Research Assessment Exercise 2001

Overview Report from the Computer Science Panel (UoA 25)

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Introduction

Computer Science is a key subject in UK universities. It has grown rapidly over the last two decades in response both to the number of student applications and to national research programmes; it now receives a larger group of applicants through UCAS than Engineering Sciences, Mathematics or Physical Sciences. The staff numbers in Computer Science departments have risen is response – there are now more Computer Science staff than in any other subject within Engineering, Mathematics or the Physical Sciences.

80 universities submitted to UoA 25, including 1560 research active staff which make up 48% of a total staff of 3245. By comparison 89 institutions submitted 1830 research active staff in 1996.

Scope and assessment of Computer Science

A wide range of technical topics now makes up Computer Science, each of which includes both a practical and a theoretical aspect: these topics include algorithms, artificial intelligence, computer architecture, etc (see Criteria 2.18.1). However Computer Science overlaps with a number of other subjects including Psychology, Linguistics, Information Management, Biology, Medicine, the Physical Sciences and the Engineering Sciences; there are long-standing interactions in topics such as human computer interaction, speech, vision, information systems, and in many others (see Criteria 2.18.2). Computer Science is inherently a key component of much interdisciplinary research.

The Computer Science panel had 13 members, and could not evaluate every technical area in every submission. Therefore, in addition to mandatory referrals, it referred a number of submissions to other panels or to Special Advisors whenever if felt it could not evaluate a submission with confidence. In addition, following experience in 1996, it established a joint sub-panel with Library and Information Management for the assessment of Information Systems. All scores from other panels or Special Advisors were reported back to the Computer Science panel though a nominated link member of the panel; in this way, the panel avoided misunderstandings between different scoring systems. Five International Advisors, three from North America, one from Europe and one from Australia were used to provide a check on scoring, particularly at the 4/5 and the 5/5* borderlines.

The panel read at least 10% of all publications submitted. It made 28 referrals to other panels, including 13 mandatory referrals, and 11 referrals to Specialist Advisors; in addition, 6 mandatory referrals were made to it. The Information Systems sub panel considered 9 submissions.

Some submissions described research which was not, according to the UoA 25 criteria, strictly Computer Science. In many of these cases the research involved the application of computers to the solution of problems in other disciplines – the research advances were usually in the subject to which the computing solution was applied, and were not in Computer Science itself where generic solutions are sought. In a small number of cases research was submitted which was neither Computer Science nor an application of computers. In such cases, the submissions appeared to have been made to the Computer Science panel for administrative reasons.

In every case, after consultation with other panels or Specialist Advisors, the panel considered the scoring of such research on the same basis as *all* other work submitted. It did so mainly because much research in Computer Science is inherently multidisciplinary, and partly because there was no RAE rule to stop researchers being submitted to inappropriate panels.

The Scores

By comparison with 1996, the average score increased by approximately half a grade to the mid 4s, although the number of 5* scores remained the same. However the proportion of 5s almost doubled and the number of 4s increased; there were no 1s and the number of 2s halved. These increases denote a clear improvement in the quality of research presented over 1996.

Why have the scores improved?

The panel asserts that the improvement in scores since 1996 reflects:

a) *Major changes in a number of departments* which have introduced the kinds of structure needed to underpin successful research including seminar series, sabbatical leave schemes, administrative support for grant writing and project management, research committees, reduced teaching and administration loads for research active staff, etc. They had diverted funds into research by pump priming, travel funds, PhD studentships; in some institutions all the QR money was given to departments and then to research groups. They had focused their appointments on research-active staff, and concentrated on priority areas. For many this investment had paid off in increased research funding, better quality publications, etc. Some of these changes were particular noticeable in post-1992 universities. There was evidence of considerable staff movement, with whole research groups changing institutions in some cases.

b) Improvement in the quality of outputs with a marked shift towards the use of refereed journals and conferences of international standing. In addition there had been an increase in esteem factors such as conference organising and journal editorships.

c) Greater selectivity in the staff returned meant that several universities restricted their submissions to staff who had made important contributions to research. However, some universities who used this tactic in 1996 submitted larger groups of researchers in 2001 across a wider selection of topics, which, in some cases, led to a reduction in the overall score.

