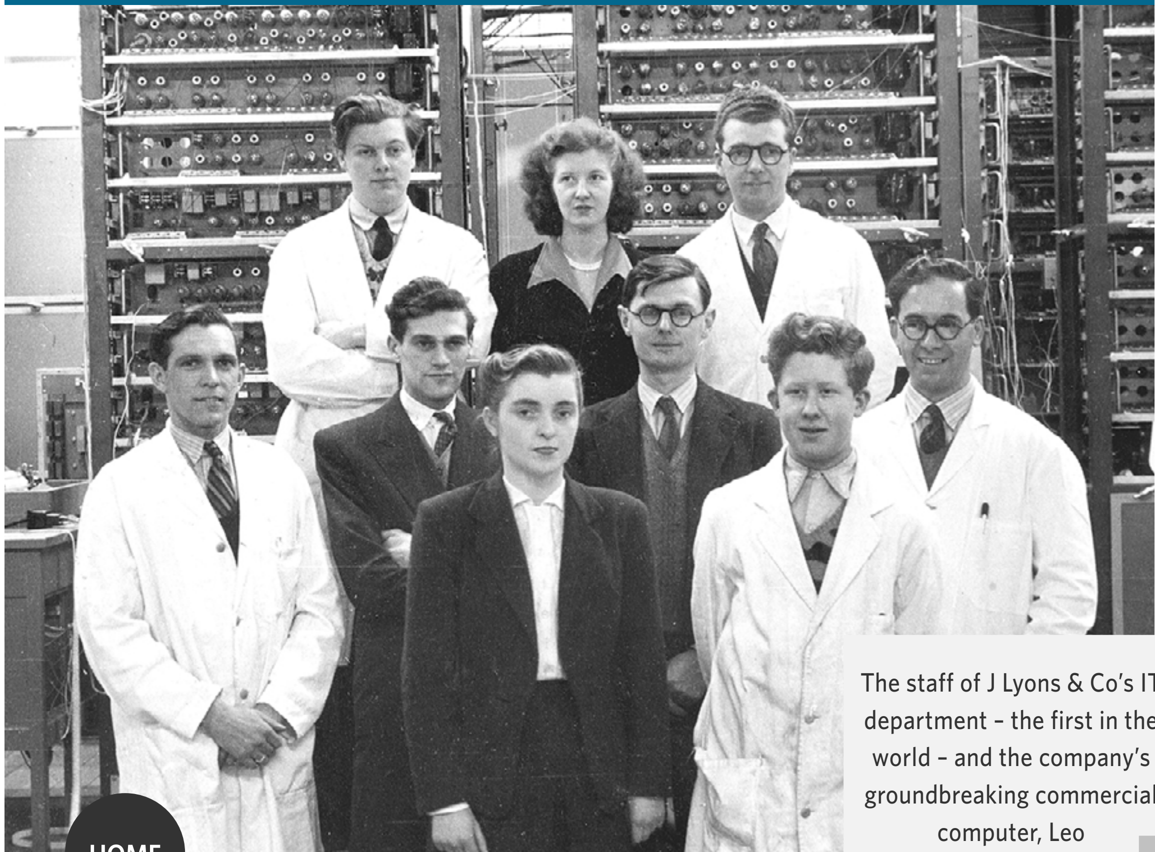
CELEBRATING 50 YEARS OF BRITISH TECHNOLOGY INNOVATION

The heyday of computing: how the Brits ruled IT

Cliff Saran examines how the 1940s, 1950s and 1960s became an age of great innovation for the British computer industry



The staff of J Lyons & Co's IT department – the first in the world – and the company's groundbreaking commercial computer, Leo

HOME

CW@50 1966-2016

The story of modern computing is tied intricately to wartime technology. One of the seminal papers of the industry – which defined the modern computer – was written by mathematician John von Neumann, who worked on how to process the vast number of calculations needed to design an atomic bomb during the Manhattan project in Los Alamos.

In the UK, Colossus, Bletchley Park's ingenious cypher-breaking machine, was bound for many years by the Official Secrets Act. But many other innovations emerged from WWII. "A lot of wartime technology put us on the road to computing," says computer scientist Andrew Herbert, a trustee at The National Museum of Computing. Much of this work came from the British wartime effort in radar.

