Summary Digest of Statistics

Executive Summary

General issues

The *Summary Digest of Statistics* contains the following:

- Comparative on resource inputs, measures of additional knowledge generated, measures of benefits to the national economy from exploitation of applicable research results and figure for the supply of MSc and PhD qualified employees to the UK labour market.
- Comparisons with figures for comparable disciplines and comparable overseas economies.
- Commentary on the policy context and position of University Computing Research in the UK.
- Annexes providing background to interpretation issues, the design and development of the digest, and additional statistics which could be incorporated on request.

Funding inputs to University Computing Research (including comparisons)

Research base and assessment

- The vast majority of computing research takes place in Computer Science (CS) departments, but the multi-disciplinary applications of computing research can make boundaries difficult to define.
- 80 CS departments, with a total of 1560 FTE staff and an average of 20 staff each, submitted to the 2001 RAE (considering 1996-2000). This compares with 50 Physics departments (total staff: 1668, average staff: 34), 58 Applied Mathematics departments (total staff: 734, average staff: 13) and 46 Electronic & Electrical Engineering (E&EE) departments (total staff: 863, average staff: 19).
- 30% of CS departments, which employ 44.7% of all CS staff, were rated 5/5* in the 2001 RAE. This compares with 53.4% of Applied Mathematics departments (50.4% of staff), 52% of Physics departments (76.9% of staff) and 39% of E&EE departments (64% of staff).

Resource inputs

DfES funding via Funding Councils

- Core government funding for university research in the comes from the HE Funding Councils for England, Scotland, Northern Ireland and Wales, and the OST-funded Research Councils.
- Universities receive an annual 'block grant' from the relevant HE funding council. Part of this is 'earmarked' for research, at a level determined by each department's performance in the latest RAE. It is assumed that the majority of 'earmarked funds' is received by the relevant departments.
- This provides a comparable sum (c. £1m per annum) to each of the four disciplines considered.

Comment: I find it practically impossible to identify the basis for the assertion in the original that: 'The nominal totals from this source for the four disciplines considered, based on the HEFCE 'QR' rate for each RAE grade, appear broadly comparable in recent years at around £1m.' This simply isn't the case: the nominal earmarked totals vary between £1,225,411 (CS in 2002-3) and £694,521 (E&EE in 2003-4), which isn't anywhere near 'broadly comparable' to the former sum. The figures for each discipline are fairly stable year on year, with no variation greater than £100,000. The figure which is 'broadly comparable' is the *average* level of funding per department, which varies from £20,212 (Physics, 2003-4) to £25,296 (Applied Mathematics, 2003-4). Variations here are due to the balance of departments between rating 4 and rating 5/5*.

DfES funding the Engineering and Physical Sciences Research Council

- EPSRC funding for CS departments in 2001-2 totalled £26.33m, which represents 9.4% of the total EPSRC Programme budget. £22.27m of this came from the IT&CS/ICT Programme.
- Total expenditure of the EPSRC IT&CS/ICT Programme in 2001-2 was £53.21m, which represents 19.1% of the total EPSRC Programme Budget. £22.27m of this was allocated to CS departments.
- The success rate of grant applications submitted by all departments to the ICT Programme in 2002 was 30%, compared with a success rate of 32.1% for grants submitted to all EPSRC Programmes. The average size of grant proposals funded by the IT&CS/ICT Programme was £139,053, compared with an average of £157,785 for all EPSRC grant proposals funded.
- Between 1996 and 2000, the contribution to total research funding in CS from central government core science base investment (OST and Research Council funding) was £102.82m. This compares with £1.057bn for Physics, £162.75m for E&EE, £33.5m for Applied Mathematics and an average of £148.87m for all Science and Engineering units of assessment considered by the RAE.

Funding from other sources

- All of the figures below relate to the period (1996-2000) considered in the 2001 RAE.
- CS received a total of £253.5m from all sources, including the Joint Infrastructure fund, UK government bodies and charities, UK industry and public corporations, and the EU. This compares with £1.2bn received by Physics, £321.83m received by E&EE, and £63.34m received by Applied Mathematics. The average for all Science and Engineering units of assessment considered by the RAE was £245.85m.
- EU Government Bodies provided £56.86m to CS. This compares with £44.3m for E&EE, £35.3m for Physics, £7.21m for Applied Mathematics and an average of £23.1m for all Science and Engineering units of assessment considered by the RAE.
- Funding from other central government sources (Departments of State such as the MOD) provided £25.5m to CS. This compares with £34m for Physics, £32.8m for E&EE, £6.7m for Applied Mathematics and an average of £19m for all Science and Engineering units of assessment.
- Funding from private industry and public corporations provided £37.5m to CS. This compares with £47.6m for E&EE, £23.1m for Physics, £3m for Applied Mathematics and an average of £28.2m for all Science and Engineering units of assessment.
- Total funding from all sources per staff FTE as considered by the 2001 RAE was £162,265 over the five years. This compares with £727,002 for Physics, £373,075 for E&EE, £85,964 for Applied Mathematics and an average of £329,109 for all Science and Engineering units of assessment.