In summary, the panel observes that the quality and presentation of research in UK Computer Science has improved over the 5-year period of the RAE. To quote a industrial member of the Computer Science panel: " … I believe that the panel has identified 5/5* departments that are playing a significant role in the international

Computer Science arena. Moreover, there are a substantial number of outstanding computer scientists working in the UK. The Computer Science community can be justifiably proud of these departments and people".

Detailed observations

1. UK work in theoretical Computer Science is usually of a very high standard, often with major international impact.
2. There was evidence of interdisciplinary work in almost every submission, with particularly strong interactions with the medical area.
3. The balance of research submitted has changed significantly since 1996: the research on vision and imaging, on agent technology, and on knowledge technology has increased in volume. There was some evidence of increased groupings of researchers in some areas and further specialisations: for example HCI has specialisations in collaborative systems and virtual environments. By comparison the work on Information Systems, and on Systems Engineering has reduced. Indeed, there appeared to have been a worrying reduction in the amount of research in Systems Engineering including research involving related technologies.
4. Almost *all* submissions contained examples of industrial exploitation, and many reported the establishment of spinout companies.

Industrial impact

The panel was surprised and pleased to see the extent of industrial collaboration. Almost every group reported collaboration with the 'users' of research results and a substantial number had generated spin-off companies or products. 'Users' included a wide range of industries (i.e. not just the IT industry itself) and many non-industrial bodies, e.g. hospitals, schools, NGOs, other scientists, as well as Computer Science users. The panel found no evidence of "a structural disconnect with industry" – indeed, there was much evidence to the contrary.

The community attracted £37.5M of industrial funding during the assessment period, more than that attracted by the Physics community. The industrial companies strongly coupled to Computer Sciences tend to be small or medium-sized, often start up companies, which receive technology transfer by staff transfer – such companies do not usually place large contracts for R & D within universities. The interactions tend to be more personal. This form of interaction may explain why the magnitude of the industrial research income, although large, is about half the level of that in Chemistry or Electronic Engineering.

Funding Base

Computer Science is funded as a laboratory subject by the Funding Councils, and so researchers can pursue research topics across the breadth of their subject from large-scale experimentation to theory. It is a subject which mixes uniquely the characteristics of a science and of engineering; it is strongly coupled to other subjects and to small spin out companies where its ideas are exploited. Computer Science has a large and diverse research base with more researchers than any other cognate subject apart from Physics and, by far, the largest number of submissions.

Given the excellent research reported, the panel were surprised that the research funding of Computer Science was so much lower than that of other cognate subjects.

In terms of OST funding alone, the average Computer Science researcher received £87k over the 5 years period; his or her Physics counterpart received £263k, a Chemist £166k and an Electronic Engineer £180k, and this is reflected in markedly lower numbers of RAs and research students in Computer Science than in other subjects. If other forms of public funding are included, then the figures diverge further: for example, Physics alone received over *£1.2 billion* in this period, and other subjects also received larger sums. Surprisingly Computer Science received no funding under the JIF initiative. Given this disparity in funding, the panel was not surprised that research in Systems Engineering, which needs large-scale and expensive experimentation, had declined in volume since the 1996 RAE. This observation is consonant with the findings of the recent EPSRC International Review of Computer Science[1].

Conclusions

The panel finds that UK Computer Science is in good health, despite the loss of some star researchers to industry and overseas academic posts. These losses and lack of funding for large-scale experimental facilities has led to decline in some areas. It finds that the standard of the research reported has improved since 1996, and that several groups remain world leaders in their fields – indeed, those departments scoring 5* and 5 can complete with the best departments world-wide. However the panel is concerned that the present health of the subject may be compromised increasingly by the wide funding gap that exists between Computer Science and other subjects nationally and with Computer Science internationally. In comparison, many of our international competitors are spending huge sums to raise the quality and status of their research for long-term strategic reasons.

[1] International Review of UK Research in Computer Science, edited by Fred Schneider and Mike Rodd, conducted for EPSRC, the Royal Society, the IEE and the BCS, published by the IEE (November 2001)