As Simon Lavington, author and digital archivist at the Computer Conservation Society (CCS), explains: "During World War Two, high-speed pulse electronics had been developed to a high state of expertise for radar."

Many of those working on radar had studied maths or physics degrees before the Second World War, and went back to their universities afterwards, enabling the use of the technology in academia. The big issue was how to design memory. "They didn't know how to store data economically," says Herbert, who is leading the Edsac reconstruction project at The National Museum of Computing. "For the first decade of computing, memory was the Achilles heel. It takes five to six valves to store just one bit."

Home
The early days
British IT innovation
Enterprise IT
Software
Storage
Datacentres
Internet evolution
Security
Mobile communications
Outsourcing
Government IT
Personal computing
Processors
Women in IT
The CIO role
Retail IT
The next 50 years

The story of computer memory

The computer, as originally defined in 1935 by the British mathematician Alan Turing – famed for cracking the German Enigma code – and later refined in the US by von Neumann in 1945, comprises an arithmetic logic unit (ALU) to run a series of calculations fetched from memory on data held temporarily in an accumulator. When a program runs, a series of machine instructions are fetched from the memory store sequentially. Each runs a simple mathematical operation on data held temporarily in the ALU – such as add, subtract, multiply or divide.

> *For caterer J Lyons & Co, there was but one option to exploit the vast benefits of electronic calculating machines: It must build its own.*

Lavington says the early pioneers could only afford to use valves to make the accumulator and a few working registers that were required to perform these mathematical operations. What they really needed was a low-cost method to build the computer's memory, needed to store the program.

Towards the end of the war, one problem radar engineers faced was of permanent echo. "They needed to cancel out the permanent echoes from hillsides and the landscape," says Lavington.

Once the landscape is removed from a radar image, anything that remains is a moving object. Radar used mercury delay lines to store blips representing these moving objects. In early computer memory designs, transducers were used to send and receive a sound blip transmitted through a tube filled with mercury.

Sound travels through mercury relatively quickly – at 1,450 metres per second, compared with 343.2 metres per second in air – and the delay between the transmission of the blip and receiving it enabled the memory engineers to send a stream of blips, representing binary data, from one transducer to another.

Another technique the early computer pioneers used was the persistence present on a phosphor radar screen, which could be used as a form of computer memory to store programs. In both cases, the blip – or data – would need to be refreshed continually, just like DRAM in modern computers needs refreshing today, otherwise the data it held would quickly fade away.

With memory came the first stored program computer. The two pioneering machines were the Manchester Baby and Electronic Delay Storage Automatic Calculator (Edsac) in Cambridge. For Lavington, the Manchester Baby represents the very first working demo of a computer, and therefore has great significance – not only to the British computer industry but globally.

Developing subroutines

Cambridge University had a mathematical laboratory that housed mechanical computing devices developed for use by the rest of the university.

"Maurice Wilkes, director of the Cambridge Maths Lab, heard about von Neumann's ideas and realised Cambridge needed a computer," says Herbert. "Wilkes went to a conference at Princeton where all the pioneers met and, on the days sailing back on the Queen Mary ocean liner, he designed Edsac – a machine that was big enough and reliable enough to do useful calculations for Cambridge scientists."

Home
The early days
British IT innovation
Enterprise IT
Software
Storage
Datacentres
Internet evolution
Security
Mobile communications
Outsourcing
Government IT
Personal computing
Processors
Women in IT
The CIO role
Retail IT
The next 50 years

With a clock speed of 500KHz, it was a relatively slow machine, says Herbert – even by the standards of the 1940s. By 6 May 1949, the team at Cambridge had a fully working machine that could print out squares of numbers.

For Herbert, the second calculation Edsac ran – printing out prime numbers – showed the full capability of a programmed machine, to run calculations and take decisions based on the results.

