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# The Evaluation of the Joint Council Initiative (JCI) in Cognitive Science and Human-Computer Interaction

**TECHNOPOLIS** & **PREST**

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**Final Report**

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**Evaluation of the Joint Council Initiative (JCI) in Cognitive Science and Human-Computer Interaction**

# Contents

# Executive Summary

## Introduction

The Joint Council Initiative (JCI) was an attempt to foster an intellectual community in an inter-disciplinary area bridging specific theoretical and applied domains, namely Cognitive Science and Human-Computer Interaction (HCI). It attempted to interact with the community by selectively altering the pattern of research and training in these domains. It commenced in 1989, committed its funding by 1992, and projects were concluded in 1996. Out of its £12m budget, approximately £10m funded 80 research projects and £2m funded Fellowships, Studentships and Summer Schools.

The evaluation of the JCI was concerned with five main issues

- The quality of the work conducted
- The effectiveness of the Initiative in terms of goal attainment
- The impact of the Initiative
- The efficiency of its implementation
- The appropriateness of the Initiative

## Quality

There can be little doubt that work of a high quality was conducted within the Initiative. The research community certainly felt that this was the case, and the Committee itself was satisfied with performance. Less partisan opinion was also positive, however. External rapporteurs reviewed project outputs and a Peer Review Panel discussed research performance with representatives from 27 projects. All agreed on the overall high quality of the work. The Initiative has played a significant role in developing computational models of brain systems and cognitive processes, and JCI research has helped shape cognitive science research in the UK. Some reservations concerning certain elements of the Initiative were expressed by the external reviewers, however. Perhaps due to over-ambition, achievements had not been as widespread as anticipated, and some work was disappointing from an HCI design perspective.

## Effectiveness

The operational aims of the JCI Research Programme were to support

- High quality multi- or inter-disciplinary research linking Cognitive Science and HCI via the application of computational principles
- Research in an area of strategic need, i.e. HCI-related areas

- Work on the periphery of each Council's interests and thus likely to fall through funding nets because of its interstitial nature

Goal attainment was mixed. On the positive side, the JCI did select and support work of high quality; work of a multi- and inter-disciplinary nature was supported; and the majority of projects did involve computational aspects. Fewer projects, however, involved either the generation of computational principles applicable to HCI, or the application of computational principles to HCI. The majority of projects (57%) can be classified as straight Cognitive Science with little immediate relevance to HCI. Twenty-nine percent were Cognitive Science projects relevant to the development of HCI. The remaining 14% were HCI projects which involved the application of Cognitive Science principles. Many of the projects were also likely to have been funded by single Councils.

Goal attainment was mixed for a variety of reasons. Confusion over the legitimacy of including projects with or without a link between Cognitive Science and HCI allowed projects with no link to be accepted and straight Cognitive Science projects to dominate. This was not as a result of proposal pressure. There were just as many HCI-oriented proposals as straight Cognitive Science proposals. There was, however, an emphasis on excellence criteria over relevance criteria which tended to favour the more 'basic' Cognitive Science projects over the more 'applied' HCI-oriented projects. During the course of the programme, attempts were made to apply relevance criteria more consistently, but this had little impact on the subsequent composition of the programme. Other efforts to equalise coverage across the themes of the Initiative via stimulation of the desired community response were also unsuccessful.

With regard to the training component of the JCI, the Training Programme was reasonably successful in increasing the supply of multi-disciplinary trained researchers in the areas covered by the Initiative. Half of the interviewees involved in Masters courses went on to conduct research in Cognitive Science and HCI areas. Most of the remainder entered industry or commerce, but did not exploit the skills acquired. Half of the PhD interviewees entered academic teaching or research, but only a quarter of these continued to work in JCI areas. Low demand for places limited the number of Fellowships the Initiative was able to fund. Summer Schools were held each year, and these were appreciated as a forum for interaction. They did not create an identifiable community of researchers, however, and the non-tagging of grants also represented a missed opportunity in terms of establishing a JCI community.

## Impact

Across the programme the completion rate was satisfactory and publication performance was good. There were real achievements in many instances, and impacts will continue to be realised over the next 10-20 years, but achievements were less than anticipated across the Initiative in both Cognitive Science and HCI. Progress was affected by over-ambitious goals and recruitment difficulties in an inter-disciplinary area.

Impact on individual careers was limited, especially in projects attempting to apply the principles of Cognitive Science to HCI, though for a small group JCI catalysed a shift into new fields, and for a third of participants JCI brought them into contact with workers in areas new to them. For a large group of researchers already involved in inter-disciplinary work, JCI provided a means to continue with this work, but for many JCI simply provided access to funds in their traditional areas of concern. Impact was greatest in terms of on-the-job training at research assistant level.

At an institutional level, JCI had most impact on departments holding several JCI grants. Work in institutions holding single JCI grants was not redirected or challenged. JCI did play a critical role in establishing CSCW in some institutions, however, and involvement in running Masters Courses had a greater impact on some institutions than collaborating in projects.

At the level of the whole research community spanned by JCI, good work was funded across a wide range of areas. The Initiative had its greatest impact on the Cognitive Science community, with some areas (e.g. connectionism) strengthened considerably. Not surprisingly, in view of the composition of the programme, it had less impact on the HCI community, and limited success in terms of creating a new community of researchers applying Cognitive Science principles to HCI. The relative success of the Cognitive Science community in the competition for funds also instilled a sense of rivalry between the Cognitive Science and HCI communities which was antithetical to the aims of the Initiative.

A small number of projects were of interest to specific firms with existing links to the host institutions, and many projects had implications for industrial applications, though often these were considerably downstream. The missing link with design limited prospects for shorter term industrial exploitation. A few projects had strong links with health and education application areas.

## Efficiency

The JCI employed a number of mechanisms to help shape developments in the sphere of Cognitive Science and HCI. None were strong enough to have the desired effect.

- Selection procedures were insufficient to produce the required programme composition
- Stimulation activities were much appreciated by the community but also had a weak shaping effect on the composition of the programme
- Naive spend management, cautious selection behaviour and grossly deficient financial information and support functions all combined to limit the extent the Initiative was able to shape current and future patterns of research and research support
- The Training Programme was efficiently implemented

Concerted efforts were made to shape the Initiative via annual conferences, summer schools, newsletters, targeted calls etc. Many of these were much appreciated by the JCI community, though more needed to be done to encourage linkages and synergy between projects, research areas and research groups. The Coordinator played a key role in all stimulation activities and constituted the strongest element of programme implementation. The calibre, enthusiasm and drive of the individual in post helped maintain the credibility of the Initiative and promote its aims. Despite all these efforts, however, enough projects of the desired type were not stimulated.

The Councils responsible for different aspects of the Initiative (Research, Training and Evaluation) operated independently. This had few implications for the efficiency of implementation or the shaping function of the JCI. Some mechanism allowing all the Councils to oversee financial administration was needed, however. Shared responsibility for overall financial management would have necessitated greater transparency and improved forward planning.

Many elements of programme implementation were weak and limited the extent to which the JCI could shape contemporary and future patterns of research. Flattened allocation profiles conflicted with the shaping goal of the Initiative as perceived by the Committee and led to early underspend and rescheduling of the Initiative. Underspend fears were exacerbated by the quality driven parsimony of the Committee and declining numbers of proposals. The Committee was also poorly served in terms of the provision of adequate and up-to-date financial information. Erroneous information (based largely on a failure to take unrecoverable underspend and recent commitments into account) led to the announcement of an additional call when there was, in fact, insufficient funding left to commit. The inadequate provision of financial information helped weaken the case for a follow-on Initiative or for other Joint Council arrangements, and episodes such as acceptance letters sent to the authors of rejected proposals did little to enhance the credibility of the Initiative in the eyes of the research community. A more demanding Committee might have insisted on improvements in the administration and financial management of the Initiative, but this does not excuse the weak support it was given.

The Training Programme was efficiently implemented, however. All the Masters and virtually all the PhD grants were taken up, and Committee selection procedures for Post-doctoral Fellowships were well specified and communicated to Panel members. There were no obvious problems with the administration of the grants, and adequate monitoring arrangements were put in place to oversee the implementation of courses in academic institutions.

## Appropriateness

When first formulated, the aims of the Initiative and the mechanisms chosen to attain the aims appeared consistent with needs and constraints, though initial estimates of the real demand for the Initiative and the willingness and ability of the research community to respond to it were optimistic. Today, the aims of the

Initiative remain broadly relevant to current needs, i.e. there is still a need to provide a theoretical underpinning for HCI, though there is more contemporary debate concerning the range of theoretical inputs likely to inform developments in HCI. Hindsight, however, casts doubt on the appropriateness of the chosen policy and implementation mechanisms.

There are many reasons why the mechanisms were inappropriate. At a tactical level

- Inadequate *ex ante* evaluation failed to reveal the limited capacity of the research community to respond
- Profile planning was lax
- Project selection mechanisms were inadequately conceived and implemented
- Aims and selection criteria were poorly communicated and shared across the Committee
- Differentiated selection rules were needed for different project clusters
- Support systems were inadequate
- External shaping, linking and community-building strategies were overemphasised. They facilitated 'networking' but were unable to build sufficient bridges to allow the JCI community to coalesce
- Annual Conferences and similar events were useful community-building devices for CS/HCI researchers, but of much more limited utility for linking separate CS and HCI communities
- The balance between 'internal' shaping mechanisms (e.g. selection procedures) and 'external' mechanisms (e.g. networking events) was incorrect. Greater emphasis on more effective selection mechanisms was needed

At a more strategic level, the arguments against a relatively short-term directed programme are persuasive. The alternatives were for more or less. The arguments for less stress that

- The capacity of the community to respond to the Initiative was limited
- Responsive mode funding would have catered for much of the work
- There is some evidence that the Initiative was counterproductive in its attempts to forge a CS-HCI community

The arguments for more suggest that

- Tweaking selection mechanisms and community-building strategies would have led to a better focus and a more cohesive community
- More sustained effort over a longer period of time was needed to change behaviour and nurture a community in an area of strategic need
- The strategic need was real

- The addition of a training component was an appropriate way of establishing a cadre of young researchers with an interest in JCI research areas, but the Training Programme was of insufficient scale and duration to create a critical mass

The choice of more appropriate strategies eventually boils down to considerations of need. Researcher-driven needs could have been catered for via 'weak' support mechanisms, e.g. responsive mode funding and screening mechanisms to 'catch' interstitial projects. Satisfying society-driven needs required a 'bigger and better' approach. If JCI was driven primarily by societal needs to enhance our understanding of human-computer interactions, then 'society' deserved 'bigger and better'.

# 1.0 Introduction

This document constitutes the final report of the evaluation of the Joint Council Initiative in Cognitive Science and Human-Computer Interaction (hereafter called the JCI), a six year programme of academic research conducted primarily in UK universities. In this **Section**, prior to outlining the structure of the final evaluation report, we provide brief background details on the Initiative itself and the evaluation exercise which accompanied it.

## 1.1 The Joint Council Initiative (JCI )

- The JCI was an attempt to foster an intellectual community in an inter-disciplinary area bridging specific theoretical and applied domains
- It attempted to interact with the community by selectively altering the pattern of research and training in a specific domain
- It commenced in 1989, committed its funding by 1992, and projects were concluded in 1996
- £10m funded 80 research projects
- £2m funded fellowships and studentships

### 1.1.1 Background to the Initiative

The JCI was an attempt to shape the course of developments in a particular intellectual domain via the funding of research projects in alignment with specific programme goals. The Initiative attempted to **interact** with the research community by **selectively** altering the **pattern** of research and training in the area.

The JCI arose out of a belief in the late 1980s that work in the area of Human-Computer Interaction could benefit from some of the more fundamental or theoretical work associated with Cognitive Science. Unfortunately, however, it was also recognised that the multi- or inter-disciplinary nature of much work in this area meant that it lay at the periphery of each Council's interests. It was thus unlikely to receive funding from any one Council (i.e. the Medical Research Council (MRC), the Economic and Social Research Council (ESRC) or the Science and Engineering Research Council (SERC - later to become the Engineering and Physical Sciences Research Council (EPSRC)). In 1987, therefore, the three Councils declared an interest in a Joint Initiative in the area, and funds were eventually approved in early 1989 for a five year programme - later extended to six years - commencing later that year.

### 1.1.2 Aims of the Initiative

The aims of research programmes such as the JCI are rarely static over time, and the aims of the JCI have both evolved and been variously expressed, perceived and interpreted over its whole lifetime. Probably the most succinct and useful expression of the aims of the Initiative, however, is as follows

**The JCI aimed to promote multi- or inter-disciplinary research linking Cognitive Science and Human-Computer Interaction via the application of computational principles.**

### 1.1.3 Project Selection Criteria

The basic selection criteria for projects remained largely unchanged throughout the Initiative's lifetime (though the consistency with which they were applied did vary). They relate to the **rationale** for the Initiative, to its **objectives**, and to general **quality** considerations applicable across the Research Councils.

The **rationale** for the Initiative was based on a perception that **quality** projects in an **important** area of **inter-disciplinary** research were not being funded by single Research Councils. The Initiative was seen as a safety net for these **interstitial** projects. The first selection criterion thus related to the interstitial nature of the projects. Projects could only be considered if they were of potential interest to more than one Research Council.

The second set of criteria related to the **match with the aims** of the Initiative, in particular the requirement for **multi– and/or inter–disciplinarity**, the establishment of a **link** between Cognitive Studies and Human Computer Interaction, and the application of **computational** principles. There was an expectation that multi–disciplinarity would involve collaborative proposals involving different departments, although this did not necessarily exclude consideration of proposals from single departments, especially if these could demonstrate a range of expertise enabling a multi–disciplinary approach.

The third set of selection criteria involved the normal academic quality criteria used by the Research Councils, namely **excellence**, **relevance** and **applicability**.

### 1.1.4 Composition and Funding: Research

The **JCI** started in late 1989 and funded some 80 or so projects, the last few of which were completed in 1996. All are listed in **Appendix 2**. **Exhibit 1** summarises the **Composition and Funding** of the **JCI Research Programme**. The overall budget for the research component of the Initiative was approximately £10 million (including administration-related costs), though actual expenditure came to just over £9 million (the shortfall was largely due to a failure to meet optimistic budget allocations in the first two years). Apart from six small projects funded under the **Small Grant Scheme**, projects were typically of three years duration and cost on average £120,000 each.

# Exhibit 1 JCI Composition and Funding

| | |
|---|---|
| **Funding** | |
| Number of projects funded (including Small Grant Scheme) | 80 |
| Total volume of research projects | £9M |
| Range of funding volumes | £17k - £292k |
| **Project Duration** | |
| Range | 9 - 60 mths |
| Average | 32 mths |
| **Coverage of Research Themes** | |
| **1. System Design** | |
| 1.1 Tools, methods and the design process | 11 |
| 1.2 Linking language to image | 3 |
| Sub-total | 14 |
| **2. Principles of Interaction** | |
| 2.1 Models of users in interaction with the system | 7 |
| 2.2 Modelling of communication and collaboration among active agents | 4 |
| 2.3 Representation of organisational knowledge | 4 |
| Sub-total | 15 |
| **3. Computational Learning Environments** | |
| 3.1 Effects of leaning on the forms of presentation, action and feedback | 3 |
| 3.2 Intelligent tutoring | 0 |
| 3.3 Support of programming | 4 |
| Sub-total | 7 |
| **4. Computational Modelling of Cognition** | |
| 4.1 Models of cognition and learning | 22 |
| 4.2 General theoretical principles of 'network' models | 10 |
| 4.3 Psychophysics and modelling of neural phenomena, especially low level vision and speech | 12 |
| Sub-total | 44 |
| Total | 80 |
| **Coverage of Scientific Fields** | |
| Cognitive activity in social, physical and informational systems | 33 |
| Conceptual knowledge | 26 |
| Neural networks and connectionism | 24 |
| Speech and language | 12 |
| Visual system | 11 |
| Memory | 7 |
| Learning and instruction | 6 |
| Spatial behaviour, movement and action | 6 |
| Communication | 5 |
| Other computational modelling environments | 2 |
| Other sensory / perceptual systems | 2 |
| Auditory system | 1 |

The Initiative called for projects in four **Research Themes** subdivided into 11 research areas or Sub-themes. Most projects accepted fell into the Theme of **Computational Modelling of Cognition** (44 projects). **Computational Learning Environments** (7) was the least populated Theme. At the Sub-theme level, **Models of Cognition and Learning** (22), **Psychophysics and Modelling of Neural Phenomena** (12), **Tools, Methods and the Design Process** (11), and **General Theoretical Principles of Network Models** (10) accounted for two thirds of all projects (55 out of 80).

Analysing the programme's composition in a slightly different way, we see that the main scientific fields covered were

- **Cognitive Activity in Social, Physical and Informational Systems**
- **Conceptual Knowledge**
- **Neural Networks and Connectionism**.

### 1.1.5 Composition and Funding: Training

Apart from funding research projects, the JCI also set aside £2 million for a **Training** component. This programme included awards at three levels

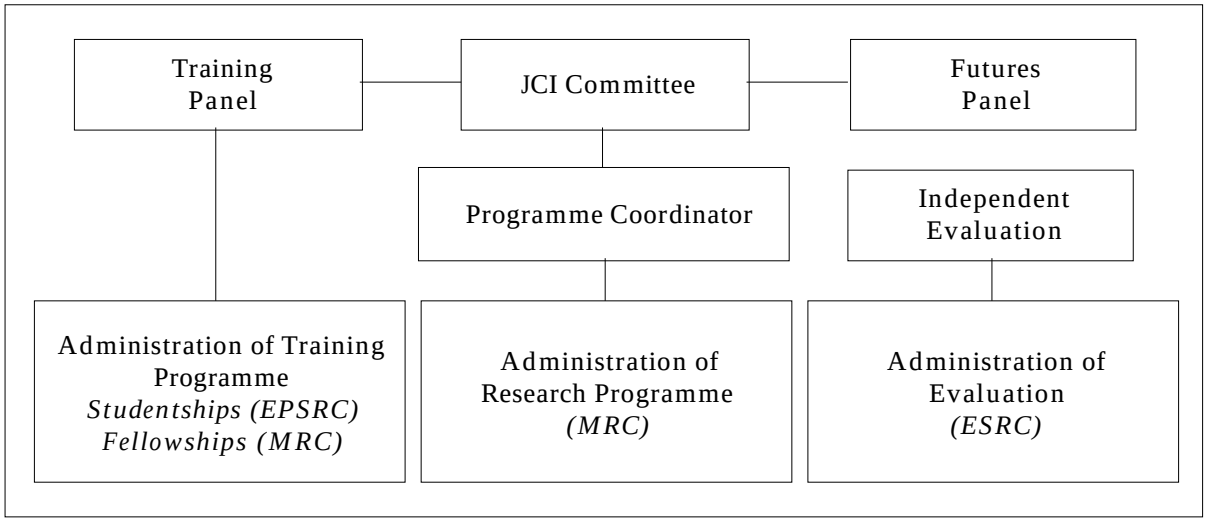
- **Advance Course Studentships** (Planned: 60 x 12 months - 70 awarded)
  *Aim - support and expand courses that take graduates from one of the constituent disciplines and equip them in one or more of the others*
- **Research Studentships** (Planned: 80 x 36 months - 55 awarded)
  *Aim - fund a proportion of doctoral degrees using the criterion of cross-disciplinary training*
- **Postdoctoral Fellowships** (Planned: 12 x 36 months - 7 awarded)
  *Aim - support research workers brought up in one discipline to gain experience of techniques from another discipline*

The JCI also supported a number of summer schools over its duration.

### 1.1.6 Management and Administration

The JCI administrative structures are shown in **Exhibit 2**. The Main Committee of the JCI comprised some 14 or so scientific members at any one time, plus the Coordinator and Observers from each of the three Research Councils, the DTI and the Initiative's evaluators. The first Chair was Donald Broadbent (Oxford), succeeded in September 1991 by Gerald Gazdar (Sussex). The prime responsibility of the Main Committee was the selection of research projects. A separate panel reporting to the Main Committee was set up to oversee the Training Programme. Chaired by Malcolm Jeeves (St Andrews), and then John Long (UCL), it had seven members, five drawn from the Main Committee plus two others. Another panel, the Futures Panel, was set up in 1991/92 to consider future support for research in the areas funded by the JCI. In the last two years of its lifetime (1994/5 and 1995/6) the Main Committee carried out its own review of the work conducted in the Initiative's research projects.

**Exhibit 2 Management and Administration of the JCI**




The role of the Programme Coordinator, Elizabeth Pollitzer (Imperial), was primarily to liaise with the research community: stimulating interest in the JCI; encouraging people to submit proposals; organising annual conferences and summer schools etc. She also took on board responsibility for general monitoring of the programme and the preparation of progress reports and position papers on a wide variety of topics related to past achievements and future directions.

The Medical Research Council was responsible for the bulk of programme administration, most of which comprised handling the administration of the research component. The EPSRC and the ESRC had less onerous roles: the former responsible only for the Training Studentships; the latter for organising the independent evaluation of the Initiative.

## 1.2 The Evaluation of the JCI

- Real time
- Two teams
- Half a junior person-year per institution per annum
- Commenced late 1990 and concluded 1996
- Tasks
  - Management
  - Desktop Analysis
  - Interviews
  - Questionnaires
- Topics
  - History and Aims
  - Projects Analysis
  - Inter-disciplinarity
  - Selection Procedures
  - Finance and Administration
  - Grant Analysis
  - Training
  - Interaction with the Community
  - Exit Analysis
  - Bibliometrics
  - Peer Review
- Issues
  - Quality
  - Effectiveness
  - Impact
  - Efficiency
  - Appropriateness
  - Methodology

### 1.2.1 Background to the Evaluation

Invitations to tender for the evaluation of the JCI were dispatched in early 1990. Outline proposals for the evaluation were received by the ESRC, the Council responsible for the administration of the evaluation, in March 1990. These were followed by full proposals in May 1990. After receipt of these, **PREST** (Programme for Research in Engineering, Science and Technology of the University of Manchester) and **SPRU** (the Science Policy Research Unit of the University of Sussex) were asked to conflate their separate proposals and submit a joint one. A new proposal was produced in September 1990, and a revised Workplan for the evaluation was accepted by the ESRC in February 1991.

The evaluation suggested by SPRU and PREST and accepted by the Councils was a five-year real-time evaluation scheduled for completion at the end of 1995, though later extended by one year to allow for the inclusion of a comprehensive Peer Review process. The evaluation became a joint effort between **PREST** and **Technopolis** in 1993 when the leader of the SPRU team left the University of Sussex to manage Technopolis, a consultancy company he had founded in 1989.

