latest developments in the Ada trail include:

- November 2020, Trinity College (Dublin), whose library had previously held forty busts, all of them men, announced it was commissioning four new busts of women, one of whom was to be Lovelace.
- March 2022, a statue of Ada Lovelace was installed at the site of the former Ergon House in the City of Westminster. The sculpture was unveiled on International Women's Day, 2022.
- September 2022, Nvidia (a gaming/graphics/AI company) announced their Ada Lovelace graphics processing unit (GPU) microarchitecture.
- July 2023, the UK's Royal Mint issued four commemorative £2 coins in various metals to "honour the innovative contributions of computer science visionary Ada Lovelace and her legacy as a female trailblazer."

Turing, Human Computers and ADA

A century on from Ada's life, the Analytical Engine remained a vision until Lovelace's notes became one of the critical documents to inspire Alan Turing's work on the first modern computers in the 1940s, which leads us to where technology is today. We would also see the advent of "human computers" such as those behind the NASA programs of the 1960s as seen in the film Hidden Figures (2016).

We should of course mention ADA, the programming language. This was developed by a French computer scientist Jean Ichbiah of Honeywell under contract to the US DoD between 1977 to 1983, to supersede over 450 other languages in use at the time. It is still named after our Ada, so by the 1970s she was definitely internationally known. I know by the 1980s I was taught about and even used punched cards on some computers.



Anyway, ADA was originally designed for embedded and real-time systems, and is ideal for very large software systems. The way the package specifications and interfaces and runtime checks work enable early problem detection during design phase. It also includes facilities to help Object-Oriented Programming (OOP) and program verification. Hence, ADA is widely used in critical systems, where any anomaly might lead to very serious consequences (accidental death, injury or severe financial loss). Examples of systems where ADA is used include avionics, air traffic control, railways, banking, military and space technology.

In short, ADA has safety-critical support features, is often an integral part of safety-critical systems and we should be very interested in it (alongside derived tools).

Software safety engineering is its own specialised discipline for those who wish to tread the path.

Our Modern 'Adas'

Audrey Canning has over forty years' experience in the application of advanced software control systems, safety-critical computer systems, manufacturing technologies and assurance of major infrastructure projects.



Audrey at the Worshipful Company of Engineers

Her career began as a design engineer developing electronic hardware, firmware and software control and signal processing systems, firstly for Marconi Space and Defence Systems, then for a SME. In 1991 she became a Department Manager at ERA Technology Ltd. During her time at ERA, she was responsible for development of avionics software standards, communication protocols, mine detection radar signal processing algorithms and research into AI.

In 1986 she established ERA's work in safety-critical computer systems (which came to be one of the most highly regarded centres in this field). During her work at ERA, she led numerous independent safety assessments in a range of sectors including oil and gas, defence, medical, nuclear, air traffic control and railway protection systems. She also set up and led two multi-million-pound collaborative research projects on safety-critical systems, one for industrial data driven systems and the other in machine learning. In 1997, Audrey set up Virkonnen, specialising in safety-critical computer applications and consultancy, an undertaking monitoring and assessment activities for government funded research. In more recent years she has acted as Engineering Safety Manager for the Piccadilly to Heathrow Line, Northern Line Signalling upgrade and a Northern Line Extension to Battersea Power Station.

Her professional activities have included being a member of the IET Council, chair of the (IEE) software engineering professional group, member of the Control and Automation Board and founder and past chair of the IET Safety Community, Engineering and Physical Sciences Research Council (EPSRC) advisory and NATO standardisation boards. In 2016 she was awarded the IEC 1906 medal recognising exceptional current achievements. In 2020 she was appointed to the Joint ISO/IEC Working Group developing standards in AI. She is currently co-chair of the IEC 61508 committee and the international lead on functional safety on the Advisory Committee on Safety (ACOS) to the IEC Standards Management Board.

She has published more than 20 papers, her most recent being 'Functional Safety, where have we come from, where are we going?' (SCSC, 2017), 'Developing Safe and Secure Standards' (IET, 2017)' and 'Safety through Systems using Artificial Intelligence', Vision Zero Summit, Japan 2022.

Yvonne Oakshott

Yvonne has worked in the defence aerospace sector for four decades, and at Leonardo Electronics for a long time. There, her current role is as a technical leadership executive and an Independent Technical Authority, responsible for the safety, security and integrity of their products.



Merlin Helicopter

Yvonne's specialist areas of expertise are airworthiness related programmable element assurance and system safety for future systems / new technologies.

She also possesses in-depth knowledge of aircraft systems, safety of weapons systems, systems and product safety, flight safety / airworthiness, recent developments in airworthiness cybersecurity, platform and subsystem safety cases (monolithic and modular), embedded software development and risk-based assurance.

Her career began as an embedded software engineer in Leonardo Helicopters (formerly Westland Helicopters) and she has worked her way up to where she is today. She successfully provides independent assurance in support of design certification and operates in a consultancy role as a subject matter expert to provide guidance to development teams. She speaks with confidence on regulatory matters, safety, programmable element (Software and Hardware) assurance, governance and certification. She is a representative on Leonardo's software process group and chairs the forum for the product technical authorities, and currently works with functional heads to develop proactive approaches to assure the safety of programmable elements across the company.