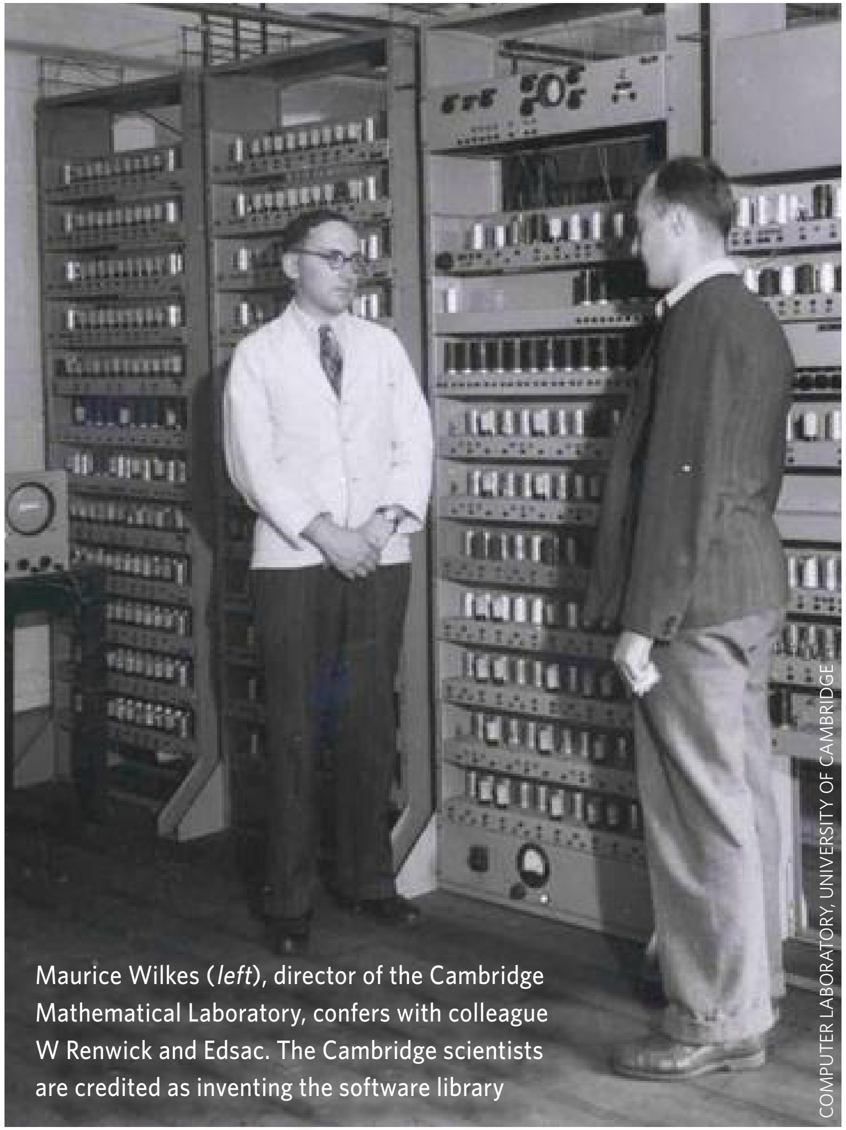
"By 1951, the maths lab was running a computing service. Wilkes, along with David Wheeler and fellow computer scientist Stanley Gill, had written reusable subroutines for input, output and mathematical functions. These were fed on paper tape into Edsac as required, along with the user's program," he says.

According to Herbert, the computer scientists at the Cambridge Mathematical Laboratory invented the modern concept of a software library.

The advent of enterprise software

The era of business software began with J Lyons & Co, Britain's largest catering company – famous for making tea, cakes and ice cream, along with running teashops, corner houses and hotels and doing the catering at Buckingham Palace garden parties.

In 1947, Oliver Standingford and Raymond Thompson of Lyons went to the US to find out about automation and were told of the pioneering work that was taking place in Cambridge. But on visiting Cambridge they were told Edsac was two years away. The Lyons board agreed to help fund Edsac. Once the machine had proved it could work, Lyons went about building its own machine, Leo, which went live in 1951.



Maurice Wilkes (*left*), director of the Cambridge Mathematical Laboratory, confers with colleague W Renwick and Edsac. The Cambridge scientists are credited as inventing the software library

Home
The early days
British IT innovation
Enterprise IT
Software
Storage
Datacentres
Internet evolution
Security
Mobile communications
Outsourcing
Government IT
Personal computing
Processors
Women in IT
The CIO role
Retail IT
The next 50 years

"The reason Lyons got going was because it was the biggest catering company in the UK and decided automation was necessary – this is how Leo got started," says Peter Lyford, chairman of the Leo Computer Society.

According to Lyford, a lot of the basic structures of modern business computing were developed in the 1950s and 1960s. "David Caminer from Lyons was the first systems analyst," he says.