### 1.2.2 Evaluation Aims

The overall purpose of the evaluation, as originally conceived, was to show the Councils and the community whether the Initiative was meeting its objectives. Accordingly, the specific objectives were to assess

- The Effects of the Initiative
- The Research Initiative
- Training and Research Experience
- Management and Administration

In addition, the evaluation aimed to

- Provide feedback to the Committee
- Identify lessons for the design of future programmes
- Report on the impacts of the Initiative
- Advance the state-of-the-art of evaluation practice

### 1.2.3 Evaluation Tasks, Topics and Issues

In addition to attending meetings of the JCI Main Committee, the Training and Futures Panels and various JCI Annual Meetings and Summer Schools over the lifetime of the Initiative, the evaluation teams carried out a number of separate exercises involving interviews with programme administration and project participants, questionnaire surveys and desktop analyses. **Exhibit 3** indicates how evaluation **tasks** carried out by the evaluation team relate to major evaluation **topics** addressed over the five year lifetime of the evaluation. **Exhibit 4** then shows the relationship between these **topics** and the evaluation **issues** which are used to structure the final evaluation report, namely

## Exhibit 3 Evaluation Tasks and their Relation to Evaluation Topics

| TOPICS | TASKS | | | | |
|---|---|---|---|---|---|
| | Management | Desktop Analysis | Interviews Administration and Committee | Interviews Participants | Questionnaires |
| History and Aims | PREST | PREST / Technopolis | PREST / Technopolis | PREST / Technopolis | |
| Project Analysis | Technopolis | Technopolis | | | |
| Inter-disciplinarity | PREST | PREST | PREST | PREST | PREST |
| Research Selection | Technopolis | Technopolis | Technopolis | Technopolis | |
| Finance and Administration | Technopolis | Technopolis | Technopolis | Technopolis | |
| Grant Analysis | Technopolis | Technopolis | | | Technopolis |
| Interaction with Community | Technopolis | | Technopolis | PREST / Technopolis | Technopolis |
| Exit Analysis | PREST / Technopolis | | Technopolis | PREST / Technopolis | Technopolis |
| Bibliometrics Analysis | PREST | PREST | | | |
| Peer Review | PREST | Technopolis / PREST | | | |
| Training | PREST / Technopolis | | Technopolis / PREST | PREST | PREST |

## Exhibit 4 Evaluation Topics and their Relation to Evaluation Issues

| TOPICS | ISSUES | | | | |
|---|---|---|---|---|---|
| | Appropriateness | Efficiency | Effectiveness | Quality | Impact |
| History and Aims | • | | • | | |
| Project Analysis | • | | • | • | • |
| Inter-disciplinarity | • | | • | | • |
| Research Selection | • | • | • | • | |
| Finance and Administration | • | • | | | |
| Grant Analysis | • | | • | | • |
| Interaction with Community | • | • | • | | |
| Exit Analysis | • | • | • | • | • |
| Bibliometrics Analysis | • | | • | | • |
| Peer Review | • | • | • | • | • |
| Training | • | • | • | | • |

- The quality of the work conducted
- The effectiveness of the Initiative in terms of goal attainment
- The impact of the Initiative
- The efficiency of its implementation
- The appropriateness of the Initiative

### 1.2.4 Peer Review

The majority of the tasks connected with the evaluation were carried out solely by the evaluation teams. An important element of the evaluation, however, involved a Peer Review exercise conducted by a panel of external, independent experts. **Exhibit 5** shows the composition of the Panel.

**Exhibit 5 The Composition of the Peer Review Panel**

**Peer Review Panel Members**

Professor David Rumelhart - Chairman (Stanford University)
Professor John Carroll (Virginia Polytechnic Institute)
Dr Clayton Lewis (University of Colorado)
Dr William Newman (Rank Xerox Research Centre)
Professor Mark Steedman (University of Pennsylvania)

The report produced by this Panel appears as **Appendix 1**. Although it was planned as part of the overall evaluation effort, with site visits and interviews with representatives of 27 of the 80 JCI projects orchestrated by the evaluation team, the Peer Review Panel followed its own project review and report writing procedures. Its final report should therefore be considered as an independent, stand-alone document for which the evaluation team cannot claim credit nor responsibility.

## 1.3 Structure of the Final Report

The remainder of this report is divided into six **Sections**. The first three of these, **Sections 2.0**, **3.0** and **4.0** are broadly descriptive in nature. They build on **Section 1.0** by providing further details of the Initiative's Origin, Aims and Implementation respectively - all of which are needed prior to assessments of goal attainment, efficiency of implementation, impact and, ultimately, the appropriateness of a policy mechanism such as the JCI.

In **Section 5.0**, the Research Component of the JCI is examined. Given the proportion of the overall JCI budget spent on research projects, this **Section** constitutes the analytical heart of the evaluation document. It is therefore

divided into five substantial **Sections**, each dealing with a major evaluation issue. **Section 6.0** deals in turn with the Training Component of the JCI.

A final **Section 7.0** makes recommendations to guide future policy based on the findings of the previous two **Sections**.

The report is accompanied by a number of **Appendices**. This first is of particular interest. It constitutes the report of the expert panel constituted to conduct an independent review of the scientific quality of the work carried out within the Initiative (**Appendix 1**). Although conducted as part of the overall evaluation (the peer review component), it can also be considered as a stand-alone assessment of the JCI. Of the remaining **Appendices**, some are descriptive (e.g. **Appendix 2** is a list of all the JCI projects) and some are methodological and analytical in nature (e.g. **Appendix 3** is a copy of an Exit Interview Checklist, and **Appendix 4** combines a copy of a Questionnaire distributed to Grantholders at the end of the Initiative's lifetime with raw results). **Appendix 5** is a complete list of Rapporteur and Committee Scores for JCI Projects, and **Appendix 6** is a list of the published outputs of JCI projects at the time of the submission of final project reports.

# 2.0 The Origin of the JCI

## 2.1 The Alvey Programme

The importance of human-computer interaction and the need for focused actions to stimulate work in this area was noted in the report of the Alvey Committee (named after its Chairman, John Alvey) which called for the establishment of the Alvey Programme for Advanced Information Technology (1983-90).[1] This Committee, in setting out its proposals for a 'Man-Machine Interface' component of the programme, noted that the area lacked a coherent thrust. Under the Human Factors portion of the proposed programme, three areas of action were identified

- Human/system communication
- Human/system cognitive compatibility
- Human-to-system expertise transfer

The overlap with the proposed Intelligent Knowledge-Based Systems (IKBS) area was also noted.

When the programme was implemented, it took some time for a strategy document to be produced in the 'Human Interface' area, and when a document did belatedly emerge in 1984 it lacked clear categories. It was not until 1986 that a stronger conceptual structure for the programme evolved, based on functional phases in the design and development life-cycle. The difficulties encountered in the formulation of a strategy were attributed to the inter-disciplinary nature of the field. A prominent participant commented

> "It was difficult to get the various communities together, because they don't recognise each other... The technology world looks to the human factors side and expects to see one answer and one discipline. It is not one discipline."[2]

The evaluation of Alvey[3] concluded that although many scientific and technical goals were achieved across the Man-Machine Interface programme, commercial exploitation was low. The programme did build on academic capabilities, however, linking these to industry and helping to focus industrial R&D efforts. An all embracing MMI community did not emerge as a result of the programme, but this was hardly surprising given its initial heterogeneous nature. The Human Interface area was strengthened noticeably by the establishment of three Human Interface Centres in Loughborough, London and Scotland, and the

[1] A Programme for Advanced Information Technology, The Report of the Alvey Committee, Department of Trade and Industry, HMSO, 1982

[2] Professor Brian Shackel, quoted in Oakley, B. and Owen, K., Alvey - Britain's Strategic Computing Initiative, MIT Press, London, 1989

[3] Guy, K., Georghiou, L. *et al*, Evaluation of the Alvey Programme for Advanced Information Technology, HMSO, 1991

Alvey Human Interface Committee became an effective voice of the research community. Future research needs identified by this Committee were to form the initial agenda for the JCI.

## 2.2 Work Outside Alvey

The Alvey Programme did not support all areas relevant to the topic of Human Computer Interaction. UK Research Councils independently supported related work.[4]

**SERC**, as the major supporter of information technology research, supported responsive mode projects outside the framework of Alvey. Its Science Board also funded some initiatives relevant to Cognitive Science and Human Computer Interaction through the Biological Sciences Committee. One initiative involving Cognitive Science, the Image Interpretation Initiative, was concerned with biological aspects of image interpretation, while another was concerned with the neurobiology of invertebrate systems.

**MRC**'s interests in the field were largely rooted in occupational medicine. The Neurosciences and Mental Health Board was interested in the significance of Cognitive Science for an understanding of the functions of neural systems. A further interest lay on the applications side (the use of intelligent aids to search large databases) and some MRC research units undertook work on HCI.

**ESRC** came to the area through support for a number of IT-related areas. The Education and Human Development Committee had supported a number of studies of teaching using computer systems. It also supported an initiative on communication and on development in cognitive systems. More general studies of IT in the workplace and elsewhere also featured.

Overall, however, the picture was one of fragmented support for the area.

## 2.3 The Bide Report

When the IT86 Committee, under the chairmanship of Sir Austin Bide, considered a follow-on to the Alvey Programme, it placed increased emphasis on 'Human Interfaces', identifying it as "a critical factor in the effective translation of IT research into applications". [5] A further reference to the area was made in the recommendations for an IKBS programme, in which an urgent requirement was identified "to develop computational techniques for representing a user's knowledge, goals and intentions". A strong continued collaborative research thrust was recommended, with a proposed budget of £25 million. In addition to a research programme, the Bide Report also recommended an Applications Scheme to encourage user-supplier co-operation in demonstration projects.

[4] The work supported by these Councils is described in 'Cognitive Science and Human-Computer Interaction - A Proposal for Joint Council Research', First Report of the Joint Research Council Working Group, June 1987

[5] Information Technology - A Plan for Concerted Action - The Report of the IT86 Committee, HMSO, 1986

The Applications Scheme was rejected in the DTI White Paper of 12 January 1988.[6] The more industry-oriented aspects of the proposed research programme emerged instead in the Systems Engineering area of the DTI/SERC Information Engineering Advanced Technology Programme (IEATP).

## 2.4 Joint Response to Bide

During the hiatus following the publication of the Bide report and prior to the Government's response, the Research Councils considered their own reaction to the report. In their combined comments, the ESRC, MRC and SERC expressed the view that the time had come for a collaborative research effort on problems of common interest concerning human use of IT systems. The rationale for this joint approach was threefold[7]

- There was growing concern that applied work in the Human Computer Interface area needed a stronger theoretical base, and that this grounding needed to draw on work traditionally funded separately (or not at all) by each of the three Research Councils
- It was recognised that while all three Councils had legitimate interests in the Human Computer Interface area, it lay at the edge of each of their responsibilities. Proposals which were multi-disciplinary, with one or more disciplines lying outside each Council's remit, risked rejection. A joint approach would provide an automatic safety net
- In some ways, these problems reflected broader concerns over interfaces between academic areas and support structures capable of dealing with them. Discussion of a joint initiative occurred during a period when political pressure for a unified Research Council was rising, and co-operation via a coordinated joint initiative offered an alternative *modus operandi*

In January 1987 the Heads of the three Research Councils approached the ABRC, declared an interest in the area and requested a special allocation of funds to commence in the financial year 1988/89.

## 2.5 Formulation of the Content

Having suggested an initiative in the area, the Research Councils then took steps to develop the research agenda and, more urgently, to prepare a detailed case in support of the bid to the ABRC. Professor Donald Broadbent, an MRC employee based at the Department of Experimental Psychology at Oxford University, was approached in the early summer of 1987 and asked to formulate a proposal at six weeks notice. Having identified the real deadline as mid-summer, Professor Broadbent rapidly convened a Joint Research Council Working Group with fifteen members and a scientific secretary (Dr. Dianne Berry), all of whom were nominated by the Councils. This group met once only.

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[6] DTI - The Department for Enterprise, Cmnd. 278, HMSO, 1988

[7] Interview, Donald Broadbent, 24 January. 1991

There was no time for wider consultation and hence the proposal was largely based on the deliberations of the Alvey Human Interface Committee. In addition to its core task of defining the follow-on to Alvey, this had identified topics suitable for Research Council support alone. The areas put forward by Broadbent's Working Group, together with suggested allocations, are shown in **Exhibit 6**.

**Exhibit 6 Topics Suggested in the June 1987 Proposal**

| | |
|---|---|
| Tools and methods for individual interaction which sub-divides into | £2.50m |
| - Formal methods of task description | £0.50m |
| - Design models of the user | £0.75m |
| - Embedded user models | £0.75m |
| - Design and research tools | £0.50m |
| Organisational aspects of IT | £1.50m |
| Learning and change in humans and machines | £2.00m |
| Principles of interaction with complex systems | £1.50m |
| Analysis and interpretation of pattern information | £1.50m |
| Cognitive representations and processes | £1.00m |

In addition, a need for trained staff was identified, leading to a recommendation for a further £1 million to be devoted to training.

Recognising the deficiencies of an approach to the formulation of programme content which had drawn so heavily on the work of another Committee, the Working Group also announced a call for outline proposals. This was issued in September 1987, with a deadline for January 1988. There was a dual rationale

- If funds were approved, the proposals would facilitate a quick start
- If not, the proposals would constitute a sound basis for the development of a revised bid

An important issue the Working Group confronted was how to identify and communicate with a community which transcended disciplinary boundaries and structures. The solution involved sending notice of the call to all departments of computer science, linguistics, physiology and psychology. In addition, notice was also sent to registrars of universities with a request to pass it on to other interested departments. This attempt to broadcast the call depended on the efficiency of internal communication mechanisms within institutions and departments, and there seems to have been more success in reaching psychology departments than any other. An additional communication route involved holding a meeting in Oxford, attended by 300 people, to clarify the object of the exercise. Overall, some 170 outline proposals totalling £24 million were generated through these endeavours.

The first bid to ABRC, though favourably received, was not funded. In a year when international subscriptions limited scope for manoeuvre in the Science Budget, the proposal just missed the cut-off point. Thus in early 1988 the process of preparing a second bid began. This time the approach was to be more 'inclusive' or 'bottom-up', at least in its first stage. The Working Group was expanded to extend its technical coverage. Sub-groups of members went through summaries of the proposals received, while the Chairman examined them all. Each member was asked to identify classes of projects where there was potential for good proposals and a general theme of interest. In the document which emerged, 11 'Themes' were identified and a number of points were made about the process and outcome of this approach.[8]

- The choice of Themes was not based on fashion, nor on the proportions of proposals received (proposal pressure). Rather, it was based on the likely contribution of the Themes to the stated aims of the Initiative and the knowledge that some research capability and interest existed in each Theme in the UK
- No dominant topic emerged. The Themes represented eleven 'growing-points', and it was expected that there would be shifts, contractions, expansions and even the abolition of Themes over time, with support for different Themes varying with their ability to stimulate proposals and research in line with the aims of the programme
- About one-third of the proposals were regarded as being both suitable for the Initiative and of a quality roughly equal to those funded separately by the Councils. This was seen to confirm the financial estimate contained in the first bid to the ABRC. However, widespread mention of the need for training provision led to this estimate being doubled to £2 million
- The call was thought to underestimate the size of the research community. The knowledge that funding was unavailable in that financial year was likely to have deterred some researchers from responding to the call, and coincidence with an ESPRIT call was another diversionary factor
- The 11 Themes were based on 57 proposals, with the number of proposals in each Theme ranging from 2-15
- There were relatively few proposals from leading groups in AI, Computational Linguistics and Neuro-physiology

## 2.6 Acceptance of the Second Proposal

The Report of the Working Party formed the second bid to ABRC. This was approved early in 1989 with funds available from the financial year 1989/90 onwards. **Exhibit 7** shows the initial allocation of funds over the expected lifetime of the Initiative.

[8] ESRC/MRC/SERC Joint Council Initiative in Cognitive Science/Human Computer Interaction, Second Report of the Working Group, A Programme for Research, May 1988

## Exhibit 7 Financial Allocation Profile

| **Financial Year** | 1989/90 | 1990/91 | 1991/92 | 1992/93 | 1993/94 | 1994/95 | Total |
|---|---|---|---|---|---|---|---|
| **Amount (£)** | 0.3M | 1.5M | 3.0M | 3.0M | 3.0M | 1.2M | 12.0M |

The Themes supported are shown in **Exhibit 8**. Funds were not pre-allocated, since each area was seen to be of roughly equal importance, despite the fact that the proposals in some areas (e.g. 4.1) were more numerous than in others (e.g. 1.1 and 2.3).

## Exhibit 8 Topics Suggested in the May 1988 Proposal

**1 System Design**

1.1 Tools, methods and the design process

1.2 Linking language to image

**2 Principles of Interaction**

2.1 Models of users in interaction with the system

2.2 Modelling of communication and collaboration among active agents (including discourse)

2.3 Representation of organisational knowledge

**3 Computational Learning Environments**

3.1 Effects on learning of the forms of presentation, action and feedback

3.2 Intelligent tutoring (The choice of learning material in the light of a model of the learner)

3.3 Support of programming

**4 Computational Modelling of Cognition**

4.1 Models of cognition and learning

4.2 General theoretical principles of network models

4.3 Psychophysics and modelling of neural phenomena, including low level vision and speech

# 3.0 Aims of the Initiative

## 3.1 Rationale

The first bid to ABRC did not contain an explicit statement of aims. It did, however, provide a rationale for the JCI. The case for an Initiative rested on two main arguments.

**Market Demand** The Bide Report placed increased emphasis on the users of IT systems. It argued that the effectiveness (and hence marketability) of IT systems was becoming increasingly linked to their usability. Knowledge concerning the human dimensions of IT system use was slight, however. Despite the existence of nearer market collaborative Initiatives, further research of a more fundamental nature was necessary - research too expensive for individual collaborative projects to incur as an overhead. Bide had argued that there was "an urgent requirement to develop computational techniques for representing a user's knowledge, goals and intentions", and this theme was echoed in the first bid to the ABRC.

**Intellectual Opportunity** Notwithstanding demand-side pressures, there were fundamental problems in psychology and neurosciences which required solution before any practical benefits could be realised. The Bide Report argued that these benefits were potentially realisable via conceptual exchanges between computation and neuroscience or psychology.

A more closely argued rationale was presented in the second bid to ABRC. This began by examining the range of disciplines which contributed to work labelled 'Cognitive Science'. Common to all disciplines was a central concern with information (in a broad sense) and, more particularly, their use of computational concepts and models. A computational approach was thus seen as a central characteristic of the Initiative, yielding both a common language and a route to applicability.

The proposal also argued that the efficient use of IT systems by human beings was ultimately dependent on progress being made in five areas or stages in the treatment of information (absorption, storage, manipulation, selection, execution), all of which were the concern of the disciplines comprising Cognitive Science. The point was made that "sound design requires a body of engineering principles, not lucky guesses", and the need for a strategic approach to the formulation and conduct of research relevant to Human-Computer Interaction was emphasised.

The rationale contained in the second bid concluded by considering needs for the future, stressing in particular the case for interaction between disciplines. Two crucial points were made

- Inter-disciplinary projects may seem peripheral from the point of view of a single Council responsible for nurturing the development of a particular discipline, but they can play a potentially critical role in the development of parallel disciplines or downstream application areas. A broader, multi-Council perspective was required to highlight their importance
- Wasteful duplication can occur when individual Councils support separate projects which necessitate the development of the same tools and methods

## 3.2 Statement of Aims

Based on the rationale described above, the second bid stated the aims of the Initiative as follows

"To enhance our understanding of the general computational principles underlying natural and artificial forms of intelligence and their application in the design of systems involving human-computer interaction."

A series of "glosses and interpretations" was also presented in order to "avoid misunderstanding"

- While the term 'computational principles' was taken to refer to the design and implementation of working computer models, it was recognised that models such as these were not appropriate in all cases, and that some projects not involving computer models would still be relevant to the overall aims of the Initiative
- While the programme was multi-disciplinary, it was recognised that not all projects needed to be, though projects within one discipline would need to demonstrate their potential impact on other disciplines or on the field as a whole
- Even though it was expected that individual projects would have a theoretical or an applied leaning, no sharp contrast between project types was expected since the great practical need was for generalisable knowledge and for concrete problems to act as foci for theoretical developments

One further point was that the research was expected to be basic or strategic, though industrial interest was welcomed.

## 3.3 The Need for Training

The need for a training course was expressed in the first bid to the ABRC in terms of

- The shortage of qualified staff in the HCI area
- The urgency connected with rectifying this shortage
- The difficulties associated with the funding of multi-disciplinary doctorates and studentships in single discipline departments

- The lack of any perceived career track in HCI to stimulate the recruitment of young researchers
- The shortage of institutions capable of providing multi-disciplinary training
- The lack of any coordinated approach to the resolution of these problems

These themes were replayed in the second bid to the ABRC, by which time they had become more concretely expressed in terms of

- The need to support and expand **Advanced Courses** that take graduates from one constituent discipline and equip them in one or more of the others
- The need to fund a proportion of doctoral degrees on the criterion of cross-disciplinary training via **Research Studentships**
- The need to support research workers that have been brought up in one discipline to gain experience of techniques from another discipline via **Postdoctoral or higher level support**

## 3.4 The Early Evolution of the Initiative's Aims

In early 1990, the JCI Committee provided the evaluators with a statement[9] of the twin aims of the Research and Training components of the Initiative.

