COMPUTING AND SUSTAINABILITY

PROFESSOR ANDY HOPPER CBE FREng FRS

An Acorn BBC Micro computer, which dominated the educational computer market throughout the 1980s

Being a dab hand with a soldering iron helped lay the foundations for a career that has changed the face of computing. Along the way, Professor Andy Hopper's research has also led to the creation of companies that contributed to Cambridge's reputation as an innovation hub. The engineer, who is equally at home in the worlds of academia and business, talked to Michael Kenward about the revolution in computing and sustainability he is helping to create.

One benefit of being among the country's most successful founders of IT businesses is that you can afford to splash out. In Professor Andy Hopper's case, he has opted for his own six-seater, single-engine aircraft. Thanks to those business successes – he has set up more than a dozen companies on the back of his research – he can also afford to keep a landing strip on his 200-acre farm near Cambridge, where he is head of the University's Computer Laboratory.

Unlike many entrepreneurs, or academics with an impressive citation record, Hopper did not fly off into the sunset to spend more time with his money, or move on to build a multinational empire. Hopper has stuck resolutely to research – with something like 50 PhD students to his credit – while also juggling new businesses to ensure that his research does not languish in journals.

This is not bad going for someone who emerged with so-so A-levels from "a reasonable comprehensive school" in London. When it came to looking for a degree course, Hopper was, he says, "an average student trying to find a home". So there was no hope of persuading one of the leading universities to let him in.

Fortunately for Hopper, he heeded family advice that computers were an up-and-coming thing. This suggestion – some time before jobs in IT became common-place – fitted in with Hopper's interest in electronics and "doing practical things". His choice of university was also family-led, as he went to study at the location of many a childhood holiday in Swansea.

Professor Andy Hopper CBE FREng FRS

ON THE RIGHT TRACK

As soon as Hopper arrived at university, things fell into place. "I always came top [of the class], from the day I turned up." He puts this partly down to the fact that Swansea University's Professor David Aspinall ran "this brilliant course that suited me. It combined electronics, computer science, programming, with some accountancy and business studies, which is just what computer technology needs."

Hopper did so well that he wanted to study for a PhD. Failing to find somewhere to do the research that would allow him to indulge in his passion for skiing, he took up Aspinall's suggestion that he talk to his contacts at Cambridge. It was late in the recruitment season for PhDs, so the message from Cambridge was 'hit the road and get here immediately'. Early in July, Hopper drove to Cambridge in his shabby Triumph Herald. "I got interviewed there and then by Roger Needham and Maurice Wilkes. I mentioned that I liked soldering, still a valuable skill in the early 1970s, and they accepted me!"

Even back then, Hopper was looking for better ways of doing things rather than to have to wire up a different circuit for every task and build separate hardware systems each time a group of computers were to be networked, Hopper put forward the idea that you can have a single-chip design to implement any network.

At this stage, Hopper's network chip existed mostly on paper, in his PhD thesis. Then he met a contact at the Rutherford Laboratory who could see a practical use for Hopper's idea and offered a grant to go back to Cambridge and to implement the idea in a VLSI (very-large-scale integration) circuit.

FROM LITTLE ACORNS

Hopper's work revealed shortcomings in the approaches used to creating VLSI chips. "We discovered that there were not so many good tools for designing these chips." Thus was born another research project, to develop those tools.

Out of this came the computer aided design (CAD) software that Acorn Computers bought from the University. Acorn was Hopper's second venture into creating a business and one of the UK's earliest makers of chips for personal computers.

Two years as a research assistant gave way to four years as a university lecturer, while simultaneously setting up businesses. The first major business success was the aforementioned Acorn Computers Ltd, which Hopper helped set up in 1978 with Hermann Hauser (see Profile, *Ingenia* 33, December 2007), and Chris Curry. Acorn did much to bring computers to consumers, with such big sellers as the Acorn Electron and the BBC Micro.

Hopper may have had a hand in creating a dozen or more businesses, as well as setting up and running a corporate research and development lab, but he has never left the University. "I have always done the normal university job at full-scale, but in addition I have been an entrepreneur. It is not just by hard work, it is by managing time and the flexibility of the system."

TOUGH TIMES

Those close links with the business world have shown Hopper that technology can lose you money. He admits that one or two of the businesses he created are "still at the races". Even successes can cause headaches.

At the time Hopper and Hauser were considered mavericks in spotting business opportunities in their research and developing them. More than 30 years later, the Department has generated nearly 150 companies.

Acorn ran into trouble around the time Hopper had saddled himself with debts to buy a house. "I had a few sleepless night then," says Hopper. "I was nearly bankrupt."

The troubles of the corporate world also came home when Hopper had the 'pleasure' of making himself redundant when he had to wind up a research and development laboratory that he had set up with Hermann Hauser in the middle of Cambridge in 1986. They created the lab for Italian computer company Olivetti when it bought out Acorn.

The new millennium coincided with a dotcom crash that created a business blood bath for the information and communications technologies sector. The Cambridge lab ended up being surplus to the needs of a new owner. So Hopper handed out redundancy notices to himself and the 60 other people in the team.