Caminer went to work for Lyons at its Cadby Hall headquarters in Hammersmith, London, in 1936, with no idea that his later work would be intrinsically linked with the development of British business computing. One of Caminer's innovations was around optimising the business processes at Lyons.

As Lyford explains: "All the tea shops put in their orders on Saturday. Caminer went round to every tea shop and made changes they needed every Saturday night." This allowed Lyons to have the bulk of the goods needed by the tea shops pre-ordered, while enabling each to tweak their individual stock orders.

Frank Land, emeritus professor in the Department of Information Systems at the London School of Economics (LSE), is regarded as the UK's first information systems professor. The young Land worked as a programmer on Leo in 1953. "We knew everything we did had never been done before," he says. "We didn't realise we were transforming everything and we shared our work in software."

> **"We knew everything we did had never been done before. We didn't realise we were transforming everything and we shared our work in software"**
> Frank Land, LSE

Among the challenges the Leo programmers faced was the size of the memory store on the original computers and trying to accomplish the calculations for programs such as an inventory system, given the time it took to read one punch card.

There was an emphasis on software quality, Land explains: "Human time was much less valuable than computer time.

"What we had on the computer was already in the right so two people had to see everything before it went onto the computer."

Widespread business adoption

When Land started at Lyons, the tea company was expanding the amount of automation it wanted to do. "We very quickly recruited six more people and, when Leo Computer Company was formed in 1955, we had 35 people," he says.

From the very beginning, the Leo programmers used a sophisticated assembly code for programming.

Among the ideas Leo adopted from Cambridge was microcode. "You could program an instruction set tuned to business computing such as to convert decimal to imperial or run checksums on the punch cards," says Land.

Home
The early days
British IT innovation
Enterprise IT
Software
Storage
Datacentres
Internet evolution
Security
Mobile communications
Outsourcing
Government IT
Personal computing
Processors
Women in IT
The CIO role
Retail IT
The next 50 years

While the Cambridge Maths Lab developed mathematical subroutines, Land says the Leo programmers developed their own routines. "One of our programmers created a floating point subroutine," he says.

The Leo quickly became a popular computer for business. Many of Britain's best-known companies – including household names such as Dunlop, Imperial Tobacco, BP, Phoenix Insurance, Heinz of baked bean fame, the Ford Motor Company, Durlachers, the Post Office, Royal Dockyards – as well as government offices and local authorities, acquired Leo Computers or used Leo services.

> "As all of Bletchley Park was secret, how could it influence the British computer industry?"
> Simon Lavington, CCS

British Rail used Leo in 1955/56 to calculate station-to-station distances, which it needed to accurately charge for rail fares. Leo was also the first machine to run weather modelling at the Met Office.

The programmers needed speed and agility, just as they do today. "In 1963/64 we were producing tax tables for the Treasury. On Budget day, we would wait for the courier to arrive with the tax changes. We had to print out the tax tables for the government very quickly," says Land. Many of the changes involved changing parameter values that could be read in by the tax program. But there was some recoding.

Intercepting Hitler's commands: a brief history of Colossus

Colossus was a 1,500-valve machine designed by Post Office engineer Tommy Flowers at Bletchley Park to enable the code breakers to crack the cypher used in the communications between Hitler and his generals during World War Two.

The machine is based on the work of Bill Tutte, who reverse engineered the Germans' Lorenz SZ742 cypher machine by analysing samples of encrypted messages to work out how they had been encoded.

The work led to the development of Tunny, a machine which emulated Lorenz.

Reading 5,000 characters per second – faster than anything ever produced commercially – Colossus's job was to crack the original settings the Lorenz operators used to send their communications. It performed 5,000 algorithmic tests every second. With the right settings, the encrypted message could be read in plain German.

- Home
- The early days
- British IT innovation
- Enterprise IT
- Software
- Storage
- Datacentres
- Internet evolution
- Security
- Mobile communications
- Outsourcing
- Government IT
- Personal computing
- Processors
- Women in IT
- The CIO role
- Retail IT
- The next 50 years

The great tragedy

In the 1940s, 1950s and early 1960s, there was a huge amount of innovation coming out of the nascent British IT industry. Along with Leo there were Elliot Brothers, Ferranti and British Tabulating Machines.

In 1962, Manchester University, Ferranti and Plessey jointly developed Atlas, the world's first supercomputer. Among the innovations in Atlas was the Atlas Supervisor, widely regarded as the world's first operating system.