**Research** Research to enhance the understanding of the general computational principles underlying natural and artificial forms of intelligence, and their application in the design of systems involving human-computer interaction

**Training** The provision of a Training Programme in which the Training Panel awards training fellowships, advanced course studentships and research studentships to increase the quality of trained manpower in the scientific areas covered by the Initiative

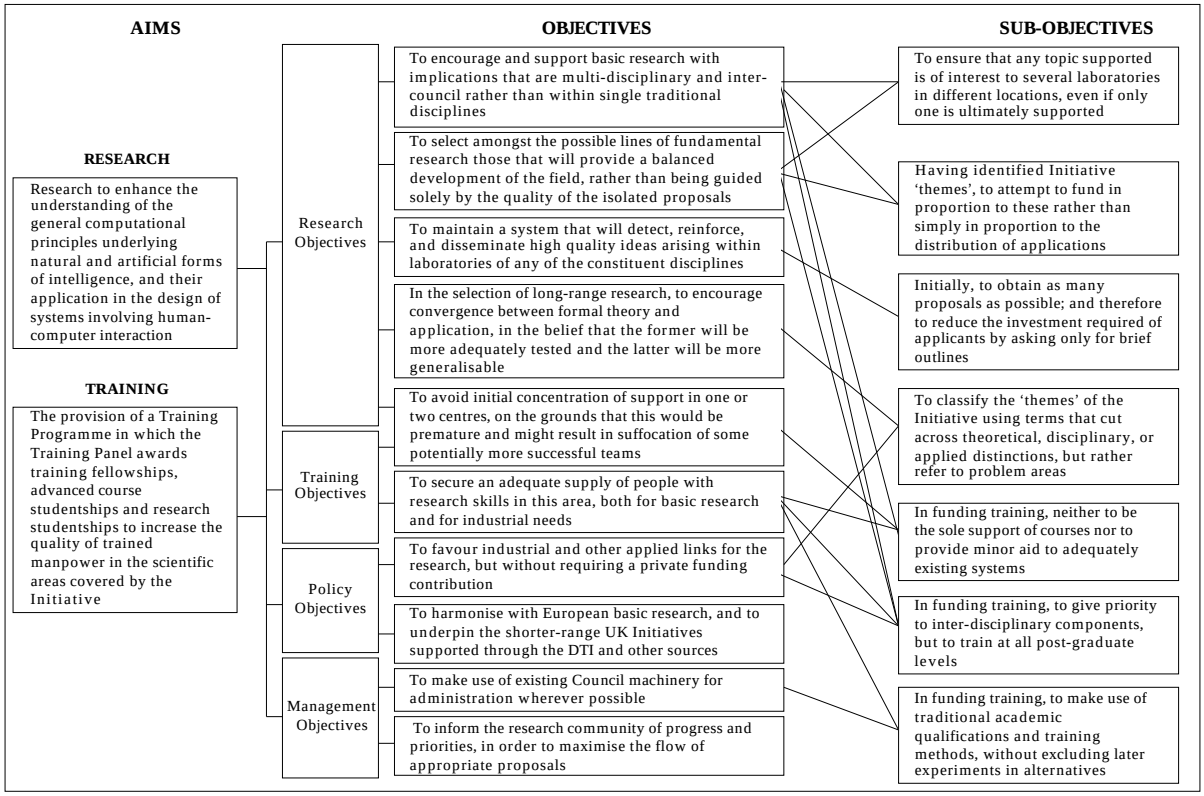
The Committee also provided the evaluators with a description of how the Committee had interpreted the two broad aims given to it by the Councils. Initiative objectives fell into two categories

- **Objectives** made explicit at one or more Committee meetings
- **Sub-objectives** which appeared implicit in a number of the decisions taken by the Committee, but which had not been stated in so many words

**Exhibit 9** summarises the situation described by the JCI Committee in its communication with the evaluators.

[9] Joint Council Cognitive Science / HCI Initiative, Evaluation Briefing Paper, 20 February, 1990

# Exhibit 9 Aims, Objectives and Sub-objectives



# 4.0 Implementation

## 4.1 JCI Main Committee

In the latter half of 1988, after it was known that the ABRC had recommended a Joint Council Initiative, the three Councils decided that it should be managed by a new, joint machinery consisting of a Committee and secretariat. The Working Group, set up to represent the Councils in respect of the bids to ABRC and to formulate the content of the proposed Initiative, was disbanded and a new Joint Committee was formed in late 1988. As noted in **Section 1.1.6**, the primary responsibility of the Main Committee was the selection of research projects. A separate panel oversaw the Training Programme and reported to the Main Committee, as did a later panel set up to consider future support in the area. The Main Committee reported annually to the Councils on all aspects of the Initiative.

### 4.1.1 Composition of the Main Committee

The Main Committee of the JCI comprised some 14 or so scientific members at any one time. All were expected to attend meetings, together with Observers from each of the three Research Councils and the Department of Trade and Industry (DTI). In the first instance, Committee meetings were also attended by two Assessors (Dr Diane Berry and Dr D G Morgan), and subsequently by the Initiative Coordinator (Dr Elizabeth Pollitzer). Once appointed, the Initiative's evaluators were also expect to attend Committee meetings. The first Chair of the Main Committee was Dr Donald Broadbent (Oxford), succeeded in September 1991 by Professor Gerald Gazdar (Sussex). The membership of the Committee, as listed in its Report to the Councils of 1989, is shown in **Exhibit 10**, together with subsequent replacement members.

### 4.1.2 Terms of Reference of the Main Committee

The terms of reference of the Committee were outlined at the Initiative's outset.[10]

- To assess research proposals within the remit of the Initiative against its priorities and against such criteria as excellence, exploitability and applicability.
- To approve for funding applications of less than £500k total commitment (applications of greater value were to be referred to the three Councils)
- To monitor the progress of research grants and to consider annual reports from Grantholders
- To keep under review developments in complementary programmes within Britain and elsewhere
- To develop a training programme and to advise on the award of studentships and fellowships funded through the Initiative

[10] Annex 1, Minutes of Meeting of the Cognitive Science / HCI Committee, 15 December 1988

**Exhibit 10 The Composition of the JCI Committee**

| Original Committee Members | Subsequent Committee Members |
|---|---|
| Dr D E Broadbent (First Chm.) | Professor G F Coulouris |
| Professor G J M Gazdar (Second Chm.) | Professor M Eisenstadt |
| Dr B Buxton | Professor E Mumford |
| Dr P Collins | Dr H Collins |
| Professor E A Edmonds | Professor J B Long |
| Professor M S Halliday | Professor T Shallice |
| Professor J A M Howe | Professor K Stenning |
| Professor M A Jeeves | Professor G Hitch |
| Professor P Levy | |
| Dr T Moran | |
| Professor K Oatley | |
| Professor D H Sleeman | |
| Professor I C Wand | |
| Professor D J Wood | |

- To make recommendations to the Councils for necessary changes in research strategy
- To report annually to the Councils through the appropriate Board or Committee

In addition, it was made clear at the outset that the joint nature of the Initiative and the desire to promote inter-disciplinary research meant that the Committee could only consider for funding applications which spanned the interests of more than one Council. Any application considered to fall solely within the remit of a single Council was to be referred to that Council, to be dealt with by the appropriate machinery at no cost to the Initiative.

It was initially envisaged that the Committee would meet three times a year - twice to consider applications and once to review and develop the strategy of the Initiative. In reality, however, the Committee met more regularly than was originally anticipated.

### 4.1.3 Calls for Proposals and Selection Procedures for Research Applications

The pre-Initiative call for outline proposals in September 1987 had elicited 165 research proposals, 147 of which were for traditional project grants of under four years duration. Fifty-seven of these were of sufficient quality and fit with the 11 Themes specified by the Working Group (see **Exhibit 8**) to persuade the Research Councils that a second bid to ABRC might succeed.

Although formal acceptance by the Secretary of State of the second bid to the ABRC was not announced until February 7th, 1989, the positive nature of the ABRC's recommendation to the Secretary of State was known earlier. Representatives of the Councils met under Professor Broadbent's chairmanship on September 30th, 1988, to consider what steps were required to establish an appropriate administrative machinery for the programme. Subsequently, when the new Committee was constituted and held its first meeting in December 1988, a decision was made to consider a limited number of full applications (based on a small number of 'exemplar' outlines selected from the pre-initiative call) at the next meeting on 13th February 1989.

The Committee also agreed on a timetable for issuing future calls and consolidated procedures for the selection of research projects. This involved calls for outline proposals in the first instance, rather than full proposals, and the first new call for outline proposals was scheduled for January 1989, to be considered at a third meeting on May 3rd, 1989. Applicants were asked to submit 1000 word outline proposals on a standard form and to indicate which Themes of the Initiative were addressed by their proposal. Each outline was submitted to the MRC and, once logged, distributed to three Designated Committee Members (DCMs) for appraisal.

The scoring system used at the Outline stage involved each appraiser using a 0–6 scale (where 6 indicates research of high scientific merit) along three separate dimensions

- **Relevance to JCI** The relevance of the proposal to the Initiative;
- **Technical Competence** The technical soundness of the proposal
- **Scientific Interest** The originality of the proposal

The system also asked for an overall evaluation score, again on a 0–6 scale. Rather than using a mechanistic formula to arrive at this composite score, DCMs were asked to consider the following points before scoring the proposal on its overall merit

- The multi–disciplinary nature of the proposal
- The track record of the applicant
- The applicant's awareness of the relevant work
- The significance of new knowledge attained through the proposal

On the basis of the DCMs' scores, outlines were placed into one of three categories for consideration at the next Committee meeting

- Those with uniformly high marks from the three appraisers (to be selected without further discussion unless a Committee member raised an objection)
- Those with uniformly low marks (to be rejected without further discussion unless a Committee member raised an objection)
- Those with mixed or borderline marks (to be discussed at the meeting)

Successful applicants were invited to turn their outline proposals into full applications for consideration at the next Committee meeting. Rejected applicants were informed by the Secretariat of the average relevance, soundness and originality scores for their project. They were also informed of the spread of interest between different Themes within the Initiative.

Full proposals were also submitted to the MRC and, once logged, copied to all Committee members. Each full application was then sent to three or four external referees (Rapporteurs) for comment and scoring. These were asked to provide an overall score on a 0-6 scale and to use 0–6 scales to score projects along the following six dimensions

- Excellence
- Technical Competence
- Inter-disciplinary Nature
- Applicability and Exploitability
- Significance for Education and Training
- Standing of Applicants

DCMs for each proposal were charged with the task of interpreting and relaying these comments back to the Committee. Each full application was discussed in full Committee prior to a secret ballot in which Committee members also used a 0-6 scale to arrive at an overall project score. Acceptance depended upon the average of the Committee members' scores for each project surpassing an agreed cut-off point - taken to be 4.0 at the outset of the Initiative but adjusted in some subsequent proposal rounds. Initial expectations were that 50% of Full proposals would subsequently be funded.[11]

The expected time-frame from the time of commencement of a call to eventual project start-up is shown in **Exhibit 11**.

**Exhibit 11 Expected Time-frame for Project Start-up**

| | | |
|---|---|---|
| Issue call | - | Start date |
| Deadline for receipt of outline proposals | - | 3 months on |
| Meeting to select successful outlines proposals | - | 4 months on |
| Deadline for receipt of full proposals | - | 6 months on |
| Meeting to select successful full proposals | - | 9 months on |
| Research projects commence | - | 12 months on |

[11] Annex 1, Minutes of Meeting of the Cognitive Science / HCI Committee held on 15 December 1988

### 4.1.4 The Composition of the Research Initiative

At the second meeting on February 13th, 1989, eleven of the 'exemplar' projects were considered for inclusion,[12] seven of which were eventually chosen to launch the Initiative (a decision later criticised by some Committee members on the grounds that the selection criteria were not clear at that stage).

At the third meeting of the Committee in May 1989, 226 outline proposals were considered, 29% of which were asked to submit full applications, and a further call for outline proposals was announced.

In all, if the process which resulted in the first seven projects is termed Round 1, there were eight selection Rounds over the course of the Initiative. **Exhibit 12** tracks the progress of outline calls and full proposals over these Rounds.[13]

**Exhibit 12 JCI Selection Rounds**

| | Outline Proposals Considered | Full Proposals Considered | Full Proposals Accepted |
|---|---|---|---|
| **Round 1** | 165 | 12 | 7 |
| **Round 2** | 226 | 60 | 21 |
| **Round 3** | 144 | 44 | 7 |
| **Round 4** | 117 | 39 | 9 |
| **Round 5** | 96 | 30 | 6 |
| **Round 6** | 55 | 21 | 5 |
| **Round 7** | 216 | 37 | 11 |
| **Round 8** | 120 | 78 | 8 |
| **Total** | 1139 | 321 | 74 |

N.B. A further six projects were supported under the small grants scheme.

**Exhibit 13** further demonstrates that the process of selecting projects was not straightforward over the whole course of the Initiative. Although we have described the selection procedure in terms of eight discrete Rounds, **Exhibit 13** shows that decisions on Full Proposals were made at 13 out of 15 Committee meetings, due primarily to deferred proposals and requests for further information and clarification.[14]

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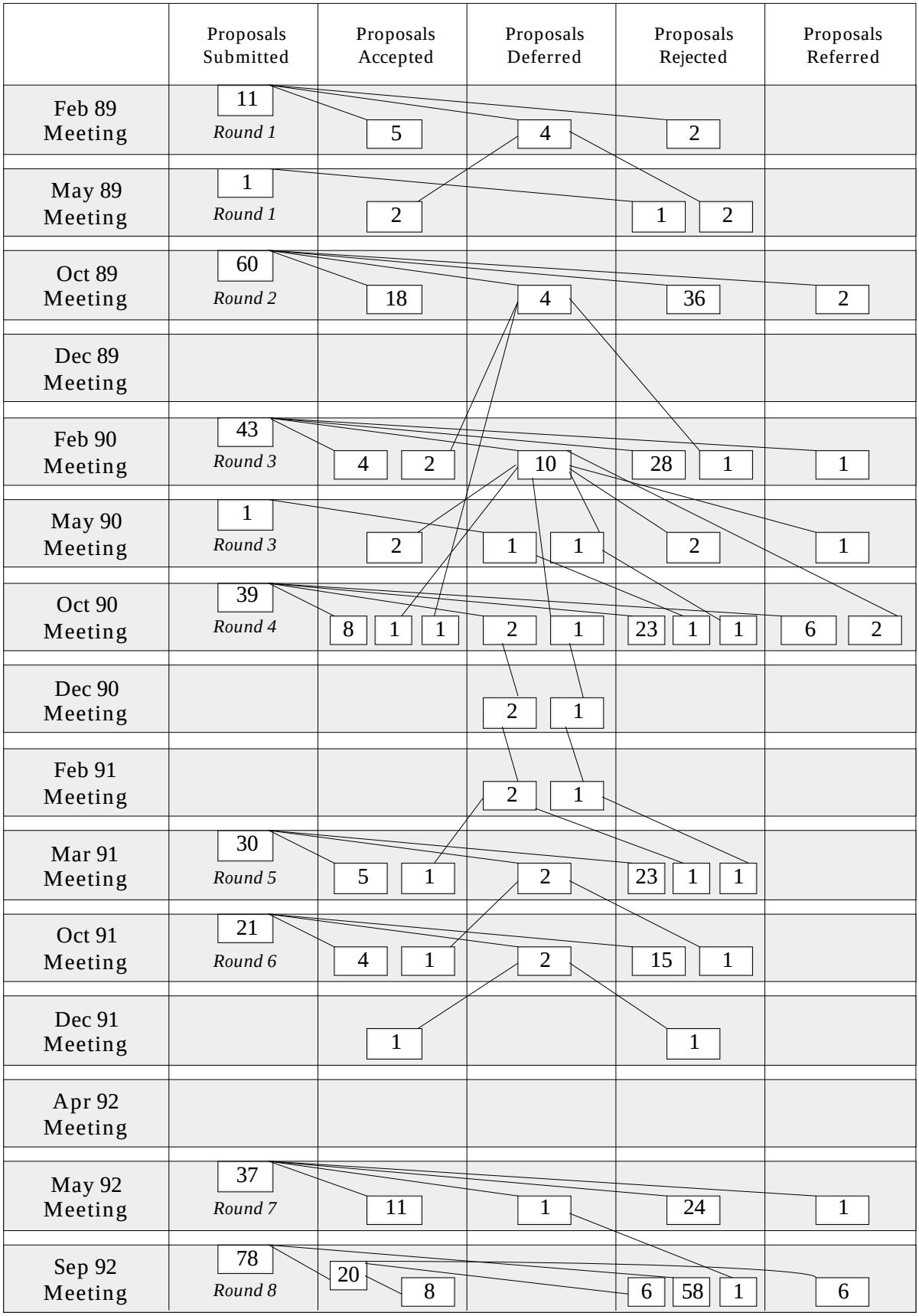
[12] Eleven were considered in the first meeting of the Committee in February 1989 and five selected. Four were deferred and two of these eventually selected at the third meeting in May 1989. A twelfth 'exemplar' project was also considered at the May meeting but not accepted.

[13] The Project List included as **Appendix 2** uses the JCI's own classification scheme and has ten rounds rather than eight.

[14] In the final Round 8, 20 proposals were accepted but funds were only available for eight.

## Exhibit 13 JCI Selection Decisions



In all, 80 research projects were funded under the Initiative. Of these, 74 were full awards and six were small awards (funded under the Small Grants Scheme). The average size of the full research grants was £120k with the smallest award being £28k and the largest £292k. All six projects funded under the Small Grant Scheme cost between £17k and £20k. **Exhibit 14** shows the distribution of full award research projects by financial size.

**Exhibit 14 Financial Size of Projects**

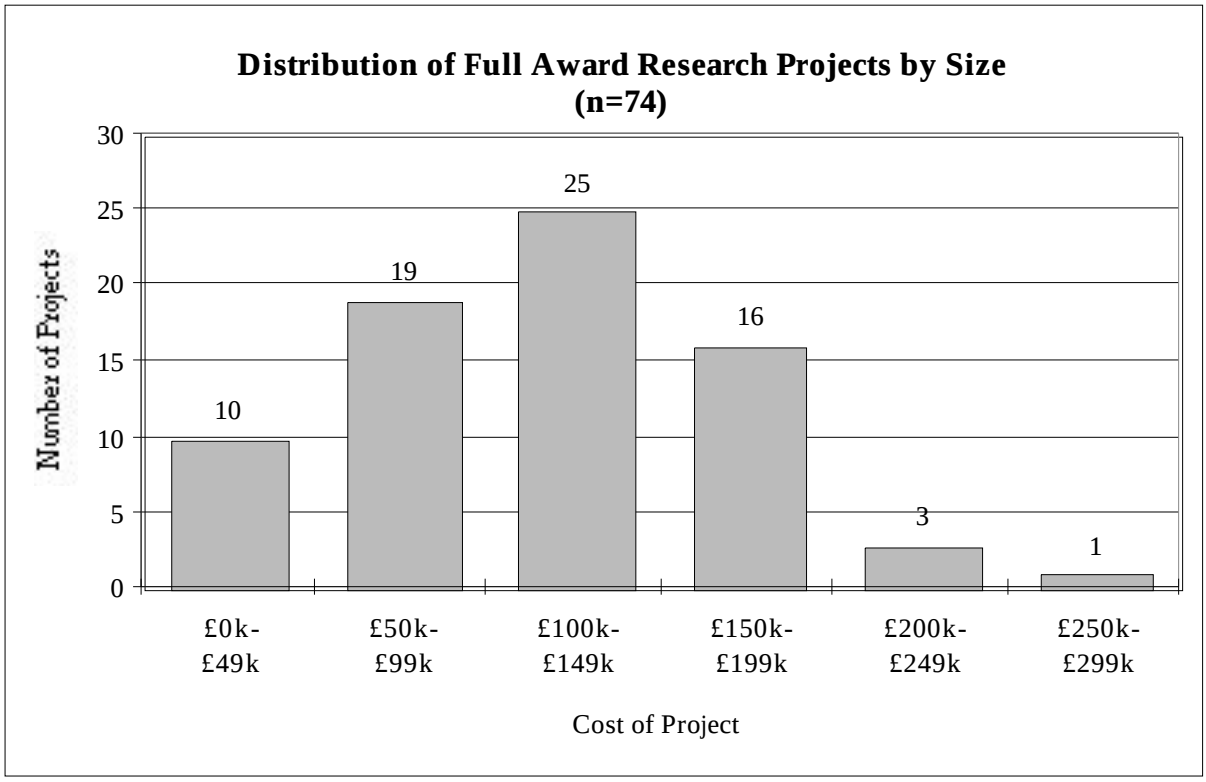



**Exhibit 15** plots the distribution of research projects by duration. The vast majority of full research projects ran over 2 or 3 years, with only two projects running for more than 3 years. The Small Grant Scheme projects were all of 12 months duration or less.

Classification of each research project against the Initiative's 11 Themes took place at various points in time, e.g. at the point of initial submission of the proposal and by the Coordinator as part of her assessment of the Initiative. **Exhibit 16** and **17** below show the distribution of research projects by JCI Main Theme and by Theme respectively and are based on the Coordinator's classification exercise.