Studentship volumes

- 4,017 research studentships in CS were funded from all sources in the period considered by the RAE. This compares with 4,089 in Physics, 3,534 in E&EE, 1,049 in Applied Mathematics and an average of 2,303 in all Science and Engineering units of assessment.
- 25% of research studentships in CS were funded from the core science base investment as defined above. This compares with 63% in Physics, 53% in Applied Mathematics, 28% in E&EE, and an average of 38% in all Science and Engineering units of assessment.
- 32% of research studentships in CS were funded by the HEIs in which they were held. This compares with 26% in E&EE, 16% in Applied Mathematics, 11% in Physics, and an average of 23% in all Science and Engineering units of assessment.

International comparisons

- A broad picture of national commitment to CS research can be gained by examining the percentage of science base investment allocated to IT programmes in different countries.
- Data from the 2001 EPSRC/IEE/BCS *International Review* is used. However, it is unclear whether the most appropriate comparison for each country is with the 19.1% of the EPSRC budget allocated to the ICT Programme or the 9.4% which comes to CS departments.
- A figure for Computing/IT research as a fraction of the total Science and Engineering budget is available for: Germany (19%), Denmark (15%), Norway (14%), the USA (13.6%), Italy (9%). A figure for Computing/IT research as a fraction of the total university research budget is available are: Hong Kong (7%), Canada (6%), Australia (6%).

Comparisons between HEI research and private sector R&D activity

- Defining the precise scope of the 'IT sector' in industry is problematic because of the very wide range of businesses to which computing and IT are relevant.
- OECD figures (1997) indicate that, alongside comparable economies, the UK had the lowest Value Added by R&D in the ICT sector (3.9%) and the second lowest share of ICT R&D in all business sectors (21.8%). The highest figures are, respectively, 17.2% (Japan) and 43.7% (Canada).
- Total investment in university Computer Science research by UK industry was around £50m per year from 1996 to 2000. This compares with UK industry's total R&D expenditure on 'Computer and Related activities' (as defined by the DTI) of around £700m per year during this period.

Output measures

Contribution to additional knowledge

- ISI statistics (2001) based on citation rates indicate that UK CS research has an average impact rating comparable with that of other OECD nations.
- The relatively low rating for CS research compared with those of Physics and Applied Mathematics is attributable to the breadth of the discipline and the exclusion from these figures of conference proceedings. In 2001, the latter were recognised by the RAE as crucial to exceptionally fast-moving fields field. Similar subject disparities are observed in all countries.

Market impact

- Mechanisms for, and rates of, technology transfer between the commercial sector and university research vary considerably between different academic disciplines.
- The almost universal relevance of IT results in an unusually large number of applications.
- The ease with which software can be copied makes it difficult to track, protect, and even define intellectual property rights in this field.
- A USA study in 2000 of University-Industry links noted the importance of technology transfer and provision of highly qualified graduates in transforming the economy, as well the fact that universities normally produce technologies but not products, while industry can produce both.
- A DTI-commissioned report in 2001 noted a relatively low R&D spend by UK ITEC companies. This may be explained by the unusually large service sector within the UK's large ITEC sector.
- The above report noted that in the UK, 53% of R&D effort in the UK occurred in communications, internet user applications, software, middleware, photonic components and microelectronics.
- This report also noted that ITEC R&D accounts for nearly half of recorded R&D effort in defence, transport, e-commerce, manufacturing, finance, banking and accounting, education and training.
- While respondents considered the *quality* of R&D workers to be a major UK strength, there was concern about the ability of UK HE to provide sufficient *numbers* to meet industrial requirements.
- The development of new products and services and techniques that improve the efficiency and effectiveness of existing technology are both key areas.
- Concern is growing about software quality issues and a commercial market in software testing is emerging. However, current market incentives are generally inimical to quality improvements.
- A USA study identified potential cost reductions resulting from feasible software testing infrastructure improvements of around $10.6bn for the supply side and $11.7bn for the user sector.

Comment: The *Digest* does not clarify the identity of respondents in this study, although it does indicate that it 'involved a significant survey as well as targeted interviews'.

Supply of experts to the Labour Market

- In 2001, 27.6% of graduates from EPSRC-funded Postgraduate (Masters and Doctoral) Studentships in IT and CS entered private sector employment, 8.7% entered fixed term academic appointments, 3.4% entered public sector employment and 5.15% undertook further training. This compares with 31.3% entering private sector employment from Engineering, 31.95% entering private sector employment from Physics and 32.25% entering private sector employment from Applied Mathematics.
- It is assumed that the majority of CS graduates entering private sector employment become IT strategy and planning professionals, software professionals, and ICT managers.