But clearly no story about the early history of British computing is complete without at least a passing note on Colossus and the wartime efforts of computing pioneers Alan Turing and Tommy Flowers at Bletchley Park.

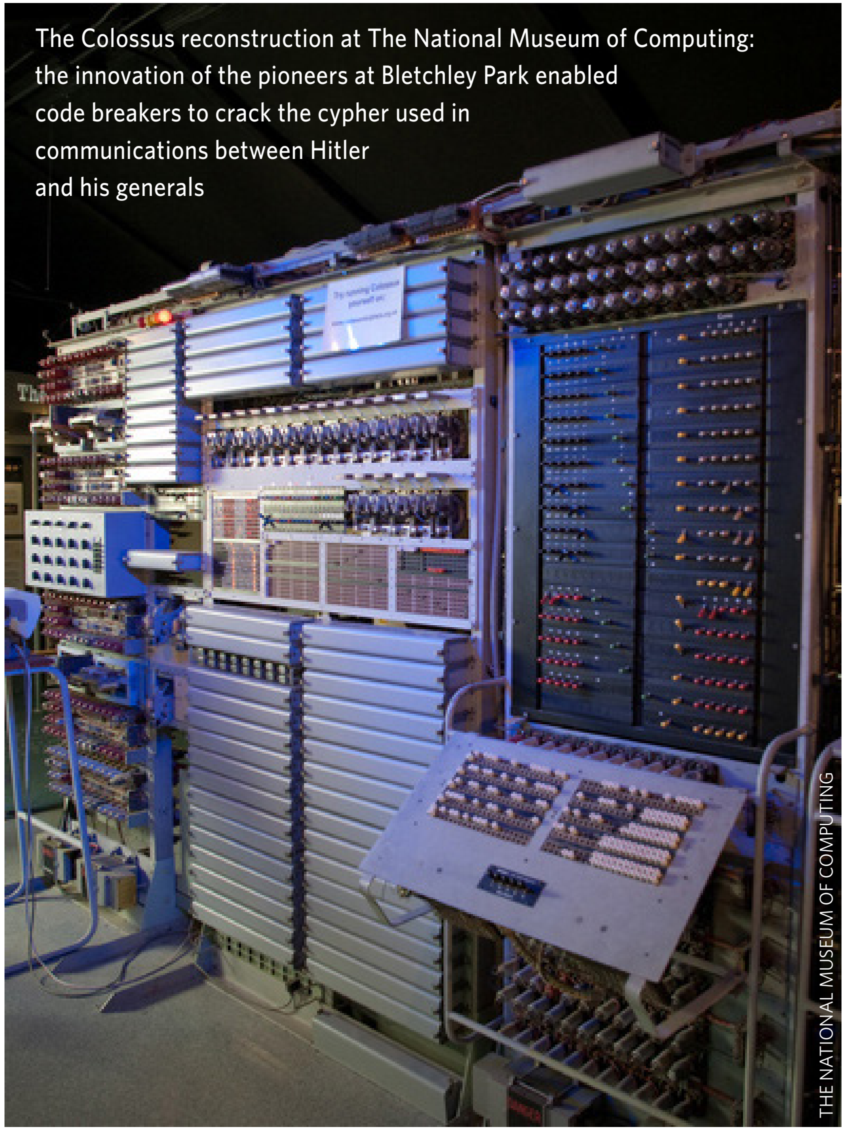
Unfortunately, as Lavington notes: "Since all of Bletchley Park was secret, how could it ever have had any influence on the British computer industry?

"It did not have any effect. There was no connection."

For Land, the gap between military and business was "a great tragedy for British computing" – whereas in the US "it was all integrated and they benefited from the link with the military".

Under the Harold Wilson government, the minister of technology Tony Benn began the initiative to create a British computer industry with the formation of ICL in 1968, which came about through the merger of International Computers and Tabulators (ICT) with English Electric Computers, which itself had acquired Elliot, Leo and Marconi.

However, the defence computing sector – in the form of Marconi and Plessey – were kept out of the merger. ■



The Colossus reconstruction at The National Museum of Computing: the innovation of the pioneers at Bletchley Park enabled code breakers to crack the cypher used in communications between Hitler and his generals

THE NATIONAL MUSEUM OF COMPUTING