**Exhibit 15 Duration of Projects**

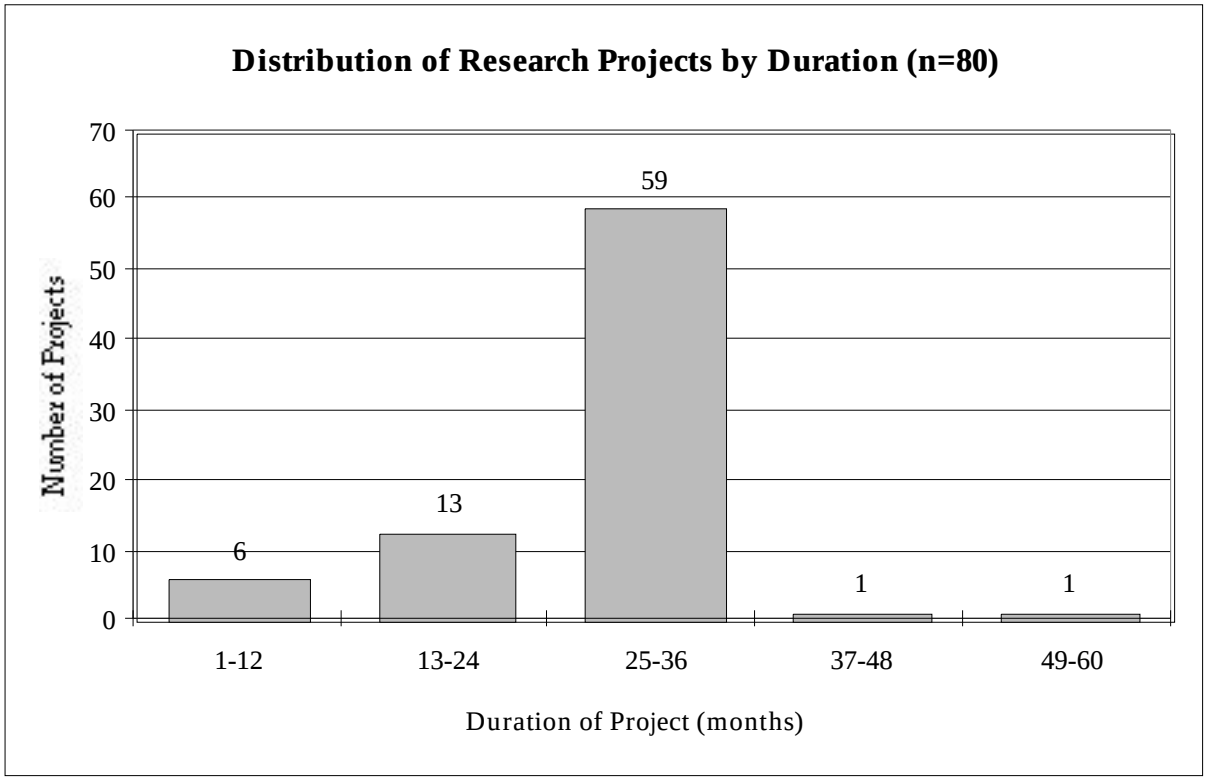



**Exhibit 16 Coverage of Main Themes**

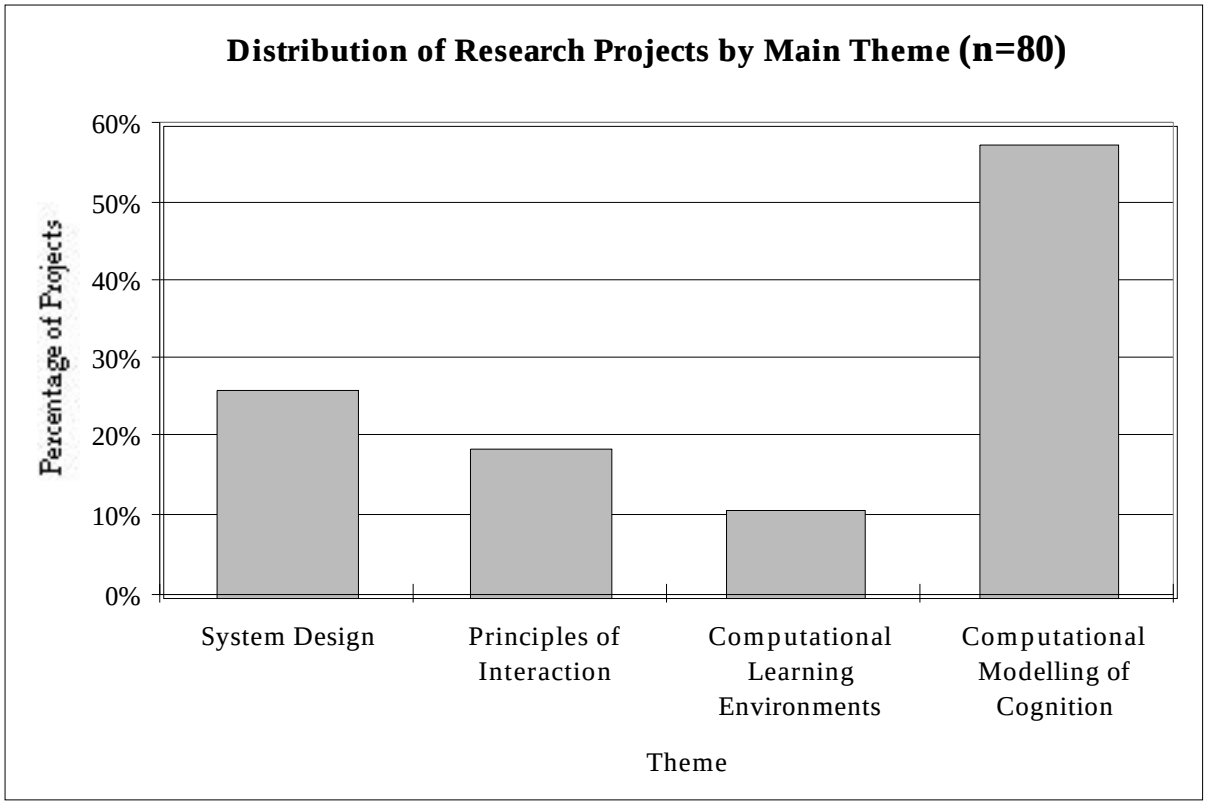
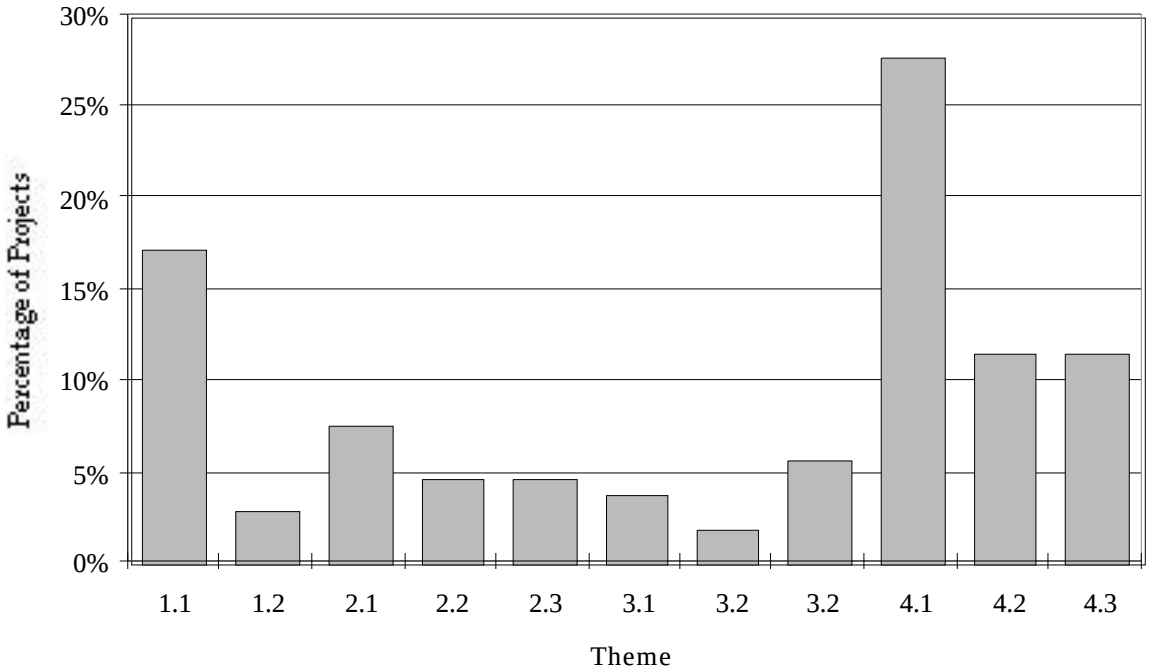


**Exhibit 17 Coverage of Themes**




**1. System Design**
1.1 Tools, methods and the design process
1.2 Linking language to image

**2. Principles of Interaction**
2.1 Models of users in interaction with the system
2.2 Modelling of communication and collaboration among active agents (including discourse)
2.3 Representation of organisational knowledge

**3. Computational Learning Environments**
3.1 Effects on learning of the forms of presentation, action and feedback
3.2 Intelligent tutoring (The choice of learning material in the light of a model of the learner)
3.3 Support of programming

**4. Computational Modelling of Cognition**
4.1 Models of cognition and learning
4.2 General theoretical principles of network models
4.3 Psychophysics and modelling of neural phenomena, including low level vision and speech

The Initiative funded 156 Grantholders across the 80 projects, though obviously large numbers of RAs were also centrally involved in the Initiative. **Exhibit 18** shows the distribution of JCI Grantholders by departmental affiliation for the 153 Grantholders whose departments / organisations / units were known in late 1996.

**Exhibit 18 Departmental Affiliations of Grantholders**

| Department | Number | Percentage |
|---|---|---|
| Experimental / Applied / Social Psychology | 51 | 33.3% |
| Computer Science | 27 | 17.6% |
| AI / AI Vision | 9 | 5.9% |
| Cognitive & Computer Science | 7 | 4.6% |
| Anatomy / Biology / Physiology | 7 | 4.6% |
| HCI | 7 | 4.6% |
| Miscellaneous | 7 | 4.6% |
| Sociology / Social Science / Anthropology | 6 | 3.9% |
| Education | 5 | 3.3% |
| Linguistics / Phonetics | 5 | 3.3% |
| Management / Business | 5 | 3.3% |
| Cognitive Science | 4 | 2.6% |
| Electrical Engineering / Electronics | 4 | 2.6% |
| Mathematics / Physics | 3 | 2.0% |
| Medicine / Pharmacology / Chemical Pathology | 3 | 2.0% |
| Ergonomics | 2 | 1.3% |
| Design | 1 | 0.7% |
| **Total** | **153** | **100.0%** |

All of the Grantholders held between one and four JCI research grants, with the vast majority (87%) holding only one. Sixteen of the researchers (10%) held two grants, two researchers held three grants and two researchers held four grants.

### 4.1.5 Internal Assessment of Research Projects

The Committee monitored and evaluated the progress of research grants both through the work of the Coordinator (see **Sections 4.4** and **5.4.3**) and through the assessment of Annual Reports prepared by Grantholders. Procedures for the assessment of Annual Reports were outlined in the Committee's Annual Report to the Councils for 1993 / 94[15]

- The JCI Secretariat requested annual reports from Grantholders
- Upon receipt, copies of the reports were sent to the JCI Coordinator and JCI Chairman by the Secretariat. The Coordinator and Chairman considered whether progress appeared satisfactory
- For grants where work was deemed to be progressing well, the Coordinator advised the Grantholders accordingly and no further action was taken

[15] Joint Council Initiative in Cognitive Science and Human-Computer Interaction (JCI), Annual Report to the Councils: April 1993-March 1994, **Appendix 2**

- For grants where a problem was identified, the Coordinator sought the advice of a DCM and appropriate feedback was given to the Grantholder. If there remained significant doubt on progress, other action involving the full JCI Committee (if timely), or MRC HQ was necessary
- The JCI Coordinator provided a composite report for the annual meeting of the JCI Committee on each grant assessed and the relevant outcome

On completion of Projects, Grantholders were required to submit Final Reports for assessment by the Committee. Procedures for the assessment of Final Reports were also outlined in the Committee's Annual Report to the Councils for 1993/94[16]

- The JCI Secretariat requested a final report
- The Grantholder returned the report within three months of termination date of grant
- A copy of the final report, together with up to two publications, a copy of the original proposal and a copy of the JCI guide for Evaluation of end-of-award reports, were sent to at least four Rapporteurs by the JCI Secretariat. The JCI Coordinator provided the names of replacement/additional referees where necessary
- The Rapporteurs' reports were sent to Grantholders as initial feedback. The Grantholders were given a short period to respond if they so wished (usually two weeks). Only reports with two but preferably three Rapporteurs reports proceeded to this stage
- The Rapporteurs' reports were sent to a DCM together with the same package of information provided for the Rapporteurs and any response from the Grantholders. The DCM was provided with copies of all of the publications submitted by the Grantholders
- The DCM presented an oral report on the final report to the annual meeting of the JCI Committee
- The DCM produced a short written statement, for feedback purposes, to the JCI Secretariat, where this was helpful
- Members of the JCI Committee were provided in their papers with a copy of the Grantholder's final report, Rapporteurs' comments, the response from Grantholders to Rapporteurs' comments (if any), and any written report from the DCM. Additional information, such as copies of the original proposal, were available to individual members on request
- The JCI Coordinator was responsible for feedback to the Grantholders following the Committee's consideration of the reports

### 4.1.6 Other Activities of the Main Committee

**Newsletters** The Committee issued regular newsletters to inform the scientific community of the Initiative's progress.

**Annual Meetings** Annual meetings were held in order to improve communications within the research community.

[16] Joint Council Initiative in Cognitive Science and Human-Computer Interaction (JCI), Annual Report to the Councils: April 1993-March 1994, **Appendix 1**

**Scientific Meetings** Early in the Initiative, a decision was taken by the Committee to adopt a scheme for the funding of scientific meetings. A special limited budget of £20k per annum was set aside and it was agreed that proposals for such meetings would be subject to the following restrictions.

- Proposals were welcomed for single meetings, with a limit on the number of participants of 10-20
- The budget for individual meetings was limited to £1000, or £2000 if a special case could be made
- The names of all participants had to be stated in the proposal
- A verifiable outcome had to be stated in the proposal

Reports documenting the progress and outcome of meetings were also expected to be made available to the Committee for evaluation purposes. In October 1991 the criteria outlined above were extended to allow for larger meeting with up to 50 delegates and a budget of up to £5000.

## 4.2 JCI Training Panel

### 4.2.1 Composition of the Training Panel

A separate panel reporting to the Main Committee was set up to oversee the Training Programme. Chaired by Malcolm Jeeves (St Andrews), and then John Long (UCL), it had seven members, five drawn from the Main Committee plus two others. The membership of the Training Panel, as listed in the Main Committee's Report to the Councils of 1989 is shown in **Exhibit 19**.

**Exhibit 19 The Composition of the JCI Training Panel**

| Original Training Panel Members | Subsequent Training Panel Members |
|---|---|
| Professor M A Jeeves (First Chm.) | Professor J B Long (Second Chairman) |
| Dr P Collins | Professor D J Wood |
| Professor J A M Howe | Dr G Webster |
| Professor G V Jones | |
| Professor K Oatley | |
| Professor H W Thimbleby | |

### 4.2.2 Terms of Reference of the Training Panel

The Main Committee of the JCI drew up the terms of reference of the Training Panel as follows[17]

- To assess the manpower needs of the scientific community and determine areas with skills shortages
- To draw up an overall strategy for training, including the need for any new courses that the Initiative might help to institute, support for suitable existing MSc courses, PhD studentships and short-term fellowships to encourage a multi-disciplinary approach
- To allocate the funds set aside for the training (£2 million over a five year period) to such studentships and fellowships as deemed appropriate
- To monitor the progress of schemes and students supported by the Initiative
- To report to the Committee annually
- To assess similar schemes in Britain and abroad and inform the Committee about such schemes
- In the short-term, to plan the Initiative strategy for October 1989

In drawing up the strategy for the Training Programme, it was decided that awards would be made at three levels

- **Advanced Course Studentships**, where the aim was to support and expand those MSc courses that take graduates from one of the disciplines covered by the Initiative and equip them in one or more of the others
- **Research Studentships**, where the aim was to fund a proportion of doctoral degrees on the criterion of cross-disciplinary training
- **Fellowships**, where the aim was to assist established researchers in one discipline to gain experience of techniques from another discipline

### 4.2.3 Calls for Applications and Selection Procedures for Training Awards[18]

**Advanced Course Studentships** Two Calls for Applications were issued for the Advanced Course Studentships, one for courses spanning the academic years 1990/91 and 1991/92, and one for courses spanning 1992/93 and 1993/94. The criteria used by the Training Panel to decide on the award of Advanced Course Studentships included

- Multi-disciplinarity of the course and degree of integration between Cognitive Science and HCI
- Computational approach and experience offered
- Technical quality and logical organisation of the syllabus
- Feasibility of course objectives
- Track record of the department

[17] Committee papers for meeting of the Cognitive Science/HCI Committee on Dec. 15, 1988, Annex 5

[18] This **Section** and its successor draw heavily on the information contained in E. Pollitzer, Overview of the Training Programme, 1992

- Existing involvement of the department in JCI research
- Likely impact of the award
- Level of support received from SERC

The Training Panel also conducted a number of site visits to Universities which had applied for, or had been successful in attaining, funding for Advanced Course Studentships. The main purpose of these visits was to provide a fuller assessment of each course and its fit with the criteria listed above. They also provided the Training Panel with an opportunity to influence the content or structure of courses to bring them into line with the aims of the Training Programme.

Final decisions on the funding of Advanced Course Studentships were taken by the Training Panel, after full discussion of all applications, and sanctioned by the Main Panel.

**Research Studentships** Two Calls for Applications were issued for the Research Studentships, one covering the academic year 1990/91, and one for studentships in both 1991/92 and 1992/93. The Training Panel considered the following questions in deciding on the award of Research Studentships

- Did the application demonstrate effective interaction between HCI and computational approaches to Cognitive Science?
- Would supervision of students cover the range of the Initiative's interest and, in particular, its aim to further multi-disciplinary research?
- Did the application describe a specific project or projects?
- What sort of JCI involvement existed in the Department?
- Did the project(s) provide for an explicit training programme?

Once again, final decisions on the funding of Advanced Course Studentships were taken by the Main Panel on the basis of recommendations made by the Training Panel after discussion of all applications.

**Training Fellowships** Three Calls for Applications were made in 1990, 1991 and 1992. The criteria adopted by the Training Panel in awarding fellowships were

- The quality of training over and above that provided by a standard research grant
- Inter-disciplinarity
- The quality of the application
- The applicant's track record
- The standing of the department and its level of involvement in JCI activities

Interviews were conducted with applicants and Panel members scored each application on a 0-6 scale. The scores were averaged and discussed by Panel members prior to the Panel's recommendations to the Main Committee.

### 4.2.4 The Composition of the Training Initiative

Overall, 132 people received training under the three schemes

- 70 Advanced Course Studentships
- 55 Research Studentships
- 7 Training Fellowships

**Advanced Course Studentships (MSc)** The first call for applications for Advanced Course Studentships covering 1990/91 and 1991/92 resulted in requests from 12 courses for a total of 54 studentships. Thirty studentships were subsequently funded as a result of this call. The second call, covering 1992/93 and 1993/94, resulted in applications from 16 courses requesting a total of 137 studentships. A total of 40 places were funded.

**Exhibit 20** shows the courses that were chosen for the awards, and the number of places that were awarded in each year.

**Exhibit 20 Awards for Advanced Course Studentships**

| Course | Number of Awards | | | | |
|---|---|---|---|---|---|
| | 1990/91 | 1991/92 | 1992/93 | 1993/94 | Total |
| MSc in Cognitive Science Manchester University | 2 | 2 | 4 | 6 | 14 |
| MSc in Advanced Methods of Computer Science: HCI Stream Queen Mary and Westfield College | 6 | 6 | 6 | 8 | 26 |
| MSc in Cognitive Science Birmingham University | 4 | 4 | 8 | 8 | 24 |
| MSc in Knowledge Based Systems Sussex University | 1 | 1 | 0 | 0 | 2 |
| MSc in Cognition, Computing and Psychology. Warwick University. | 2 | 2 | 0 | 0 | 4 |
| Total | 15 | 15 | 18 | 22 | 70 |

**Research Studentships (PhD)** The Training Panel awarded five Research Studentships at the Initiative's outset in 1989. The first formal call for applications, covering 1990/91, resulted in 21 applications from Institutions requesting a total of 58 Research Studentships. The full quota of 25 studentships

was awarded as a result of this call. The second call, covering start years 1991/92 and 1992/93, resulted in a further 21 applications from Institutions requesting over 100 studentships. Again the full quota of 25 studentships was awarded, all of them for the academic year 1991/92.[19] **Exhibit 21** shows the departments receiving the Research Studentships.

**Exhibit 21 Awards for Research Studentships**

| Institution | Number of Awards |
|---|---|
| Psychology/Computing, Aberdeen | 2 |
| Psychology, Birbeck | 1 |
| Psychology, Birmingham | 5 |
| Centre for Cognitive Science, Edinburgh | 4 |
| Linguistics, Edinburgh | 1 |
| Pharmacology, Edinburgh | 2* |
| Psychology, Edinburgh | 1 |
| Cognitive Science Centre, Essex | 3 |
| Centre for Non-linear Studies | 1* |
| Psychology, Leeds | 2 |
| Computing, Manchester | 2 |
| Open University | 4 |
| Computing, QMWC | 3 |
| Computing, UCL | 1 |
| Ergonomics, UCL | 2* |
| Psychology, UCL | 3 |
| Psychology, Sheffield | 2 |
| Computing/Psychology/Control Engineering, Sheffield | 3 |
| Psychology, St Andrews | 4 |
| School of Cognitive & Computing Sciences, Sussex | 2 |
| Laboratory of Experimental Psychology, Sussex | 1 |
| Psychology, Warwick | 2 |
| Psychology/Computing/Electrical Engineering, York | 3 |

* Not taken up

**Training Fellowships** The first call for applications for Training Fellowships in 1990 yielded ten applications and resulted in the award of four Fellowships. The 1991 call resulted in five applications, two of which were successful, whilst the 1992 call resulted in only two applications, one of which was funded.

[19] Thinking that JCI-funded activities would have to end by the end of December 1995, and given the high quality of the applications, the Panel decided to award all of the available 25 three-year studentships in 1991/92. (Pollitzer, 1992)

### 4.2.5 Internal assessment of Training Awards

No formal assessments were made, though the Training Panel, with assistance from the JCI Coordinator, did actively monitor the progress of the awards. A major component to this ongoing assessment was the paper entitled 'Overview of the Training Programme' produced by the JCI Coordinator in 1992.

### 4.2.6 Other Activities of the Training Panel

In addition to making training awards, the Panel sponsored Summer Schools on an annual basis. Aimed primarily at research students and research assistants working in the areas covered by the Initiative, the schools were an attempt to introduce an inter-disciplinary approach to young workers in the field. Five Summer Schools were funded, two in 1990 and one each in 1991, 1992 and 1993. Each lasted for a week and was attended by roughly 30-40 persons, the majority of whom were JCI-funded PhD students.

## 4.3 JCI Futures Panel

### 4.3.1 Composition of the Futures Panel

The Futures Panel was set up in 1991 to consider the future of the Initiative and to make a case for future support for research in the areas funded by the JCI. This Panel first met in September 1991.

It was agreed by the Main Committee that membership of the Panel should include the Chairman, scientific members representing the interests of each Council, and an Officer from each Council. The JCI Coordinator acted as scientific secretary to the Panel. The membership of the Panel as listed in its initial meeting[20] is shown in **Exhibit 22** (though it should be noted that Professor Gazdar succeeded to the Chair on the death of Professor Broadbent).

**Exhibit 22 The Composition of the JCI Futures Panel**

**Futures Panel Members**

Dr D E Broadbent (Chairman)
Professor G Gazdar (representing the scientific interests of the ESRC)
Professor T Shallice (representing the scientific interests of the MRC)
Professor M Harrison (representing the scientific interests of the SERC)
Dr K Levy (MRC)
Mr P Linthwaite (ESRC)
Dr D Worsnip (SERC)

[20] Minutes of the first meeting of the JCI's Sub-committee to consider the Future of the Initiative, 11th September 1991

### 4.3.2 Terms of Reference of the Futures Panel

The terms of reference of the Panel were

- To consider the future of the Initiative - either in terms of the management of the end of the Initiative or to recommend a second phase
- To advise the parent Committee, and through it the Councils (ESRC, MRC, SERC), on if, when and how a bid should be made to the ABRC for continued funding

### 4.3.3 Activities of the Futures Panel

The Panel asked a sub-group consisting of its academic members (Professors Gazdar, Harrison and Shallice) and the JCI Coordinator to write a document making the case for continued tri-council support for the area covered by the Initiative. The first meeting of the sub-group was held in October 1991 and a decision was taken to conduct a wide trawl for ideas from the community. This effort culminated in the paper entitled 'The Funding of Cognitive Science and Cognitive Engineering after the Joint Council Initiative'.[21]

## 4.4 JCI Coordinator

The role of the Programme Coordinator, Elizabeth Pollitzer (Imperial), was primarily to act as a representative of JCI via liaison with the research community. This role encompassed general activities such as

- Stimulating interest in the Initiative
- Acting as a representative of JCI
- Acting as a communication channel within and outside the JCI community
- Ensuring a networking of JCI with other programmes or organisations
- Monitoring and advising on the progress of JCI

More specific duties included

- Evaluation of annual and final reports from Grantholders (which included selecting Rapporteurs, consulting with designated Committee members on scientific problems, consulting with MRC on management problems, providing feedback to Grantholders, providing a composite report to the JCI Committee, updating the JCI Summary Document)
- Organisation of JCI annual meetings and summer schools
- Preparation of JCI Project Summary Document
- Preparation of JCI Newsletters
- Preparation of annual reports to the Councils
- Preparation of JCI progress reports for the Committee

[21] First presented to the Main Committee at its meeting on December 12, 1991 and subsequently redrafted and presented at the meeting of April 2, 1992.

- Dissemination of information relating to the scientific progress of JCI (via special journal issues etc.)
- Communication with other programmes and organisations
- Evaluation of JCI Training Programme
- Organisation of, and attendance at, JCI Committee meetings

## 4.5 JCI Ad Hoc Working Groups

At various points throughout the Initiative, though predominantly towards its conclusion, various *ad hoc* Working Groups were set up to consider such matters as the provision of training after the end of the Initiative and the routing of relevant research proposals on completion of JCI funding activities.

# 5.0 Research Programme

As noted in **Section 1.2**, the evaluation of JCI has been structured and organised in order to comment on five key evaluation issues

- The quality of the work conducted
- The effectiveness of the Initiative in terms of goal attainment
- The impact of the Initiative
- The efficiency of its implementation
- The appropriateness of the Initiative

In this **Section** we review each of these issues in turn for the Research element of the Initiative.