Throughout her career, Yvonne has contributed to the success of a wide variety of commercial and research-based programmes, interacting with customers, industry representatives and academia.

Yvonne is Vice Chair of the strategic Defence System Safety Group (DSSG), an important group whose purpose is to advance safety practice and safety governance of defence systems by representing the consolidated views of the UK defence industry.

As a long-term member of the SCSC Assurance Case Working Group, Yvonne also provides expert input into industry guidance. To date she has authored four safety-related conference papers.

She has been a co-recipient of BAE and Leonardo Industry Awards for her safety related research work, she is a great role model for women and passionate about helping and developing those looking to follow a technical career path

Outside work, Yvonne has a long association with archery and during the 1990s was ranked one of the top four ladies in the UK!

Zoe Alderman



Zoe did not have a traditional route into engineering; her first degree was in Politics, followed by a postgrad in History and Education (whilst also running a pub and restaurant). She had always wanted to be a history teacher (or possibly a writer for Private Eye) so it came as a bit of a shock to realise that she wasn't actually very good at it; she helped children pass exams but was unable to inspire them with a love of the subject and gained much admiration for those who do it their whole lives.

While mulling over her options, she went temping at a local engineering company, Westinghouse Signals (now Siemens), and there discovered a world she hadn't realised existed. She lasted one day on the photocopying, then went to find something more interesting to do. In her first year there she helped write maintenance manuals, tried requirements traceability, wrote interface specifications, searched out supporting evidence for contractual variations, and did software testing. She was then offered a job in the safety team and sent back to university for a third time, to do an MSc in Safety Critical Systems Engineering. The team she joined were endlessly supportive as she worked her way through the skills of RAMS engineering, and she ended up specialising in safety cases.

Zoe finds great joy in pulling together the strands of evidence into a logical argument and establishing the limitations of that argument. She is a clear advocate of safety being a lot more than just understanding failure modes and their impact on systems; safety engineers have to extract information from experts, need to manage change to improve processes, create logical arguments that need sufficient depth to inform readers without blinding them with detail, and need to have the conviction in their work to hold firm when others try to cut corners. They also need to be open to questioning of their work, without taking it as a personal slight, and acknowledge errors when they have been made.

After nearly two decades at Westinghouse, Zoe moved into contracting to enable her to work more flexibly around family commitments. It also enabled her opportunities to travel, including Korea, Hong Kong, Sweden, USA and Canada. This enabled her to work with a whole variety of safety cultures and processes, alongside different technologies.

Zoe has an abiding love for the London Underground, from its grimy beginnings to its sparkling new stations, and was fortunate to lead the safety team that delivered the first stages of the Victoria Line signalling system into service. Her last job saw her back at Westinghouse/Siemens, which was a challenging role on the Crossrail SCADA project and was the most fun she had had in a long time (it being a hugely demanding project with tight deadlines, brilliant co-workers, and enormous complexity!) After Crossrail, Zoe decided that she would take the Gap Year that she could never afford when she was younger. At time of writing, she is still on sabbatical, but intends to return if the right job arises. Preferably underground!

End Notes

It is worth reflecting in today's safety world of concerns about AI that Ada speculated that Babbage's machine was "*a thinking or ... reasoning machine*" but warned "*It is desirable to guard against the possibility of exaggerated ideas that arise as to the powers*" [of the machine]. Wise words from the 19th century indeed.

My own interest in Ada Lovelace began a long time ago as I'm a former pupil of the same secondary school that Babbage attended, and so I became aware of her at a young age. I was also in the second year ever of 'O Level' Computing and one of only two or three girls in my year to take it. I learnt to program in a few computer languages, mostly C and FORTRAN, but ironically can't claim to have learnt ADA, nor subsequently become a software engineer, being more interested in physics, the hardware and other forms of engineering. I do however suspect that my life would have turned out differently if I hadn't known about Ada back then, as she was an ever-present inspiration throughout my school years.



Blue plaque, St James Square, London

References

[1] Ada Lovelace Day – Celebrating the achievements of women in science, technology, engineering and maths: www.findingada.com, accessed Sep 2023.

[2] Key Women of Newstead Abbey - Newstead Abbey, https://newsteadabbey.org.uk/key-women-of-newstead-abbey, accessed Sep 2023

[3] The Thrilling Adventures of Lovelace and Babbage: The (Mostly) True Story of the First Computer, ISBN-10: 9780141981536, Syndey Padua, 2016.

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Wendy Owen

Wendy has nearly 35 years' experience in systems assurance across a wide range of highly regulated industries covering energy, defence, transport and process sectors. Her career has largely been in engineering consultancy, also with time in product development, research and regulatory. She is a Fellow of WES and the Safety & Reliability Society, and within SCSC a task lead in the Security Informed Safety Working Group (SiSWG) and a member of the Steering Group. Wendy is also the DEI (diversity, equity, and inclusion) lead for the SCSC.

This article is dedicated to Maria, who was the first person at her university to combine computing and fine art, nowadays a strategic CTO, long time BAFTA judge and STEAM advocate.

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