UK COMPUTING RESEARCH COMMITTEE

Bridging the "valley of death": improving the commercialisation of research

Response from the UK Computing Research Committee

The UK Computing Research Committee (UKCRC), an Expert Panel of the British Computer Society, the Institution of Engineering and Technology and the Council of Professors and Heads of Computing, was formed in November 2000 as a policy committee for computing research in the UK. Its members are leading computing researchers from UK academia and industry. Our evidence reflects the experience of researchers who each have an established international reputation in computing.

What are the difficulties of funding the commercialisation of research, and how can they be overcome?

Research into computing has had, and continues to have, a good record of commercialisation. There are however generic problems that face most UK academics (these are discussed first) and a few specific difficulties that are mentioned at the end of this section.

It is also important to recognise that, despite the UK's acknowledged strengths, most innovative research originates outside the UK and always will. It is therefore essential to encourage UK exploitation of overseas research with at least as much energy as is devoted to exploiting UK research. Often, this will require specialist knowledge of the research topic and this will be most easily accessed in university departments.

An academic group that seeks to exploit its research commercially needs both competent personnel and financial resources years ahead of having anything to show for it. Most universities cannot give an academic the time they need to invest in building bridges tomorrow; a lecture at 9am Monday is certain; any income from commercialising research is uncertain and will not happen for a few years even if the venture avoids bankruptcy and litigation.

Often in UK universities, the central administration taxes departments so much anyway, that the incentives where it matters are negligible. Student satisfaction, such as it is, will always trump industry collaboration, unless there is sustained cash up front that also allows almost all of the ideas to fail. Some will succeed, but only if lots can try. Individual scientists and engineers in universities can do wonderful work with industry; unfortunately, their university management have different priorities (often derived from central Government actions such as the REF) that mean that members of staff are incentivised to deliver peer-reviewed research papers and high student satisfaction scores ahead of commercialising their research. Furthermore, the needs and objectives that academics have for publishing world class research can often be at odds with those of the private sector where exclusivity and non-disclosure agreements may be required in order to protect ongoing investments.

Getting early-stage funding is hard for many academics: most venture capitalists and business angels won't touch companies that do not already have revenues and customers. The really, really early-stage venture funds seem to have dried up, and there is neither resource nor will for most universities to invest from their own funds.

There's also the issue of universities misunderstanding the value that pure research brings to a start-up, and therefore over-valuing the technology they're licensing, either to a start-up or an existing

company. It is rare for universities to have the expertise to make these judgements, and to negotiate commercially realistic deals on commercially realistic timescales. Universities often demand far too much equity in start-up companies, jeopardising their success.

Academics (and University management) often confuse great technology with great business. There may be research that is technically interesting and that is valued very highly by the researchers and the university, but that has no commercial value at all since there is no reasonable plan for return on investment. We need an effective way of establishing connections between technologists who have great ideas and equally creative people who can build equally innovative business plans that allow the commercialisation of those ideas for which there is a practical route to market.

In some of the more entrepreneurial US universities academics are only paid by the university for 75% of their time, and expected to go out and consult, create companies or otherwise generate wealth with the remaining 25%. This seems to set up effective industry collaboration that brings money back to both the academic and the institution (in the form of research grants, studentships etc to keep the pipeline of ideas flowing). Of course in the US professors are able (if they have the income to cover it) to hand off many responsibilities like labs and supervisions to "assistants" (typically PhD students) to maximise the utilisation of their own time spent on research, scholarship and lecturing.

Taxing academics' consulting incomes or demanding stakes in their start ups is short sighted and a disincentive. It is far better to encourage your entrepreneurs to be highly successful in the hope they'll then come back and give you new buildings, scholarship programmes and so forth.

Perhaps a more complex issue is whether a university has right to exploit research that the academic chooses not to exploit personally although, in many fields such as Computing, virgin intellectual property is rarely valuable unless it comes with the inventor as part of the package.

Computational science infiltrates other disciplines, so that commercial exploitation of computing research isn't just packaging a product but can involve quite deep changes to the way one thinks about the problem being solved. Data intensive medicine currently demonstrates this.

Are there specific science and engineering sectors where it is particularly difficult to commercialise research? Are there common difficulties and common solutions across sectors?

Computing research is commercialised in ways that may differ markedly from the approach in other sectors.

Software "apps" can be marketed through App Stores, such as Apple Inc's iTunes store, but competition is intense, individual apps sell typically for 99p, and almost no-one recovers the realistic costs of development.

Some innovative software-based services have been commercialised extremely successfully – Facebook and Google being the leading examples – but the commercial model is extremely unusual, as it requires huge investment to provide free services so that a vast population of users is developed and monetised through advertising revenue and added-value services.