## 5.1 Quality

- Four assessment mechanisms
  - Rapporteurs
  - Committee
  - Peer Review Panel
  - Participant Self-assessment
- All agreed that work of a high quality had been conducted within the Initiative

The rationale for the programme as a whole presumed that the potential existed for work of high quality to be undertaken in the Cognitive Science / HCI area in the UK. Project selection criteria and procedures also reflected a concern with supporting work of a scientific excellence. It was important from an evaluation perspective, therefore, to check on the attainment of this goal.

Four assessment mechanisms were used to check on the quality of the work performed over the course of the Initiative. Two mechanisms were instigated by the JCI Committee and are thus labelled **Committee** mechanisms, and two **Independent** mechanisms were employed by the evaluation team.

**Committee Mechanisms**

- Analysis of the Rapporteurs' scores for Final Reports (see **Section 4.1.5** for a description of the procedures involved in reviewing Final Reports and **Appendix 5** for the project scores awarded by the Rapporteurs)
- Analysis of the Committee's own Final Report scores (again see **Section 4.1.5** and **Appendix 5** for procedures and scores respectively)

**Evaluation Mechanisms**

- Inspection of the Peer Review Panel's report (see **Appendix 1**)
- Analysis of a Self-assessment questionnaire distributed to Grantholders (see **Appendix 4**)

### 5.1.1 Rapporteurs' Assessment of Quality

At the end of each project, Final Reports and attached publications were examined by Rapporteurs. A full list of these publications is provided as **Appendix 6**. Each project was assigned a score of between 1 and 5 for the 'overall quality of the research and its results'. **Exhibit 23** illustrates the scoring system used[22] and **Appendix 5** shows average scores for each project.

**Exhibit 23 Rapporteur's Scoring System**

**5 - OUTSTANDING**
Well executed work which has made, or with confidence can be predicted to make, a major impact *internationally* as well as nationally, both within and beyond its immediate focus or intended application, contributing substantially to theory and / or practice

**4 - VERY GOOD**
Soundly conducted work which has or is likely to make an important contribution to its own academic field or intended application

**3 - SATISFACTORY**
Competent work which is unlikely to make anything more than a modest contribution to its own academic field or intended application

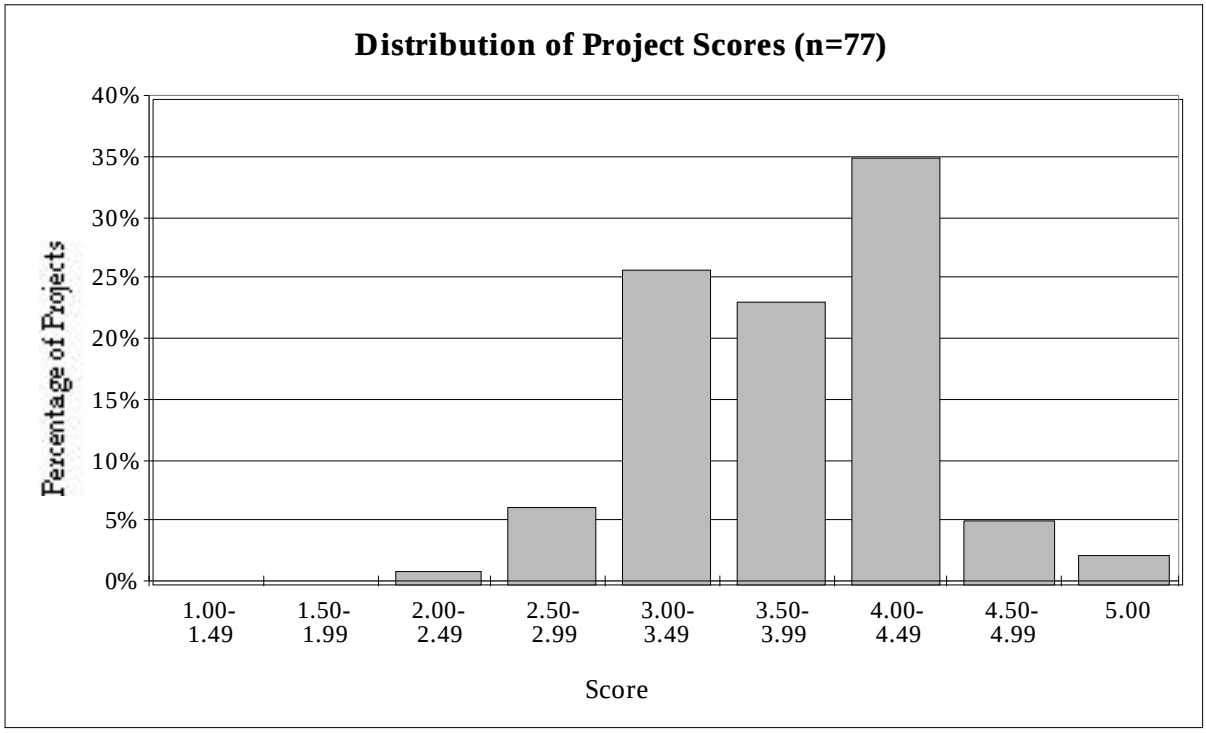
**2 - POOR**
Unsatisfactory work with limited or no impact, or which is compromised by poor design or execution

**1 - UNACCEPTABLE**
Work which was badly executed or clearly misconceived, with no research product.

Averages of the Rapporteurs' scores for each project were calculated for 77 of the 80 JCI projects. Their distribution is shown in **Exhibit 24**. Forty-three percent of projects achieved an overall score of 4 or more, indicating that the Rapporteurs considered them to be of a very high quality. A further 49% achieved an overall average score of between 3 and 4, and only 8% of projects achieved an overall score of less that 3, indicating a less than satisfactory performance. Thirteen projects (17%) received a score of 5 from at least one rapporteur. No projects received a score of 1 from any rapporteur.

[22] A point to note (and discussed in JCI Committee meetings) is that several Rapporteurs reported a problem in using the five point scale above. The 'leap' from 'Satisfactory' to 'Very good' was found to be too great an interval, and left many Rapporteurs wishing to use a score of 3.5.

**Exhibit 24 Rapporteur's Average Scores**




One problem in analysing these scores is that they refer to *overall* quality. It is thus difficult to determine which criteria the Rapporteurs took into consideration when making their judgment. Another problem is the tendency of scorers to avoid the extremes of the scale, making it difficult with five point scales to differentiate between scores clustered in the middle. Nevertheless, it is still true to say that the great majority of projects received scores ranging from 'Satisfactory' to 'Outstanding' (92%), indicating that, according to the Rapporteurs, the Initiative certainly produced work of an acceptable quality.

### 5.1.2 JCI Committee's Assessment of Quality

As part of their review of Final Reports (see **Section 4.1.5**), the JCI Main Committee was presented with the scores of the Rapporteurs. After presentations by DCMs and some discussion, the Committee awarded its own project scores (see **Appendix 5**). This was not done via a secret ballot mechanism, however. The normal practice was for the DCMs to suggest a score, and for this to be accepted unless there was any openly expressed dissent. If this was the case, further discussion aimed at establishing a consensus ensued, with the Chair having the final word.

In reality, their was a tendency for the DCMs to suggest scores similar to the averages of the rapporteurs' scores, and for openly expressed dissent to be a rarity. Even when there was dissent, it was unusual for the suggested scores to be amended drastically. It is not surprising, therefore, that the Committee's scores did not differ markedly from those of the Rapporteurs, and for them to display the same bias towards 'Satisfactory' to 'Outstanding' projects.

While not wishing to detract from the overall conclusion of the exercise - that the Initiative had supported work of a very high standard - it is possible to speculate that the distribution of Committee member's scores would not have been so positively skewed if a secret ballot mechanism had been employed. Certainly the tenor of the debates surrounding a small percentage of projects hinted that some Committee members felt the suggested scores were too high, though few appeared willing to press this point too forcibly. Coming at the tail-end of a long tenure as Committee members, there was little incentive to conduct overlong debates of an essentially self-critical nature (since poor project performance reflected badly on the Committee's collective judgment in selecting projects in the first instance). In future, a secret ballot mechanism should avert this type of acquiescence and allow a more critical appraisal of project achievements, though the very involvement of Committees in internal self-assessment exercises of this nature raises issues of credibility.

### 5.1.3 Peer Review Panel's Assessment of Quality

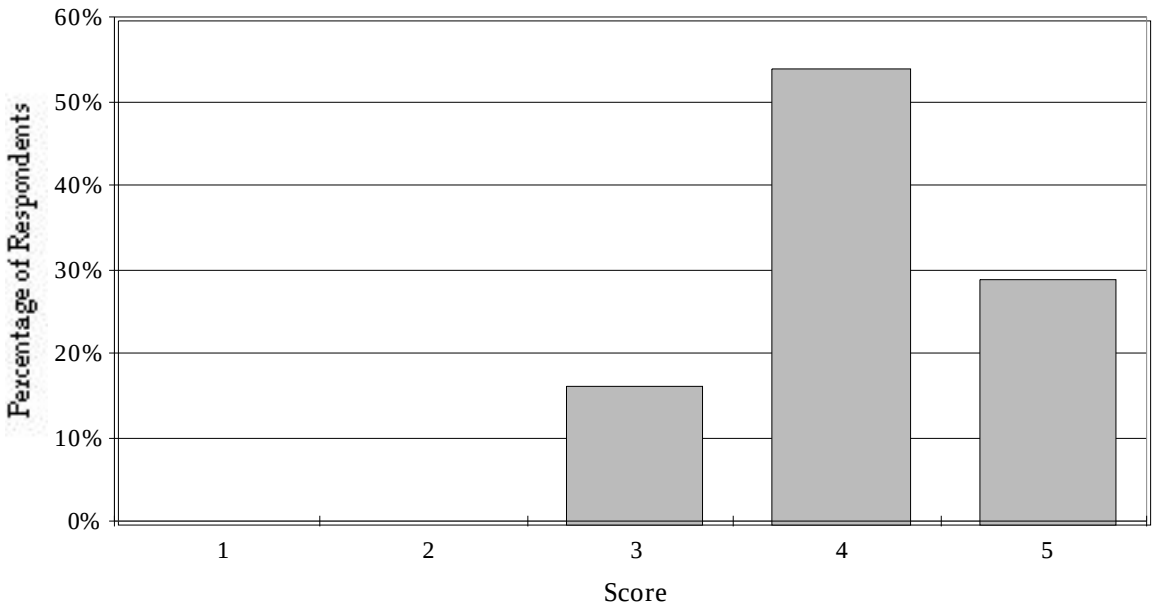
The external evaluation component which should have proved the richest source of quantitative data on project performance and the quality of the research supported under the JCI was the Peer Review Exercise (see **Section 1.2.4**). Members of the Peer Review Panel were originally asked to score projects along a number of evaluation dimensions, including the quality of the work conducted in projects. This would have allowed comparisons to be made with the other mechanisms used to assess quality. However, of its own volition the Panel decided not to use a scoring system, and instead opted for a more qualitative appraisal of the Initiative as a whole. In consequence, detailed information on project performance and quality contained in the Peer Review Report (see **Appendix 1**) is limited.

The Panel Report did nevertheless contain some overall statements about the quality of the work carried out under the Initiative. The Panel concluded that the JCI had delivered scientific results, and went on to describe the work in a general sense as 'interesting' and 'important'. In separate reviews of 'Cognitive Science' projects, 'HCI' projects, and projects described as linking 'Cognitive Science with HCI', they considered 'Cognitive Science' projects to be of a 'high quality', and referred to many as 'outstanding' and most as 'interesting'. In comparison, although they did not consider that work in the 'HCI' area was 'very strong' (projects in the 'Cognitive Science and HCI' category were considered stronger scientifically), project performance was said to be of a 'reasonably high' standard.

### 5.1.4 Participants' Self-assessment of Quality

Towards the end of the evaluation, Initiative Grantholders were circulated with a Self-assessment Questionnaire in order to elicit structured comments on their JCI projects.[23] This is included as **Appendix 4**. One section of this questionnaire asked Grantholders to score their projects using 1-5 scales along a number of evaluation dimensions. One of these scales related to an overall project score (see Question A12 in **Appendix 4**). Another related to the quality of the work conducted, taking into account factors such as the production of high quality outputs (see Question A11, **Appendix 4**). **Exhibits 25** and **26** show the distributions for overall project scores and for quality alone.

**Exhibit 25 Grantholders' Self-assessments of Overall Project Scores**




1 Work which was badly executed or clearly misconceived, with no research product
2 Unsatisfactory work with limited or no impact, or which is compromised by poor design or execution
3 Competent work unlikely to make anything more than a modest contribution to its own academic field
4 Soundly conducted work which has or is likely to make an important contribution to its own academic field
5 Well executed work which contributes substantially to theory and/or practice, and which has made, or is likely to make, a major impact internationally, both within and beyond its immediate academic focus

[23] For the 80 JCI projects, 178 questionnaires were distributed to 152 Grantholders. The response rate was 32%. In a follow-up telephone survey of non-respondents, it was established that 43% had moved/gone away/could not be contacted; 10% promised to return the questionnaire but didn't; and 15% said they were either too busy or had devoted enough time already to the evaluation.

**Exhibit 26 Grantholders' Self-assessments of Quality**


Both distributions are similar, with overall project scores slightly more favourable than those for quality alone. Generally speaking, Grantholders considered their work to be of a high quality - more so, for example, than either the external Rapporteurs or the Committee itself. Sixteen percent of projects received a score of 5 from at least one Grantholder, compared with 17% of projects receiving a score of 5 from at least one external rapporteur, but in the middle range the scores of Grantholders were considerably higher than those given by either the Rapporteurs or Committee members.

### 5.1.5 Quality Summarised

It is perhaps not surprising that Grantholders' self-assessments were generally favourable, nor indeed that the Committee's own assessment of projects was similarly positive. Both mechanisms are open to criticism on the grounds of self-interest. This should not obscure the fact, however, that all mechanisms - including the external peer review (to which the criticism of self-interest does not apply) - suggested that the work carried out within the context of the Initiative was of a high quality, and in some cases exceptionally high. A major aim of the Initiative was support for work of scientific excellence. All the indications are that this goal was achieved.

## 5.2 Effectiveness

### 5.2.1 Aims Revisited

- Operational Aims
  - The JCI aimed to promote high quality multi- or inter-disciplinary research linking Cognitive Science and HCI via the application of computational principles
  - It aimed to support work in an area of strategic need i.e. HCI-related areas
  - It also aimed to support work likely to fall through funding nets because of its interstitial nature
- Key Elements
  - High quality work
  - Multi- and inter-disciplinary research
  - Computational principles
  - Cognitive science underpinning HCI
  - Interstitial nature

The effectiveness of an Initiative can be interpreted as the extent to which operational programme goals are achieved. In assessing effectiveness, therefore, it is important to refer back to these operational aims and to pick out the key elements which need to be scrutinised.

The aims of the JCI and the ways in which they evolved were described in depth in **Sections 2.0** and **3.0**. From these descriptions it is clear that the aims of the Initiative are multi-dimensional. Five dimensions in particular are important, and these can be restated as five questions which have to be asked if effectiveness is to be assessed.

**Five Key Questions**

- Did the JCI select and support work of high quality?
- Was work of a multi- and inter-disciplinary nature supported?
- Did JCI projects involve computational aspects or principles, particularly those relevant to the development of HCI?
- Did the Initiative support Cognitive Science which underpinned HCI?
- Did the Initiative support work unlikely to have been funded by single Councils alone?

### 5.2.2 JCI Goal Attainment

- JCI goal attainment was mixed
  - The JCI did select and support work of high quality
  - Work of a multi- and inter-disciplinary nature was supported
  - The majority of projects involved computational aspects
  - Fewer projects involved either the generation of computational principles applicable to HCI, or the application of computational principles to HCI
  - The majority of projects (57%) can be classified as straight Cognitive Science with little immediate relevance to HCI. Twenty-nine percent were Cognitive Science projects relevant to the development of HCI. The remaining 14% were HCI projects which involved the application of Cognitive Science principles
  - Many of the projects were likely to have been funded by single Councils

**Did the JCI select and support work of high quality?**

**Section 5.1** reviewed the issue of quality. The inescapable conclusion is that the Initiative did select and support work of high quality.

**Was work of a multi- and inter-disciplinary nature supported?**

The questionnaire to Grantholders threw some light on this issue. **Exhibits 27** and **28** (which are based on the responses to Question C4 in **Appendix 4**) indicate that none of the respondents regarded their projects as mono-disciplinary. The vast majority regarded their projects as multi- and / or inter-disciplinary.[24] The responses to another question (C5), which asked Grantholders to indicate the disciplines / sub-disciplines spanned by their JCI projects,[25] revealed that the average JCI project spanned 9.4 disciplines / sub-disciplines.

The exit interviews revealed that many participants thought of their projects as inter-disciplinary or multi-disciplinary simply because they conceived Cognitive Science and HCI in this way, rather than as single disciplines.[26] Many were truly multi- / inter-disciplinary, however, in that they involved collaborations between individuals from different disciplines - sometimes working in the same department; sometimes in different departments in the same institution; and occasionally in different organisations. In a quarter of the projects covered by the exit interviews, inter-disciplinarity manifested itself at an individual level, with individuals trained in one discipline using techniques and insights drawn from others.

[24] These terms were not defined in the questionnaire. The distinction made by Grantholders between multi- and inter-disciplinary is thus unclear.

[25] Recipients of the questionnaire were provided with a list of 65 disciplines / sub-disciplines potentially associated with Cognitive Science and HCI (see Question C5 in **Appendix 4**).

[26] The large number of terms generated to describe the constituent disciplines / sub-disciplines connected with Cognitive Science and HCI (see Question C3, **Appendix 4**) is testimony to their multi-faceted nature.

**Exhibit 27 Grantholders' Self-assessments of Multi-disciplinarity**

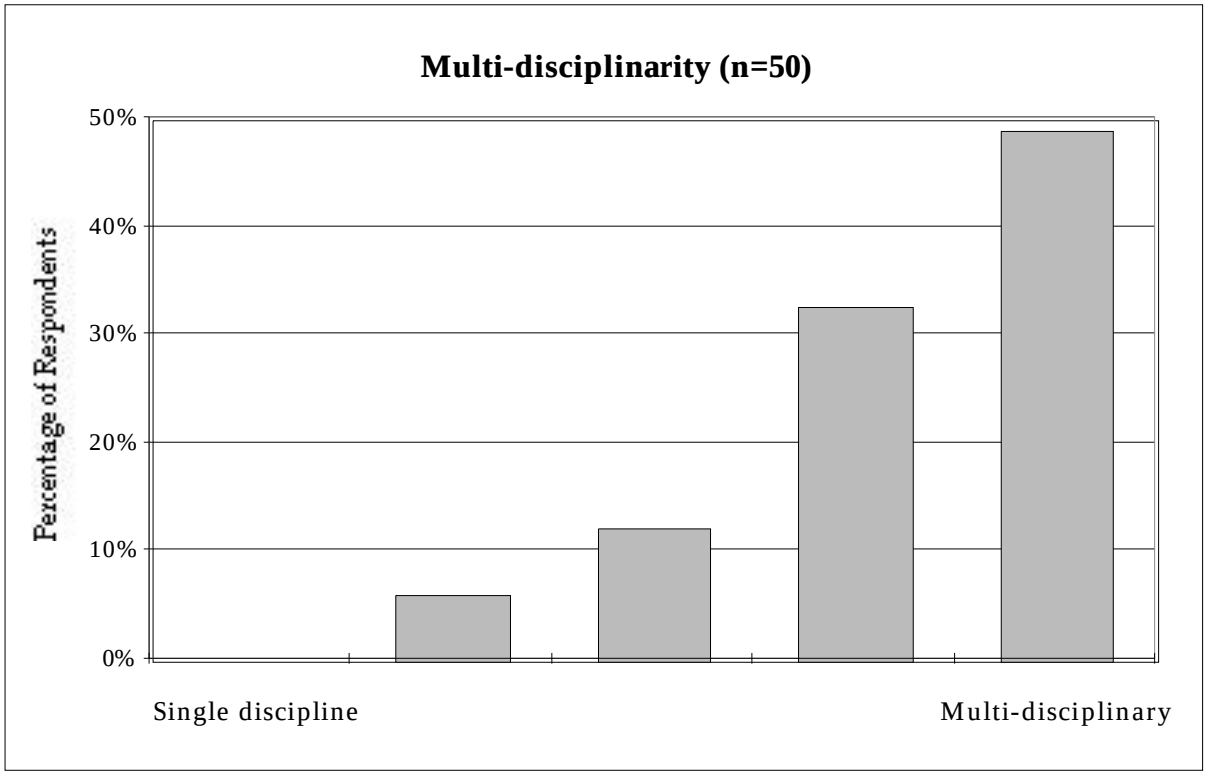
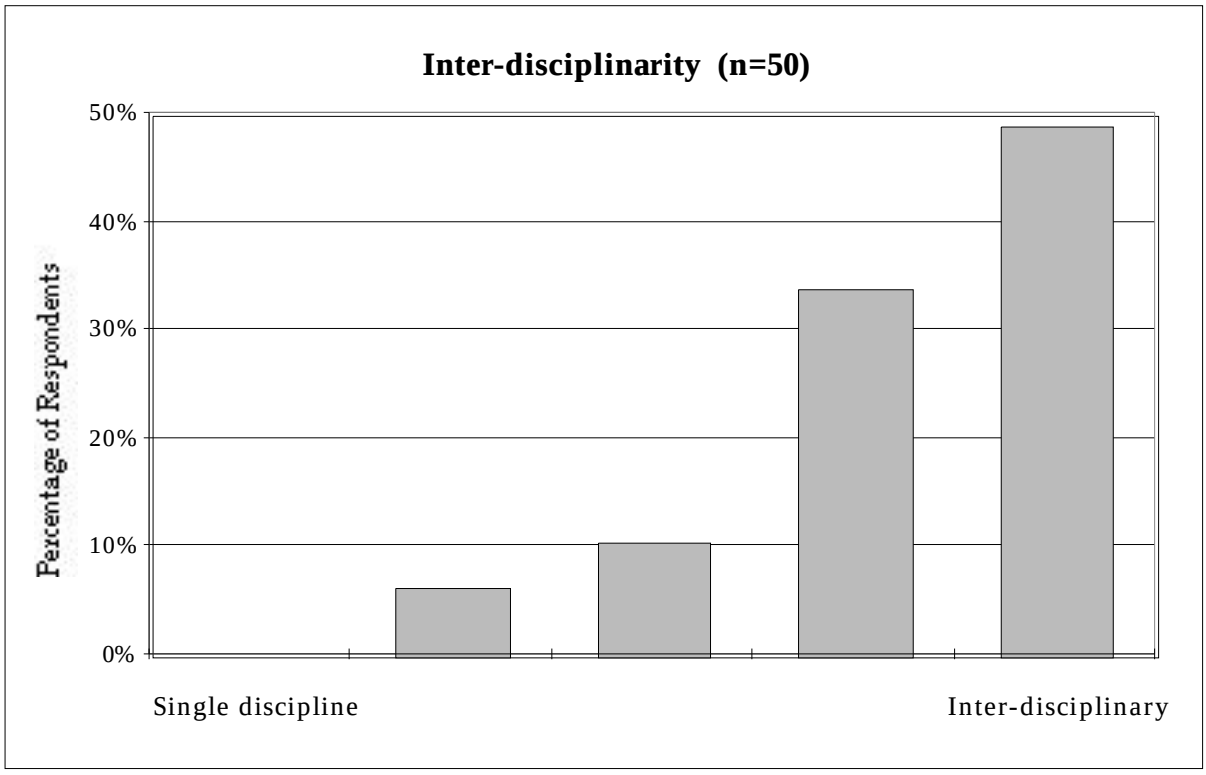