The closure did not stem the flow of new ideas and businesses. Several of the lab's projects have, sometimes years later, been the basis of new businesses. For example, one of the biggest successes to emerge from the lab and, by his own account, Hopper's own biggest business achievement, was Virata. First set up in 1993 as Advanced Telecommunication Modules Ltd, the company went on to attract one of the UK's biggest start-up investments. It floated on the NASDAQ stock exchange, before, as is common in tech businesses, ending up as a part of a larger company.

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Today's young researchers see nothing strange about starting a business. PhD students in Cambridge are now exposed to business issues, thanks to courses from Hopper and other successful alumni. "We also have a business club for current and former students of the Cambridge Laboratory," he adds.

BUSINESS TEMPLATE

Hopper's belief in the importance of people explains his approach to the birth of new businesses. "My fundamental model has not changed in 30 years, which is that a PhD student becomes a business partner." He then reels off the names of companies that came about in this way, with Hopper and his research students as the core technical team: Telemedia Systems, RealVNC, Ubisense, and so on. "They are people who had a long-term date with me. They have put up with me. We start a business and then we start another business. So there is this cascade."

This is how Hopper manages to keep up the flow of ideas. It also lets him continue in his self-proclaimed role of troublemaker for tech businesses, what he calls the "frighten them to death model". Not for Hopper the idea of doing research to solve short-term problems for companies – the "service model" as he describes it. "I want to undermine the business models of my business partners. And I want to collaborate with them on that. That's where the start-ups come from."

The young people around him are the biggest source of new ideas. For a start, says Hopper, they are the people who do unexpected things with computers, things that a corporate research lab might not dream of. "That is why I am here in a university," says Hopper. "I can think disruptive, really disruptive."

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The next area where Hopper wants to be disruptive and to lay waste to existing business models is to exploit what computers can do for the environment. This might seem a bit rich for someone who insists on flying his own aircraft, but even the plane isn't without its environmental plus points – it has a CO_2 monitor aboard, gathering data as Hopper flies, so he now has CO_2 measurements at 10,000 feet from around the world.

He took those measurements on a round-the-world solo flight last year. He flew to New Zealand to join his wife and their two children (they went by scheduled flights). His wife, a Professor of Plant Biochemistry at Cambridge had taken up a three-month fellowship at the University of Canterbury in Christchurch.

Hopper doesn't really try to justify his hobby. "It is the most ridiculous thing," he admits. However, he has more substantial ways of making up for the environmental impact of his flying than merely measuring CO_2 levels. "I am driven by computing and sustainability," he says.

Why not, he suggests, put arrays of computers where sustainable energy is readily available? "You can take the computing to where energy is, places that are so far away that you can't get the energy back from them." In the middle of the oceans for example, it might be easier to connect computers to the world and to the power than to move the energy to somewhere that can use it.

Another idea is to create a digital infrastructure that allows the developing world to get wealthier without consuming the planet. He talks of building a platform to benefit eight billion people, "so that they can gazump us". Can they afford to buy the kit? Well, we already have business models that "give away" mobile phones, he points out.

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Hopper wants to attack computing and its energy use at all levels. As well as moving computing to where the renewable power is, he advocates a move to "energy proportional computing and computation, where every bit of energy is used for a useful purpose or is switched off". This idea comes back to how computing happens at the chip level, Hopper's original inspiration.

He also wants to see progress on the software front, with research into "high-end scalable computing" for sustainability. This could, for example, lead to better models for research in climate change.

As you would expect of a serial entrepreneur, Hopper believes that there is money to be made from these ideas. And the UK is well placed to make it. While the United States has thrown much of its public support for research and development behind defence technology, the UK has quietly built up expertise in green computing. But we need to act now, says Hopper. "We have got another few years. But no more than that."

Hopper's own group of researchers has been on the case for five years. They are looking into ideas like developing a smart meter that gives everyone a constant track of their energy consumption.

Where will the money-making ideas come from in this research? It is too early to tell, Hopper replies. But he has an unmatched track record in finding ways to make money out of researching.

The Computer Laboratory's Digital Technology Research Group at the University of Cambridge, 2008. Professor Hopper with Professor Sir Maurice Wilkes FREng (on his right), PhD students, research associates, computer officers and lecturers

BIOGRAPHY – Michael Kenward OBE
Michael Kenward has been a freelance writer since 1990 and is a member of the *Ingenia* Editorial board. He is Editor-at-Large of *Science|Business*.

PROFESSOR ANDY HOPPER – HONOURS AND DISTINCTIONS

Awarded PhD in Communications Networks, University of Cambridge, **1978**. Elected Fellow of Institution of Engineering and Technology, **1993**. Elected Fellow of The Royal Academy of Engineering, **1996**. Awarded Royal Society bronze medal for achievement, **1999**. Awarded Academy's Silver Medal, **2003**. Awarded Mountbatten Medal by the Institution of Engineering and Technology, **2004**. ACM Sigmobile Outstanding Contribution Award, **2004**. Awarded honorary Fellowship of Swansea University, **2005**. Elected fellow of the Royal Society, **2006**. Awarded CBE for services to the computer industry **2007**.