What, if any, examples are there of UK-based research having to be transferred outside the UK for commercialisation? Why did this occur?

The UK has always been in the forefront of innovation in computing. The Manchester University Small-Scale Experimental Machine was the world's first true computer (June 21 1948); it was rapidly followed by Maurice Wilkes' Cambridge University computer EDSAC (1949), which was the first computer with

integrated input-output. EDSAC was commercialised by Lyons Bakery, becoming Lyons Electronic Office (LEO, 1951), the first commercial computer, running the world's first commercial software.

Since then, the UK has invented and patented the floppy disk, virtual memory, several important programming languages, software development methods, electronic design tools, and several computer architectures. Although some of these inventions have led to significant UK-based companies (ARM plc and Autonomy plc, for example), the UK does not have the share of world markets in computing that our history of innovations would suggest could have been achieved.

The reasons for this are many and interrelated: the post-WW2 economic situation relative to the USA, the relatively small home markets, the relatively small size of R&D investment in the UK (especially in Defence equipment), the decisions taken by Government agencies regarding UK patents, the failure to implement the recommendations of the Bide committee in the 1980s following the successful Alvey programme, and the loss of control of Government IT purchasing policy in the 1990s, when the Public Purchasers' Group dissolved and the Central Computing and Telecommunications Agency was replaced.

What evidence is there that Government and Technology Strategy Board initiatives to date have improved the commercialisation of research?

The TSB KTNs and KTPs have attracted considerable interest and involvement and they have been accompanied by much more contact between academia and industry, but it is difficult to determine direct causal relationships. Within the TSB programmes there is an inherent desire that they are led from the private sector. Whilst the private sector is a key ingredient, if we are serious about bridging and exploiting the UK research base, universities must be not only allowed but encouraged to lead in these initiatives.

A scheme such as Smart (renamed from GRAND) offers a vital proof-of-concept funding source that aims to seek out projects of creativity, innovation and risk. The appraisal process, which uses three "appointed assessors", may however contradict this aim: if decisions are based on assumptions of known facts, it is possible or even likely that safe, low risk options will be selected, rather than picking out ambitious or speculative proposals.

What impact will the Government's innovation, research and growth strategies have on bridging the valley of death?

The Government has announced that the TSB will establish an Open Data Institute and a Connected Digital Economy Catapult. We welcome both these initiatives. The experience from Germany's Fraunhofer Institutes is that it may be necessary to provide public support for such centres for more than a decade before they become fully self-sustaining, but that this investment can then deliver great benefits.

Should the UK seek to encourage more private equity investment (including venture capital and angel investment) into science and engineering sectors and if so, how can this be achieved

The improved R&D tax credits and the tax incentives for investing in start-ups provide Government support for private equity investment in commercialising computing research. Private equity is, however, risk adverse and needs confidence to invest. It may spend a relatively large amount of money to investigate and protect this potential investment. Often relatively small amounts of grant money will simplify and streamline this process.

Better business plans would attract greater VC funding and improvement here is a priority. One UKCRC

member saw a Stanford spin-out become a $2B company and the only reason it succeeded was because the third person involved after the two Stanford Professors was a Chief Financial Officer who said “nice but it won’t fly. Let’s do it this way” and pretty much invented the technology IP licensing model.

We need better mechanisms, including forums and funding, for connecting technical innovators to the right kind of business entrepreneurs (with emphasis on the right kind). Good research without a business plan dies on the vine.

What other types of investment or support should the Government develop?

As stated earlier, UK computing research has a good record of commercialisation. The opportunities in the future are very great, because of the strength that the UK has in many key areas of computing science, micro-electronics, communications and software engineering. We cannot say whether or not these strengths will be enough to overcome the disadvantages of low Government R&D investment, failure to use public purchasing power to pull through strategic research strengths into products and services, and small home markets.

We would like to see the Government support the development of markets for a new generation of secure and reliable software products by working with the European Commission towards Europe-wide product liability legislation to cover software products. At present, the software industry is unique in being able to sell products that contain many functional defects and security vulnerabilities without any consequent liability: for example, when a security breach occurs because of a wholly-avoidable software vulnerability, the software manufacturer and vendors simply blame their customers for failing to apply maintenance patches fast enough! This is increasingly unacceptable. If a timetable was announced for the introduction of strict liability (with appropriate consultation over how this would be interpreted and enforced), the software industry would have the incentive to adopt the modern software engineering methods that can largely eliminate these problems, and the UK would benefit twice: once through access to much improved products and once through the take-up of computing methods, tools and expertise where the UK is a world leader.

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for UK Computing Research Committee
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