**Exhibit 28 Grantholders' Self-assessments of Inter-disciplinarity**

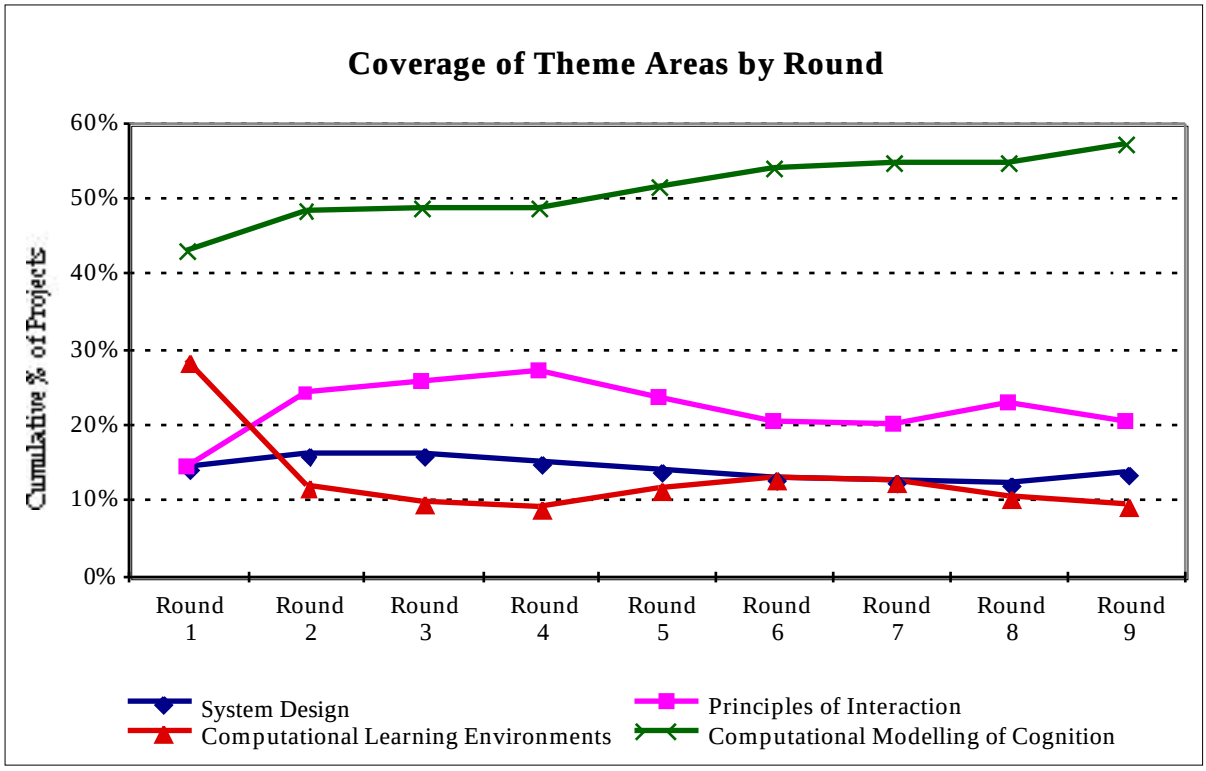


**Did JCI projects involve computational aspects or principles, particularly those relevant to the development of HCI?**

Projects funded under JCI were classified into four Main Theme areas and 11 Sub-theme areas (see **Exhibit 1**, **Section 1.1.4**). Most projects accepted fell into the Theme of Computational Modelling of Cognition (58%). Computational Learning Environments was the least populated Theme (11%). At the Sub-theme level, Models of Cognition and Learning (36%) and Tools, Methods and the Design Process (23%) accounted for over half the projects (55%).

Analysis of the coverage of research Themes over time reveals that after the first round of funding, Theme Area 4, the Computational Modelling of Cognition, came to dominate over the other Theme Areas. Furthermore, this trend continued round on round without exception to the point where projects in Theme Area 4 constituted well over half of the Programme (see **Exhibit 29**).

**Exhibit 29 Coverage of Theme Areas by Round**




It is clear from the above that the majority of JCI projects involved a significant amount of computational model development. **Exhibit 30** confirms, however, that while most Grantholders said their projects were aimed at the development of computational models, an appreciable number were not. Further analysis also reveals that most model development projects had a strong Cognitive Science orientation. In marked contrast, few projects with a strong HCI orientation involved model development to the same extent.

**Exhibit 30 Grantholders' Self-assessments of Computational Model Development**

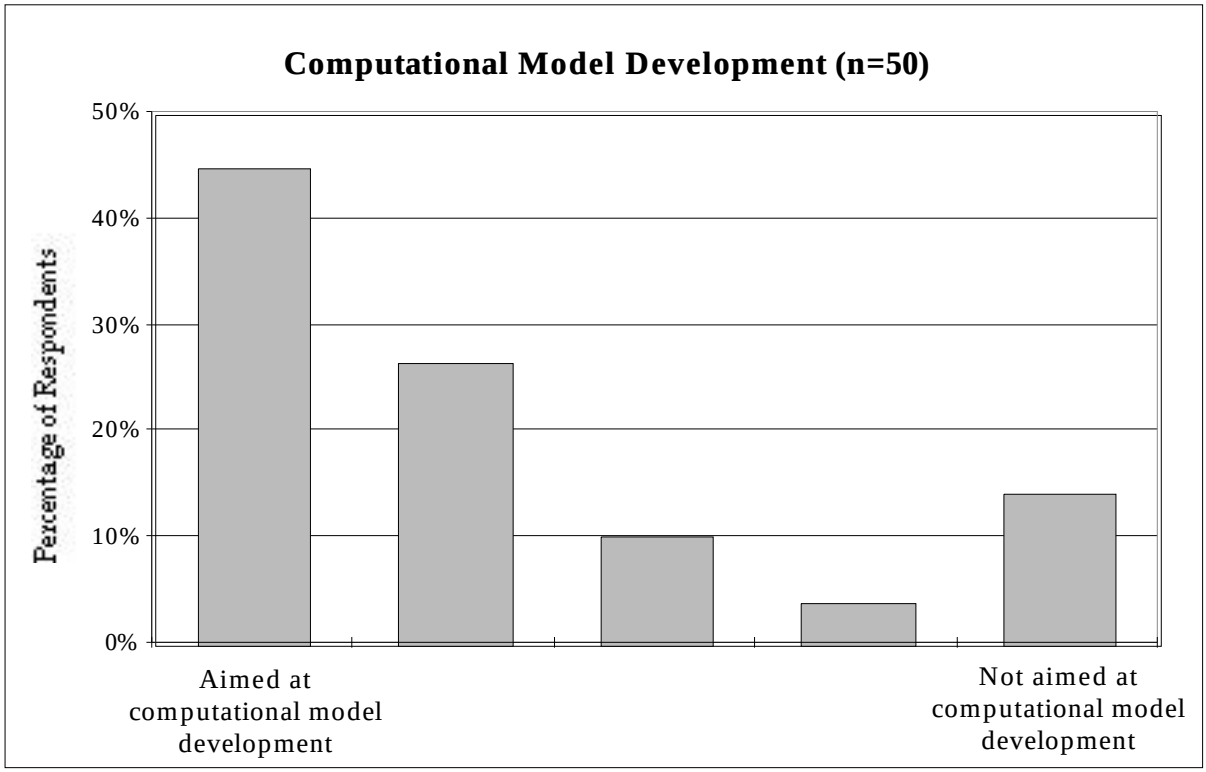



**Exhibit 31** goes on to reveal the diversity which existed between projects which did, in the eyes of the Grantholders, enhance understanding of computational principles and those which did not. Some 44% were said to have strongly advanced understanding (scores of 1 and 2) compared to 33% at the other end of the scale (scores 4 and 5). Again further analysis reveals that projects said to have enhanced understanding most had a stronger Cognitive Science orientation than an HCI orientation, though in this instance the difference was less marked.

**Did the Initiative support Cognitive Science which underpinned HCI?**

The relationship between Cognitive Science and HCI is central to the issue of inter-disciplinarity and at the nub of the issue of goal attainment. The analysis of aims presented in **Sections 2.0** and **3.0** clearly illustrates that the Initiative as a whole was meant to link the two areas such that HCI developments could benefit from the theoretical underpinning provided by Cognitive Science.[27] Exploring this relationship thus constituted an important element of the evaluation and a number of exercises tackled the issue.

[27] As we shall see, members of the JCI Committee interpreted the aims of the Initiative in different ways when it came to selecting projects. From an evaluation perspective, however, it is important to assess JCI against its original objectives in the absence of any coherently planned and agreed changes.

**Exhibit 31 Grantholders' Self-assessments of Enhanced Understanding of Computational Principles**

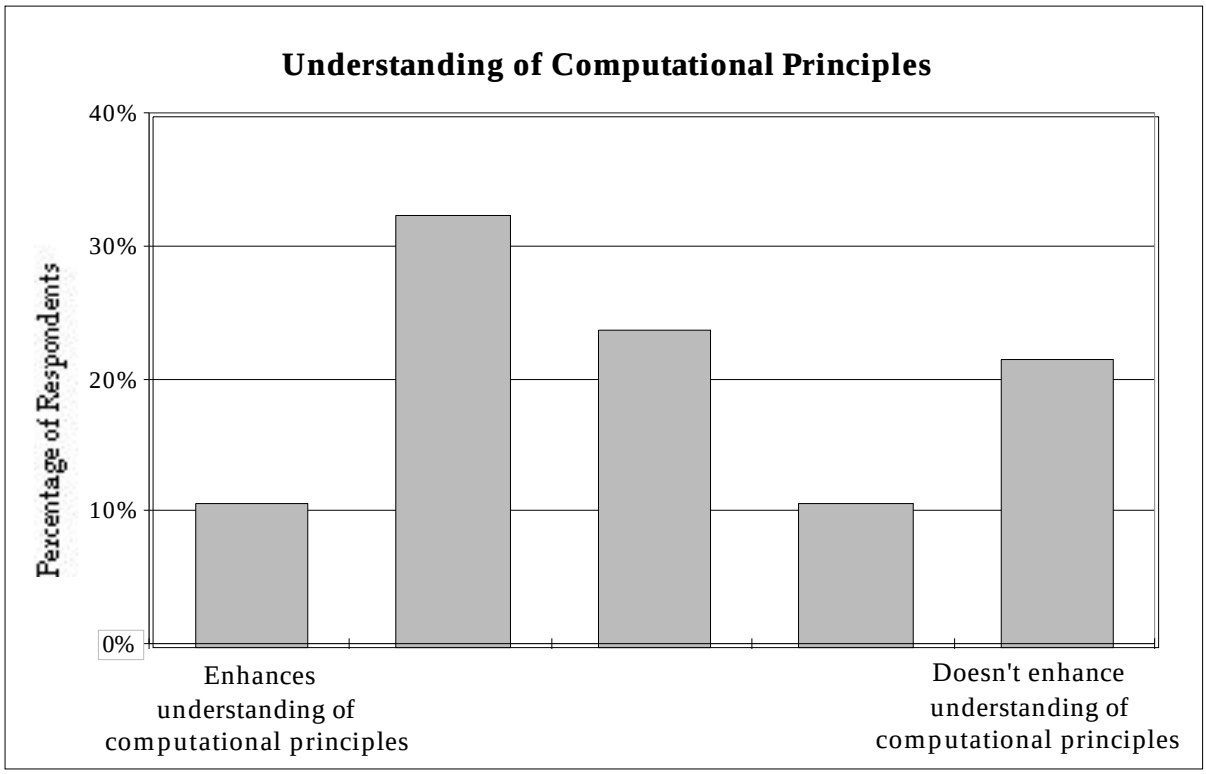



**Exhibit 32** shows how Grantholder's classified their projects. Nearly half the projects (47%) in this sample were classified as 'pure' Cognitive Science, with no mention of any relationship with HCI. This does not exclude the possibility that these projects had (downstream) implications for HCI, but it does suggest that the Grantholders concerned considered these to be indirect, tenuous or remote. For the remainder, seven percent of the sample classified their projects as 'pure' HCI', while 41% did describe their projects as containing both Cognitive Science and HCI elements.

The picture which emerges of a large cohort of 'Cognitive Science' projects, a moderately sized cohort of 'Cognitive Science-HCI' projects and a small 'HCI' cohort is supported by a fuller analysis of all JCI projects conducted by Elizabeth Pollitzer, the Coordinator of the Initiative. She classified projects into three types

- **CS Projects** which sought to advance Cognitive Science knowledge only (i.e. contained no statements suggesting that the work was motivated by or will be applicable to HCI)
- **CS-HCI Projects** which addressed problems in Cognitive Science which are (also) of concern to HCI
- **HCI Projects** which dealt with the application of existing Cognitive Science knowledge to the design of HCI systems

**Exhibit 32 Grantholders' Self-assessments of Research Areas Spanned by Projects**

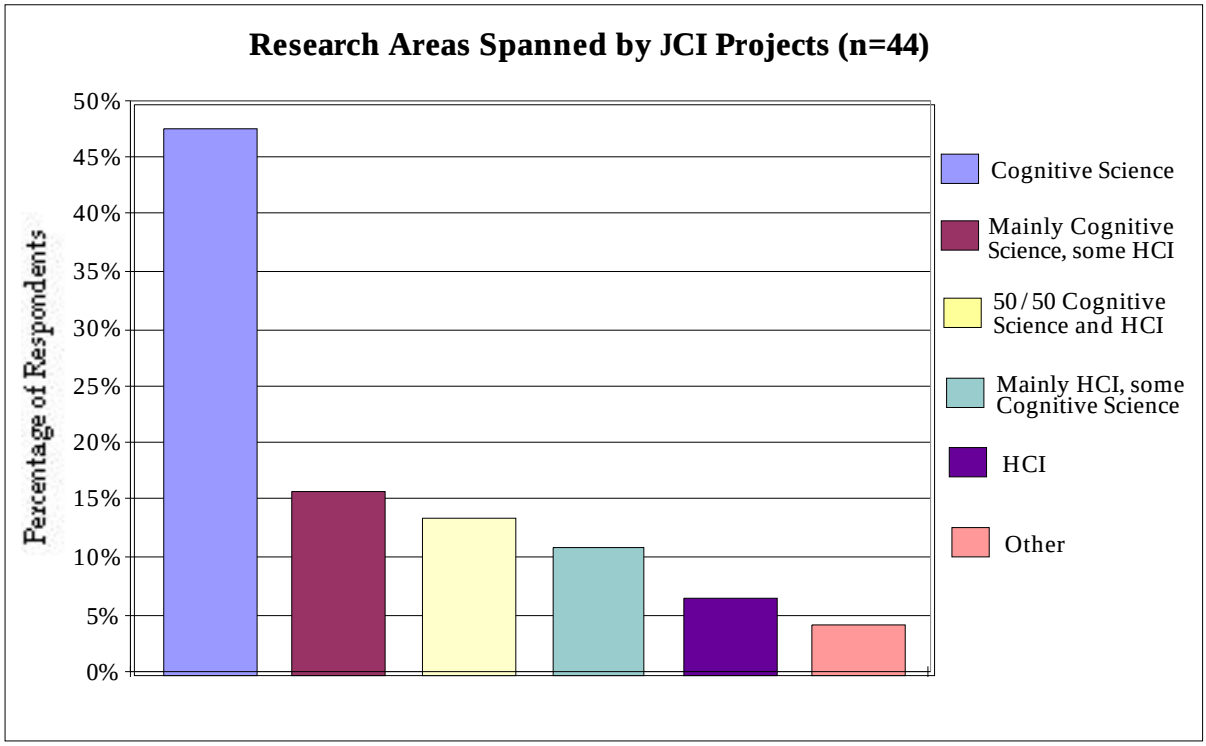



**Exhibit 33** shows clearly the dominance of the Cognitive Science projects considered by the Coordinator (and substantiated in the exit interviews conducted by the evaluation team) to be of little or no direct relevance to HCI. **Exhibit 34** further shows that most of these fell into Main Theme 4, Computational Modelling of Cognition.

The Peer Review Panel examined the relevance of project **outcomes** for Cognitive Science and HCI. Its report (see **Appendix 1**) discusses projects in terms of

- 11 projects with outcomes relevant to progress in Cognitive Science
- 6 projects with outcomes relevant to progress in HCI
- 10 projects with outcomes relevant to progress in Cognitive Science as a theoretical basis for HCI

The Self-assessment exercise also provided an opportunity for researchers to comment on project outcomes using the same classification scheme. Most researchers claimed that their projects had contributed to more than one area. **Exhibit 35** shows that almost all of the researchers claimed to have produced results of relevance to progress in Cognitive Science; exactly half felt that their project outputs were of relevance to progress in HCI; and just over 40% felt that they had produced outputs of relevance to progress in Cognitive Science as a theoretical basis for HCI.

**Exhibit 33 Coordinator's Classification of Projects by Area**

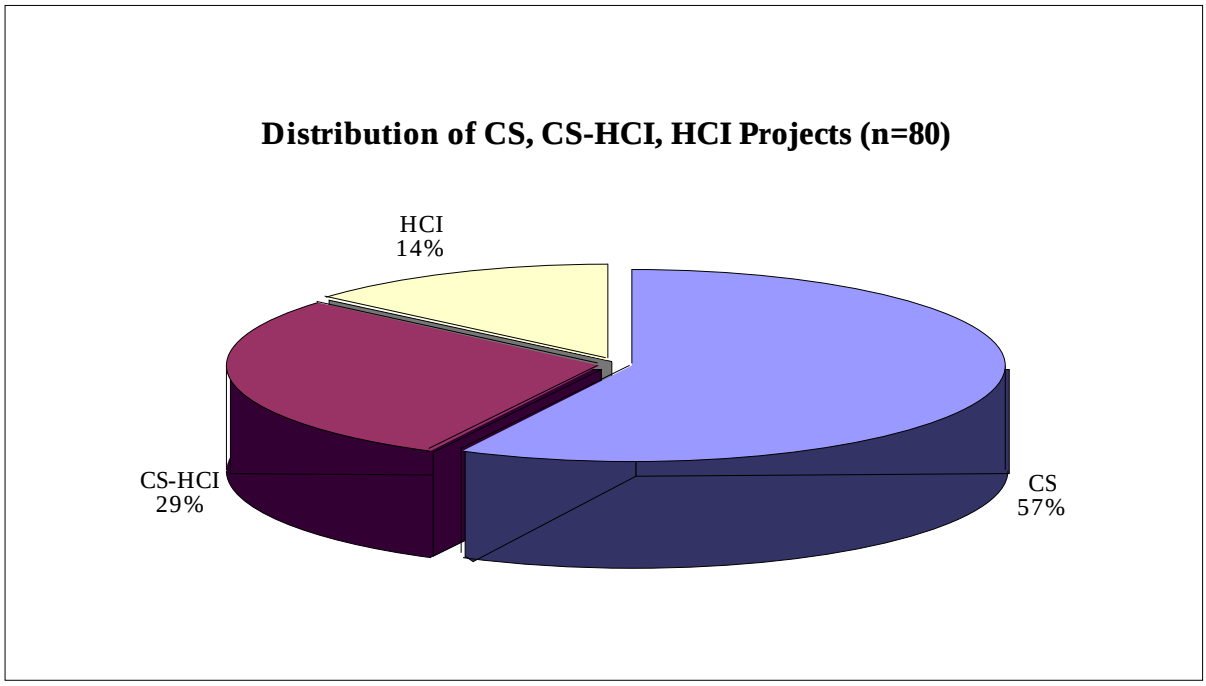



**Exhibit 34 Coordinator's Classification of Projects by Main Theme and Area**

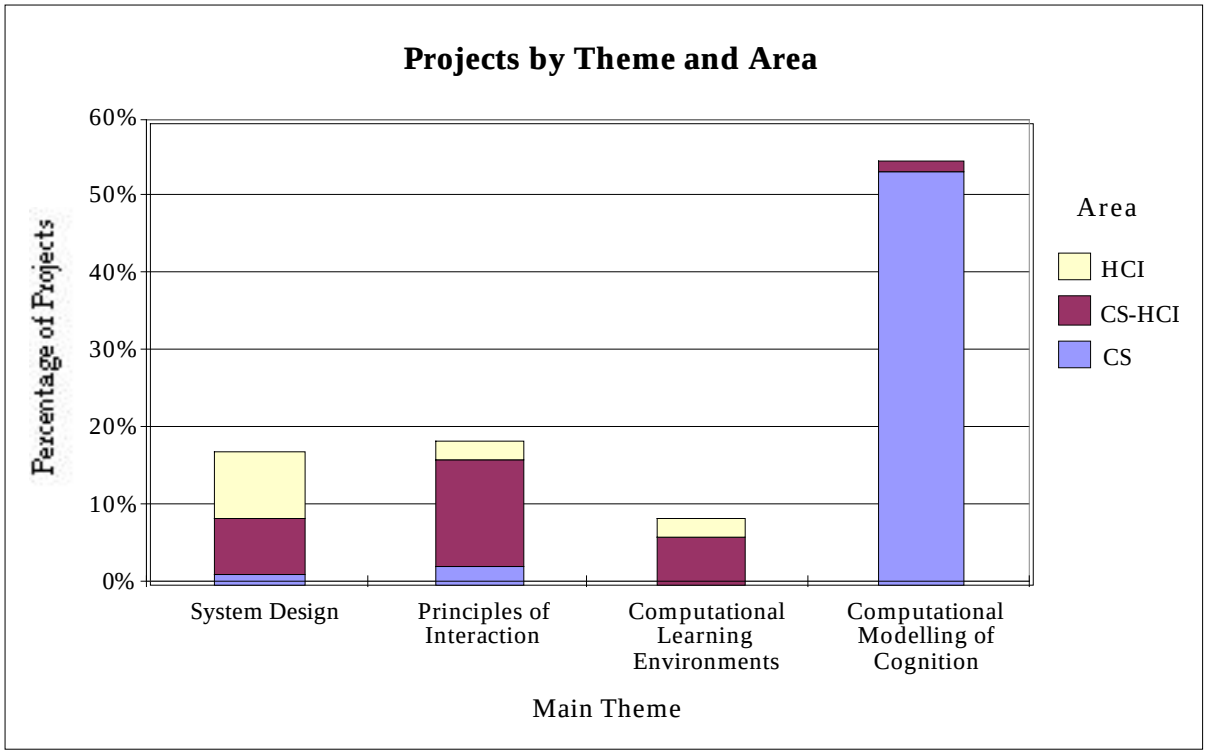
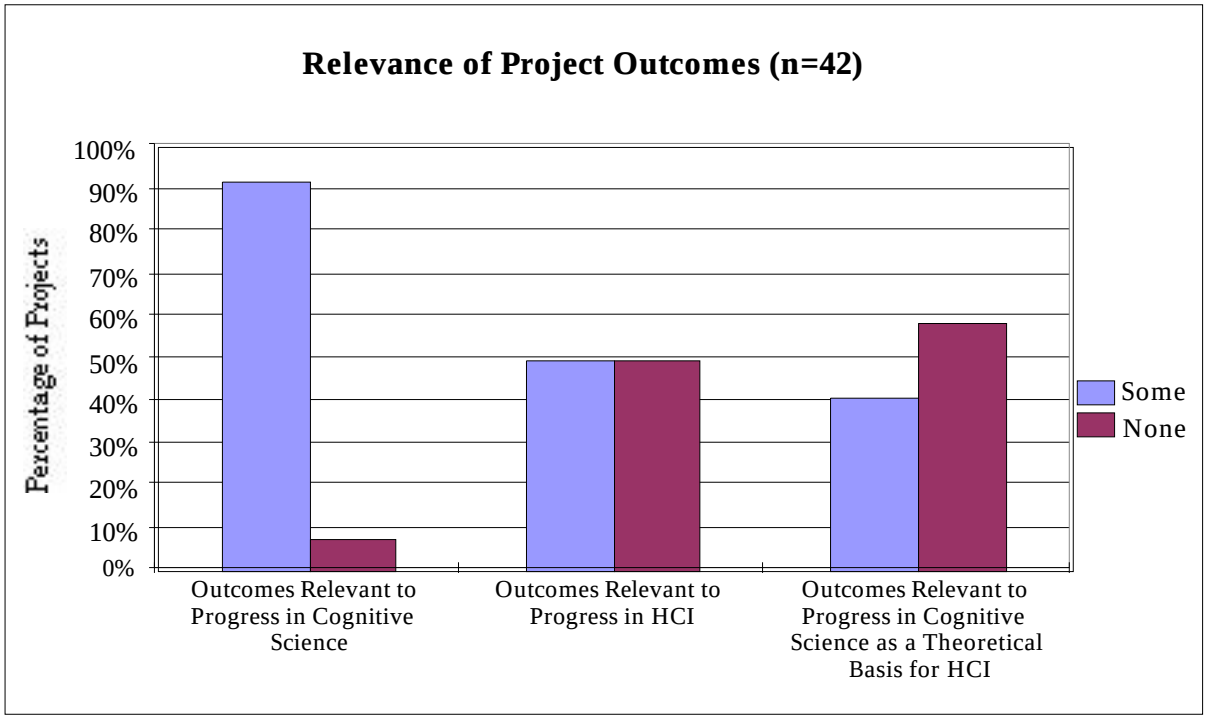


**Exhibit 35 Grantholder's Classification of Relevance of Project Outcomes**



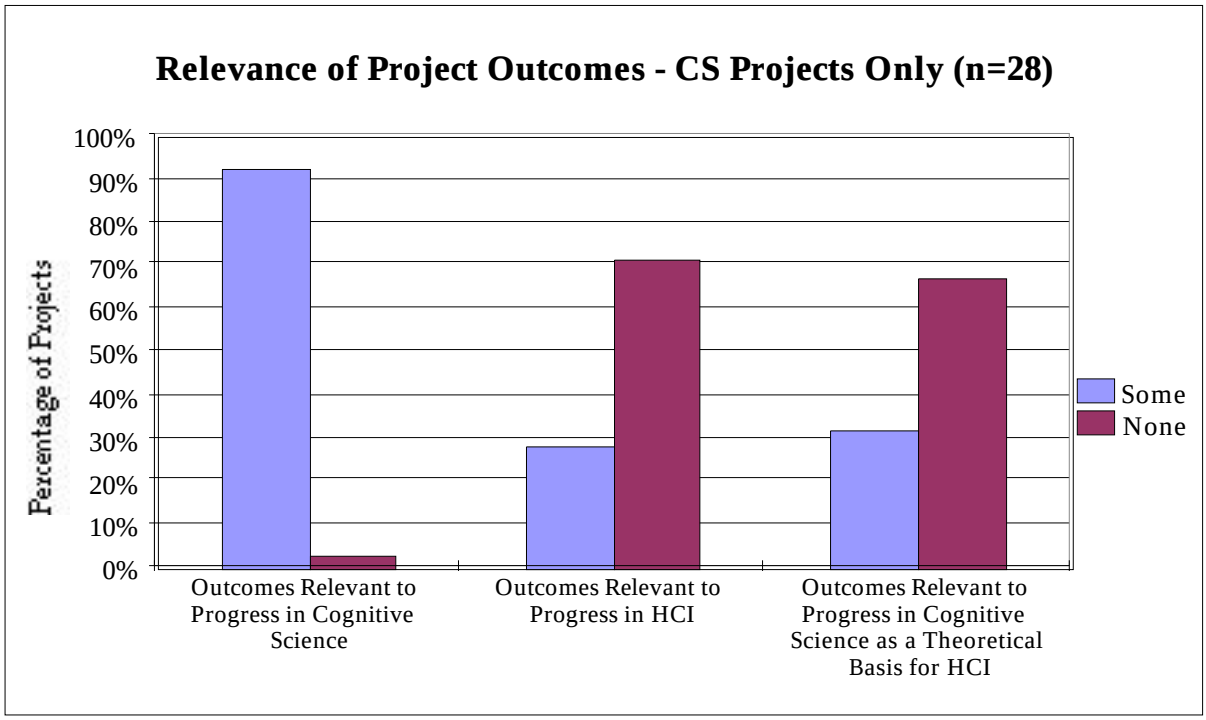

The above analysis was repeated in order to compare and contrast responses from those researchers who had conducted 'straight' Cognitive Science projects (CS) and those who had conducted projects with an HCI component (CS/HCI and HCI). **Exhibit 36** shows the results for the CS projects only. Roughly two-thirds of the researchers stated that their projects were of no relevance to HCI, and that they had not contributed to the development of Cognitive Science as a theoretical basis for HCI.

Overall, it is difficult to escape the conclusion that the majority of projects in the Initiative can be classified as straight Cognitive Science with little immediate relevance to the development of HCI. If we take the Coordinator's estimates, 57% of projects fell into this category. A further 29% were Cognitive Science projects relevant to the development of HCI, and the remaining 14% were HCI projects which involved the application of Cognitive Science principles.

**Did the Initiative support work unlikely to have been funded by single Councils alone?**

Implicit in the thinking which led to the JCI was the idea that high quality, multi-disciplinary projects relevant to Cognitive Science and HCI risked not being funded because these areas lay at the edge of each Council's responsibility. These 'interstitial' projects, it was feared, might fall through the net, and a joint approach was expected to preempt this via the provision of a safety net.

**Exhibit 36 Grantholder's Classification of Relevance of Project Outcomes - Cognitive Science Projects Only**

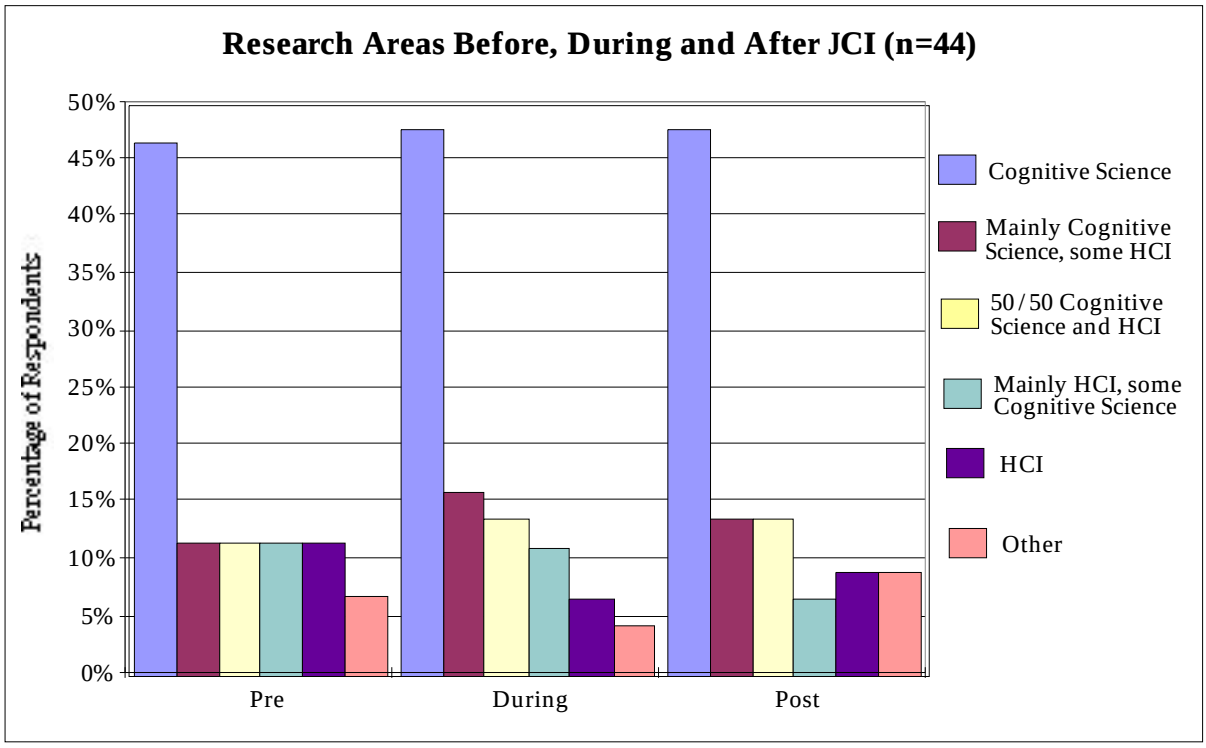



There are three issues here. One is whether or not so-called interstitial projects really existed in sufficient numbers to warrant a specific programme catering for them. The second is whether or not the Initiative managed to fund any (or enough) of those which did exist. The third is whether these would have been supported by single Councils in the absence of the JCI.

We consider the first issue in a later **Section**. Concerning the second point, much turns on how interstitial projects are defined. If 'multi-disciplinarity' is the defining feature which places projects at the edge of each Council's responsibility, the Initiative certainly catered for them. The Initiative also catered for high quality, multi-disciplinary projects relevant to Cognitive Science alone (witness the preponderance of straight Cognitive Science projects). Many of these have to be considered as interstitial because of their high computational element - the second successful bid to the ABRC used the example of a study in computational modelling of purposive behaviour to help define an interstitial project by noting that it was peripheral to computing science but attractive nevertheless because of its potential impact on neuroscience. The Initiative did not cater so well, however, for projects relevant either to HCI alone or to Cognitive Science and HCI taken together, yet these are probably the easiest projects to categorise as interstitial projects of peripheral concern to individual Councils.

The issue of whether or not JCI projects would have been supported by single Councils in the absence of the JCI is more difficult to untangle. For evidence we turn to analyses of the research interests of Grantholders pre- and post-JCI, and to an inspection of Grantholders' funding sources. **Exhibit 37** shows the profile of research areas spanned by Grantholders pre-, during and post-JCI. The number of researchers in each category remained roughly the same from pre-Initiative days through to the present. Sixty-six percent of respondents also described their pre-JCI and post-JCI research activities in the same terms as their JCI research activities, indicating that the JCI did not result in any major displacement or reorientation of research for the majority of respondents. Another analysis of funding sources conducted by the evaluation team demonstrated that 80% of Grantholders were used to (and very successful at) obtaining grants from single Councils (and often from more than one), and that they continued to seek funds from single Councils both during and after their JCI projects. When coupled together, these findings do tend to suggest that the JCI was an alternative source of funding for projects which stood a reasonable chance of being funded elsewhere if the JCI had not come into existence.

**Exhibit 37 Grantholder's Classification of Research Areas**



### 5.2.3 Understanding Performance

- Why was goal attainment mixed?
  - Confusion over Cognitive Science and/or HCI (i.e. between project and Initiative definitions of relevance)
  - Proposal pressure for straight Cognitive Science was not a factor
  - Dominance of excellence criteria over relevance criteria
  - Failure of readjustment strategy involving more consistent application of relevance criteria to each project
  - Similar confusion over coverage of Themes
  - Implicit adoption of an equalisation strategy
  - Failure of efforts to shape the Initiative via stimulation of the desired community response

It is apparent from what we have seen so far that performance was mixed in terms of the attainment of Initiative goals. The quality and multi-disciplinarity of the bulk of projects supported are not in dispute. The situation is less clear cut regarding the computational focus of projects, the preponderance of straight Cognitive Science projects and the relatively weak emphasis on projects which genuinely linked Cognitive Science and HCI.

There can be no doubt that the inclusion of many straight Cognitive Science projects involving computational modelling elements was in keeping with one interpretation of the aims of the programme as expressed in the successful bid to the ABRC. As noted in **Section 3.2**, the overall aim specifically allowed for projects which "enhance our understanding of the general computational principles underlying natural and artificial forms of intelligence". However, the full statement of the Initiative's overall aim goes on to add "...and their application in the design of systems involving human-computer interaction". Stated in this form there is an element of ambiguity concerning the use of the term 'and'. Does this allow for the inclusion in the Initiative of two different types of project - those aimed at understanding computational principles of natural and artificial forms of intelligence and those aimed at the application of general computational principles in the design of systems involving HCI? Or does it imply that individual projects must contain both elements, which would mean that all projects should be of some relevance to HCI?

One of the "glosses and interpretations" presented in the second bid to the ABRC to "avoid misunderstanding" suggested that there should be no sharp difference between project types vis-à-vis theoretical or applied leaning because of "the great practical need ... for generalisable knowledge and for concrete problems to act as foci for theoretical developments". This would seem to indicate a preference for all projects to contain elements with some implications for HCI, or at least for the more theoretical projects to be linked in some way with the more applied projects.

Despite this gloss, however, the reality of the situation is that straight Cognitive Science projects with few or no implications for HCI came to dominate the programme, and there can be little doubt that this emphasis was out of kilter with the original rationale for the programme, namely the desire inherited from Bide to provide a more theoretical base underpinning developments in HCI.

How did this situation come about? One explanation for the inclusion of CS proposals stems from the ambiguity expressed above. It was apparent in Committee meetings attended by the evaluators at the start of the evaluation period in 1990/91 that a degree of confusion existed amongst Committee members over the aims of the Initiative. Some members thought it legitimate to construct an Initiative which contained both straight CS and HCI-oriented projects (an Initiative level interpretation of CS **and** HCI). Others argued that each project should contain CS and HCI elements (a Project level definition of CS **and** HCI).

In part this lack of consensus was caused by changing membership and, perhaps, by inadequate briefing of new members, but this does not explain why long–standing members also appeared uncertain. It was also not due to the absence of any documented aims. These were expressed in the bids to the ABRC and were reiterated in the early papers and minutes of the JCI Committee. As such they were available to Committee members.

That said, however, the way the documented aims of the Initiative were expressed over time did vary in content and emphasis (see **Section 2.0**), and although they became more fully expressed over time, there must be some doubts over the clarity of their documented expression given the failure of the Committee members to internalise a common, shared understanding of the Initiative's aims.

Eventually, after a series of discussions which absorbed the Committee in 1991 concerning the legitimacy of including CS projects not directly or even remotely concerned with HCI, a consolidated stance was reached which recommended a strong preference for projects containing both CS and HCI elements. But the point to note here is that this consolidation was not swift. Much of the funding available for the Initiative had already been committed. There can be little doubt that the JCI would have benefited from a mechanism designed to speed up this process. The eradication of ambiguity and the circulation of concise, standard statements of aims and criteria to each Committee member prior to every meeting, and their restatement at the start of each meeting, would have been obvious reinforcement mechanisms.[28]

The inclusion of CS projects is perhaps explained by the confusion which existed over the legitimacy of including certain project types, but this does not explain the dominance of CS projects. Neither does proposal pressure appear to have been a factor, i.e. HCI-oriented proposals were not swamped by the number of CS proposals received by the Committee. In a report discussing the progress of

[28] This tack was adopted by the second Chairman of the Training Panel after discussions concerning aims had taken place in the context of the Main Committee meetings.

proposals,[29] the Coordinator noted that in the first four 'true' calls (i.e. Rounds 2 - 5 in the terminology adopted in **Section 4.1.4**, **Exhibit 12**) the number of 'CS' Outlines received was lower than the number received for 'CS / HCI' (see **Exhibit 38**).

**Exhibit 38 Progress of Proposals in Rounds 2 - 5**

| | CS | | | HCI | | | CS / HCI | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage | Outline | Full | Funded | Outline | Full | Funded | Outline | Full | Funded | Outline | Full | Funded |
| Oct 89 | 89 | 33 | 11 | 47 | 3 | 1 | 82 | 24 | 6 | 218 | 60 | 18 |
| Feb 90 | 52 | 20 | 5 | 41 | 6 | 0 | 47 | 20 | 3 | 140 | 46 | 8 |
| Oct 90 | 33 | 16 | 7 | 33 | 11 | 1 | 52 | 16 | 2 | 118 | 43 | 10 |
| Feb 91 | 26 | 13 | 4 | 25 | 3 | 0 | 45 | 18 | 2 | 96 | 34 | 6 |
| Total | 200 | 82 | 27 | 146 | 23 | 2 | 226 | 78 | 13 | 572 | 183 | 42 |

This **Exhibit** also shows clearly that success rates in terms of the passage from the Outline to Full Proposal stage were similar for both the CS (41%) and CS / HCI (35%) areas, but that subsequently CS proposals were much more successful than any other category in gaining eventual funding.

The key to understanding the eventual emphasis on CS projects lies in the selection process and the procedures and criteria utilised by the Committee. Analyses and comparisons of the scores awarded by external Rapporteurs and by Committee members at the Full Proposal stage for different rounds is revealing. For the Full Proposals considered at the Committee meeting of 15 March 1991, for example,

- Committee members and Rapporteurs concurred that relatively few projects scored highly enough to rank above the agreed cut-off point (4.0 on a scale of 0-6), and that the majority of the high scorers were CS projects
- Lowering the cut-off point slightly (to 3.5) would not have had any impact on the number of successful projects allowed by the Committee, but it would have doubled the number allowed by the Rapporteurs, many of them HCI-oriented projects

Overall, the Committee tended to score HCI-oriented projects more harshly than CS proposals, certainly more so than the external Rapporteurs, though all were in agreement that the scores of the HCI-oriented proposals were generally lower than those for CS projects.

[29] Elizabeth Pollitzer, Progress of Proposals vs. the JCI Funding Conditions, Annex 2 of Main Committee papers for the meeting of October, 1991

In her analysis of proposal progress,[30] the Coordinator concluded that the HCI community had greatest difficulty answering the requirements of the JCI research model, which demanded that both relevance and scientific quality criteria were met. In particular, this community was said to have objected to the 'narrowness' of the JCI criterion concerning the need for proposals to use a computational approach. The report also contained a detailed analysis of why HCI-oriented proposals tended to fail. From this it is clear that most proposals failed not because they did not meet the JCI relevance criteria, but because of their failure to comply with the scientific quality criteria. In comparison with theoretically-oriented Cognitive Science proposals, it is perhaps not surprising that applications-oriented HCI proposals had less of an academic feel to them. *A priori*, one would expect proposals of this type to fare better in terms of relevance criteria than scientific quality criteria.

There is also a suspicion that the majority of JCI Committee members tended to give more weight to scientific quality criteria than to relevance criteria. Certainly this was the impression gained by the evaluation team members in attendance at Committee meetings, though furnishing evidence to prove this point is difficult given that projects were given a single score - as opposed to separate scores for scientific quality and relevance - in the secret ballot which followed open discussion of the merits of individual proposals.

In the Committee discussions which took place concerning the relative weights of scientific and relevance criteria, the position was eventually taken that relevance criteria should be given greater emphasis (implying acceptance of a prior lack of due weight), but that scientific quality standards should not be lowered. This certainly led to more discussion in Committee meetings about the issue of relevance, but as we saw in **Exhibit 29**, the Committee continued to vote via its secret ballot mechanism primarily for projects with a CS orientation.

This failure to readjust the balance of the Initiative has to be considered in the context of the rationale for the programme. We know that the Initiative was based on a perception that quality projects in an important area of interdisciplinary research were not being funded. As far as research policy mechanisms are concerned, it is crucial to differentiate between the two implicit strands contained here: **strategic need** arguments and **unrewarded excellence** arguments.

When there is the assumption of unrewarded excellence, the policy task is to find a mechanism which allows this excellence to be rewarded. There should be no question of relaxing excellence criteria. When there is the assumption of strategic need, the policy task is to find a mechanism which encourages people to work in a particular area deemed to be important. Here it is perfectly feasible to relax excellence criteria. The emphasis is on plugging gaps rather than building on strengths. Although there is little point in funding third–rate applications, there are arguments in favour of funding borderline cases.

[30] Elizabeth Pollitzer, Progress of Proposals vs. the JCI Funding Conditions, Annex 2 of Main Committee papers for the meeting of October, 1991

The conflation of strategic need and unrewarded excellence arguments in the JCI rationale led to an unresolved tension over the legitimacy of relaxing selection criteria. Although relaxation did occur to a limited extent (on two occasions the cut-off point was lowered from 4.0 to 3.5), JCI members were sensitive to criticism of lowering academic standards, and it was this more than anything else which led to a programme composition out of alignment with the primary aim of building a theoretical base for developments in HCI.

One other related issue deserves to be mentioned in the context of programme composition, and again it is a tale of some confusion concerning the aims of the programme and the directions given to the Committee. In **Sections 2.0** and **3.0** we saw how the whole thrust of the Initiative had been proactive in nature - an attempt to foster research and a research community in a designated area of strategic need. We also noted that the second bid to the ABRC stated that the choice of Initiative Themes was based on their likely contribution to the stated aims of the Initiative and the knowledge that some research capability and interest existed in each Theme in the UK . Subsequently, by the time the JCI had become a reality, Committee members were being instructed to give equal priority to all Themes,[31] to give equal weight to all Themes,[32] and "to attempt to fund in proportion to Themes rather than in proportion to the distribution of applications (in order to) select among the possible lines of fundamental research those that will provide a balanced development of the field, rather than being guided solely by the quality of the isolated proposals".[33]

However, the second bid to the ABRC also expressed the view that the Theme areas represented 11 'growing-points', and it was expected that there would be shifts, contraction, expansions and even the abolition of Themes over time, with support for Themes varying with their ability to stimulate proposals and research in line with the aims of the Initiative. This perspective suggested a line of action in stark opposition to the 'equalisation' strategy adopted by the Committee, calling as it did for a 'substitution' strategy in which new Themes would be identified and old ones dropped if suitable proposals did not appear. Both perspectives called for the Committee to take steps to stimulate the 'balanced development of the field', but in very different ways

It is impossible to say what would have happened if the Committee had adopted a 'substitution' strategy rather than an 'equalisation' strategy. What can be said, however, is that the Committee's attempts to adopt an equalisation strategy did not have the desired effect. As early as December 1989, the Committee was discussing the uneven response across Themes, the uneven success rate (especially in HCI-related areas) and ways of responding to this. A decision was taken not to close any Themes but to adopt an equalisation strategy which took two forms[34]

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[31] Minutes of Meeting of the Cognitive Science / HCI Committee held on 15 December 1988

[32] Minutes of Meeting of the Cognitive Science / HCI Committee held on 3 May 1989

[33] Joint Council Cognitive Science / HCI Initiative, Evaluation Briefing Paper, 20 February 1990

[34] Minutes of Meeting of the Cognitive Science / HCI Committee held on 19 December 1989

- **Internal mechanisms affecting the selection process**, specifically a decision to facilitate selectivity via a grouping of proposals into Themes and the provision of average scores for these Themes
- **External mechanisms involving attempts to stimulate proposals in undersubscribed Themes**, e.g. restricted competitions, fellowships in particular areas, research workshops to encourage bids etc.

In February of 1990 another internal mechanism designed to ensure a balanced portfolio was mentioned, namely the selective awarding of grants after proposals had been ranked on merit,[35] though this method did not subsequently find favour with a Working Group convened to discuss the fostering of HCI research.[36] It was accepted, however, that the Committee could apply a selective weight at the scoring stage, and at the October meeting that year an attempt was made to weight proposals in different Theme areas, specifically by awarding a negative weight to proposals in Theme 4.1, Models of Cognition and Learning. This was not repeated subsequently, however.

The Working Group discussed a number of other mechanisms to increase the volume and quality of HCI-relevant work. These included

- Selective calls for proposals (considered to be problematic in that selective calls sometimes lead to inappropriate proposals tailored to fit the selected Theme)
- Earmarking a specific budget for each Theme (rejected as the number of proposals considered under each Theme at each meeting were extremely small)
- Invitations to identified teams (specific invitations were rejected because of the fear of raising false hopes, but identification and targeting via visits designed to stimulate interest were recommended)
- The drawing up of model applications (rejected because of the variety of topics spanned by the Initiative)
- Intensive feedback (recommended at the outline stage)

In the event, in pursuit of its equalisation strategy, the Committee did come to rely more on external mechanisms, involving proactive interactions with the research community, than on internal mechanisms involving modifications of selection procedures and criteria. We discuss some of these external mechanisms in a later **Section** when we review the role of the Initiative Coordinator. Here we simply note that despite the best intentions of the Committee and the efforts of all associated with it, the goal of balanced development was not attained. We shall also suggest in a later **Section** that a focus on internal mechanisms affecting the selection process might have been more rewarding.

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[35] Minutes of Meeting of the Cognitive Science / HCI Committee held on 27 February 1990

[36] Fostering Human-Computer Interaction Research, Report of a Working Group, December 1990

## 5.3 Impact

Attainment of the operational aims of the JCI was considered in the last **Section**. At a higher level, the Initiative set its sights on catalysing and nurturing a research community in an area of strategic need. It is vital, therefore to consider some of the outputs, outcomes and impacts of the research which was conducted. We know that the project mix was out of alignment with original expectations, but that the Initiative nevertheless produced work of a high quality. We need also to understand whether project outputs and outcomes were in line with expectations and what impact the Initiative had on individual researchers, on the institutions in which they work, on the research community generally and, further downstream, on industry and other potential application areas.

### 5.3.1 Outputs and Outcomes

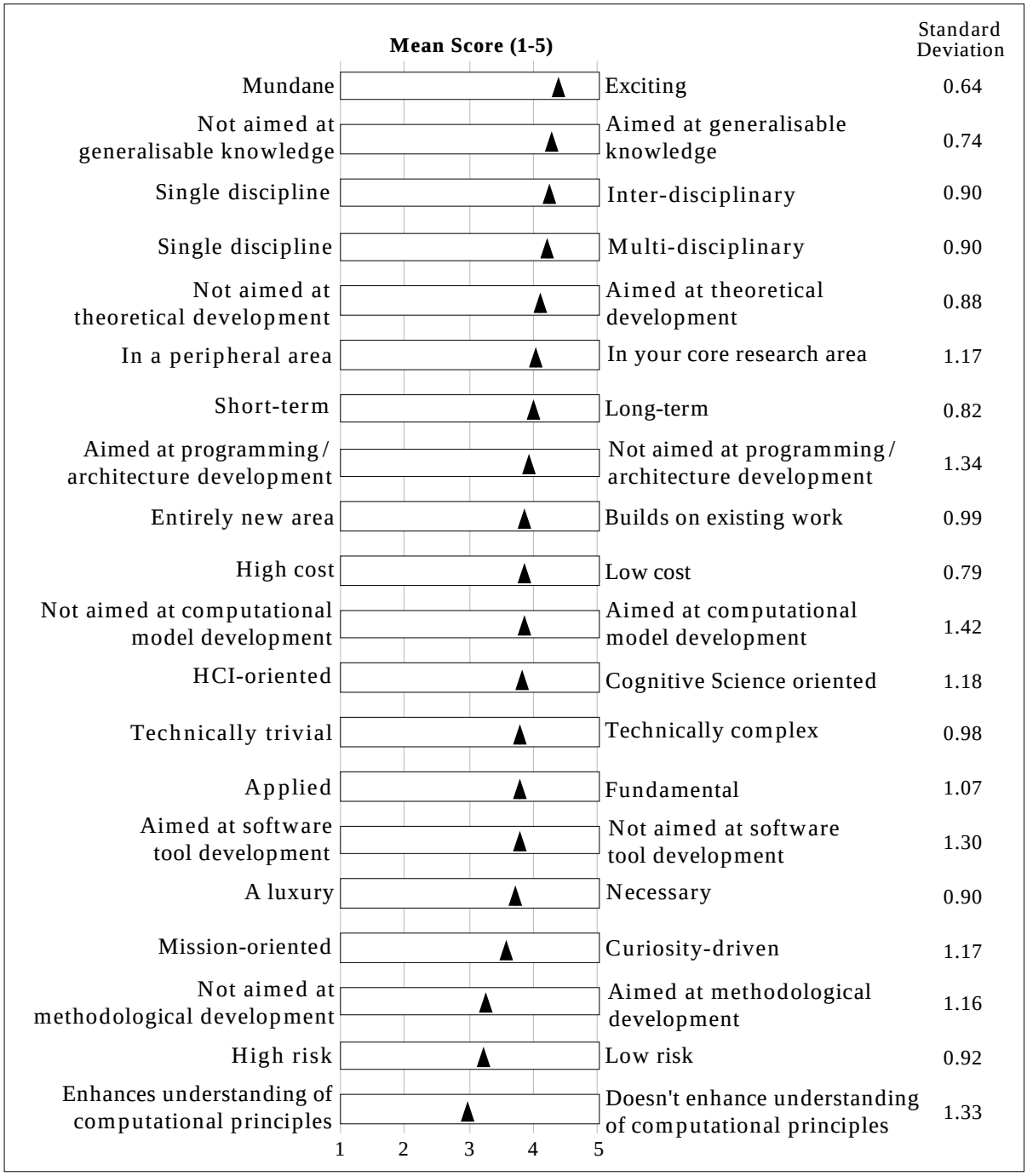
- Outputs and Outcomes
  - Satisfactory completion rate and publication performance
  - Real achievements in many instances, but less than anticipated across the Initiative in both Cognitive Science and HCI
  - Progress affected by over-ambitious goals and recruitment difficulties in an inter-disciplinary area

The type of output expected of an Initiative such as JCI can be judged from the nature of the work conducted. **Exhibit 39** is based on responses to the questionnaire completed by Grantholders (see Question C4, **Appendix 4**). It attempts to characterise the nature of the work conducted in the Initiative via the use of semantic differentials.

Apart from indicating that the work was inter- and multi-disciplinary, long-term and exciting (all in keeping with the nature and aims of the Initiative), it reveals that

- Most of the work was aimed at theoretical development (particularly CS projects) and generalisable knowledge
- Much of it was aimed at computational model development (especially CS projects)
- Little of the work was primarily HCI-oriented
- Little of the work was aimed at either programming/architecture development or software tool development
- There was an even mix of projects which did or did not aim at methodological development
- There was an even mix of projects which did or did not aim at an enhanced understanding of computational principles

**Exhibit 39 The Nature of JCI Research**




Apart from the type of output and outcome usually associated with academic research, e.g. enhanced understanding, improved knowledge and publication in academic journals, expected outputs and outcomes based on the actual composition of the programme were thus theoretical advances and computational models.

Participants themselves discussed their outputs in terms of the categories shown in **Exhibit 40**, which is based upon an analysis of participants' interview responses. As expected, publications figure highly (see **Appendix 6**), but 'theoretical advance' was less widespread than might have been expected from the nature of the work being undertaken.

**Exhibit 40 Participant's Classification of Project Outputs**

| Type of Output | Number | Percentage |
|---|---|---|
| Publications | 16 | 52% |
| Computer applications | 12 | 39% |
| Models / simulations | 9 | 29% |
| Theoretical advance | 7 | 23% |
| Methodological advance | 5 | 16% |
| Applied advance | 4 | 13% |
| Other | 3 | 10% |

Based on their inspection of Final Project Reports,[37] the Rapporteurs considered that the majority of projects had been completed in a satisfactory manner and had produced a broad array of project outputs and deliverables. Classification of the main scientific achievements of projects listed by Rapporteurs revealed that

- Over half the projects led to greater understanding / increased knowledge of the area
- The main achievement for over a third of the projects was the development of a novel or improved computational model
- One quarter of the projects led to significant methodological developments

while other main scientific achievements listed were

- Theoretical developments (19%)
- Production of software (18%)
- Programming / architecture developments (14%)

Again we note that achievements in terms of theoretical development were not extensive (19% compared with the 75% of Grantholders claiming that their projects were thus oriented). Similarly, the development of novel computational models was only considered an achievement in a third of projects. This is despite 71% of Grantholders claiming that their projects were primarily aimed at computational model development. We also note from the report of the Peer Review Panel that the lack of tangible results had been disappointing from an HCI design perspective. The Panel suggested that workers in HCI had used a model of research more appropriate to CS (at the basic science end of the spectrum), and had not focused on more applied aspects of the work.

[37] By the end of April 1996, 77 out of 80 Final Project Reports had been submitted to the JCI and reviewed by 194 Rapporteurs, each report being reviewed by between one and four Rapporteurs.

Grantholders themselves, however, were satisfied that project targets had largely been met (see **Exhibit 41**). When they were asked to say whether the stated project goals and objectives had been achieved, surpassed or underachieved

- Four percent considered that most goals had been surpassed
- Eighty-six percent considered that most goals had been met, with more than half this group thinking that some had been surpassed
- Only six percent thought that few goals or objectives had been met, and none of the Grantholders reported a significant underachievement of all goals

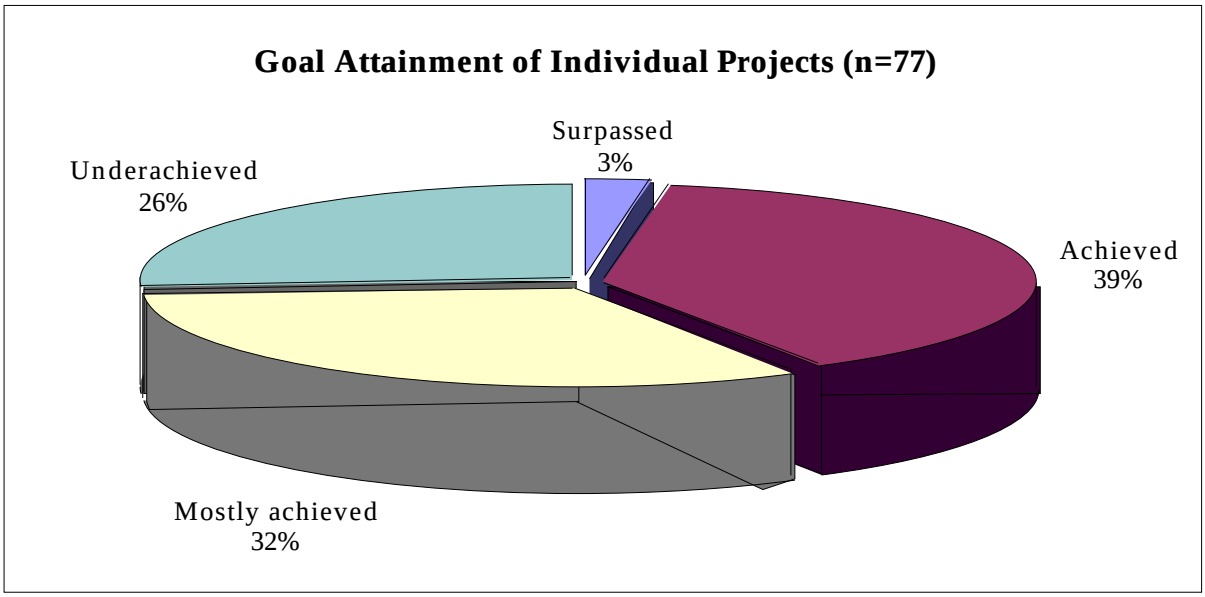
**Exhibit 41 Grantholder's Assessment of Goal Attainment**

| Rating | Goal Attainment | Number | Percentage |
|---|---|---|---|
| 1 | Significant underachievement of all goals | - | - |
| 2 | Few goals or objectives met | 3 | 6% |
| 3 | Most goals met | 20 | 41% |
| 4 | Most goals met and some surpassed | 22 | 45% |
| 5 | Most goals surpassed | 4 | 8% |
| 6 | Unable to make a judgment | - | - |

The Rapporteurs agreed with Grantholders that the majority of projects had met their stated objectives, but disagreed over the size of the cohort which had failed to live up to expectations. **Exhibit 42** shows that,

- Three percent of projects had surpassed their stated goals and objectives
- Seventy-one percent had achieved all or most of their stated aims
- Twenty-six percent of projects had underachieved

**Exhibit 42 Rapporteurs' Assessment of Goal Attainment**



This assessment is closer to Grantholders' own assessments of project performance as opposed to goal attainment (see **Exhibit 43**). When asked to score their projects in terms of the soundness of research agendas, the adequacy and deployment of resources and overall project organisation and management, a quarter considered their performance to be adequate rather than good or exemplary (though none considered their performance to have been weak).

**Exhibit 43 Grantholder's Assessment of Project Performance**

| Rating | Goal Attainment | Number | Percentage |
|---|---|---|---|
| 1 | Very poor performance | 0 | - |
| 2 | Weak performance | 0 | - |
| 3 | Adequate performance | 12 | 25% |
| 4 | Good performance | 32 | 67% |
| 5 | Exemplary performance | 4 | 8% |
| 6 | Unable to make a judgment | 0 | - |

In discussing their projects and their work, researchers were keen to point out some of the factors affecting both project performance and goal attainment. Some of the barriers to progress were those which apply to all research projects: under-staffing; limited funding; difficulties recruiting the right personnel; lack of employment continuity; personality clashes etc. However, some were specific to inter-disciplinary research. Not surprisingly, recruitment difficulties were exacerbated by the requirement for individuals to adopt inter-disciplinary perspectives, and by the uncertainty surrounding the future of funding in this fledgling area. The very act of collaboration was another factor which sometimes complicated project progress, but in others it was the spur to success.

Six researchers interviewed towards the end of the evaluation (19.4% of the sample) stated that their projects had achieved all their goals. Some regarded this as a great success, and were very satisfied with their achievements. Others were less satisfied. One, for example, felt that the original goals were too simplistic, and that the real issues of interest had turned out to be far more intractable. Another said that the project had achieved everything it had set out to achieve, but that the system developed still had limited capabilities.

In interviews, over half the researchers (58.1% of the sample) argued that goal attainment had been real but limited. Issues tackled in projects were often more complicated than initially envisaged. In one project there was still room for the software developed to be improved. In another, results could not be applied in as many contexts as originally envisaged. Elsewhere researchers found it much harder to link computing and psychology than anticipated, and lack of appreciation of the complexity of a problem made it hard to model with real data in another. Workers in one project found it difficult to train a neural network, which blocked progress in other areas. Another researcher admitted that there had been an overstatement of the goals in the original proposal, which resulted in the cognitive psychology element of the project being realised, but not the AI

component. Both Grantholders and Rapporteurs remarked on a number of occasions that the stated aims were overly ambitious. Underachievement, therefore, does not necessarily indicate poor performance, though it was sometimes due to poor project design.

Two Grantholders, admitting that they had not succeeded in achieving any of their project goals, explained that they had anticipated four years of funding but had only received funding for two. Another researcher changed tack completely after making slow progress towards the original aims. Instead she completed what can only be called a piece of straight psychology research. The results were good, but they were not relevant to JCI. Other Grantholders attributed lack of original goal attainment to external scientific developments - projects were sometimes overtaken by events - and for some researchers the attainment of original aims did not seem to be an important issue. One, for example, could not remember what the original aims of his project had been, but was satisfied with achievements. For him, outcomes were more interesting than relevance to original aims.

**Outputs and Outcomes Summarised**

Although most projects were completed to the satisfaction of external rapporteurs, an appreciable number under-performed in terms of goal attainment. Advances in theoretical development and progress in the development of computational models were less widespread even in the Cognitive Science community than might have been expected, and the Peer Review Panel expressed concern over the lack of outputs in some HCI-oriented projects. Progress was affected by a number of factors, the most salient of which were over-ambitious goals and difficulties recruiting the right type of personnel to tackle inter-disciplinary research topics.

### 5.3.2 Impact on Individuals

- Impact on individual careers has been limited, especially in projects attempting to apply the principles of Cognitive Science to HCI
  - For a small group, JCI catalysed a shift into new fields
  - JCI brought a third of participants into contact with workers in areas new to them
  - For a large group of researchers already involved in inter-disciplinary work, JCI provided a means to continue with this work
  - For many, JCI simply provided access to funds in their traditional areas of concern
  - Impact was greatest in terms of on-the-job training at research assistant level

The JCI was an attempt to modify the pattern of research in Cognitive Science and Human-Computer Interaction. It was thus expected to have some effect on the careers of researchers, on their contacts within the research community, and on their professional behaviour patterns. The evaluation effort explored impacts on individuals via interviews and questionnaires.

**Careers**

A major aim of the JCI Programme was to encourage individual researchers to approach their research in a different way, and to take on board the ideas and issues of other disciplines. It is valid, therefore, to examine the impact on the careers of the individuals who participated in the Initiative, and to see if their work took off in different directions as a result of being involved.

For some researchers, the Initiative provided an opportunity to explore a field of growing importance. The Initiative acted as a catalyst. One psychologist had been interested in connectionist models before the Initiative, and involvement in the programme strengthened his knowledge and expertise. It also initiated him into the use of computational modelling. Another project allowed a researcher to move into IT. In another, a cognitive psychologist and an AI specialist had been discussing working together, and the Initiative provided the catalyst to do so. This then became the main work of the psychologist for that period. The Initiative also provided an opportunity for two people to start working together on the application of computational models to neuro-psychological problems.

Although these developments are promising in terms of the goals of JCI, it must be noted that there were only four projects in this category (12.9% of the sample). In this sense the JCI had a limited impact in terms of persuading researchers to change the direction of their line of work.

Grantholders in two projects did not change the direction of their work, but JCI did allow them to pursue aspects of what they were already doing. In another piece of research, the JCI allowed more speculative and potentially more exciting work to be carried out.

Some researchers left the Initiative disillusioned with inter-disciplinary work. One psychologist returned to straight psychology, and does not want to work in computing, or in the field of Cognitive Science, again. He did, however, gain technically - he learnt to programme in several languages. Another researcher embraced the idea of bringing together Cognitive Science and HCI under the Initiative but subsequently found that his career has suffered, damaging his reputation as a psychologist. In this instance JCI did have a marked impact, albeit a negative one.

About one third of Grantholders interviewed stated that they had not changed research directions, primarily because they felt themselves to be in an inter-disciplinary area anyway - they had already made the leap. One welcomed the

Initiative because it gave her the opportunity to pursue the inter-disciplinary field of computational linguistics. However, she subsequently had to go abroad, due to lack of research funding in the UK. One psychologist made the leap into Computer Science and developed an interest in HCI via a prior SERC grant. JCI allowed a further move into sociology. For one researcher, the Initiative allowed the continuation of work begun in his PhD thesis, and for another the JCI project built on post-doctoral research. One researcher felt fortunate that funding had allowed him to carry on in the area, but he had not been able to get follow-up funding post-Initiative. A computer scientist said that the Initiative had further extended his move towards becoming a part-time psychologist.

Several researchers said that projects, and involvement in the Initiative, had had very little effect on the overall direction of either their research or their careers. Funding had allowed researchers both to pursue existing career tracks and to explore new research directions, but for many these constituted natural progressions along well-established research trajectories and could not be considered as radical shifts in direction. One psychologist working in Cognitive Science freely admitted that his project should probably not have been funded by the Initiative, as it had nothing to do with its aims. However, although his project was pure Cognitive Science, and could have been funded from elsewhere, the Initiative's insistence on inter-disciplinarity did persuade him to collaborate with someone with whom he would not have previously worked.

Two researchers said that the JCI had made it easier for them to work with computational principles, but one admitted that Psychology itself had moved in this direction anyway. This is an important point which makes the additionality of JCI difficult to determine.

Another researcher said that, although the Initiative had not had a major effect on his research, it had affected the way he thought about and approached issues. These more intangible aspects of impact on individuals are hard to assess. The psychologist was subsequently determined to stay in his own field, but with his newly acquired computational skills he was prepared to contemplate, at some point in the future, taking his research in a slightly different direction. It is very difficult to predict how exposure to other disciplines will bear fruit over a period of time. This point was also an issue for the JCI Training Programme. Students entering into work situations which make make no call on skills acquired during Master's programmes may nevertheless approach work in a different way, or utilise these skills at a later date

In some projects, impacts on research assistants (RAs) engaged in the work were most critical, although experiences were mixed

- One RA was put on an academic track, given a good training, and was subsequently approached by a company
- In another project, one RA worked along the same lines as the project itself, another financed his PhD in the same field, and a research student produced papers from the project and was keen to work in the same field

- The RA in question took over another project, gained a great deal from it and became a university lecturer
- One RA left for Canada when he could not get funding for the work he wanted to do in the UK.
- Another RA in the same project went to Spain after having made the move from Computer to Cognitive Science
- Yet another found employment in industry because he did not want to stay in the area, yet JCI had still influenced his thinking
- One young Grantholder was waiting to get a grant proposal funded. The RA on the grant wanted to continue but could not get funding
- A group of researchers from one project could not find a person with the right mix of skills - speech and computation. The RA eventually appointed acquired the skills needed, but subsequently could not find a post at a higher level than RA
- The RA from one project would probably have become a straight psychologist had it not been for the JCI grant
- Two RAs in another project found that their JCI experience helped them to gain university appointments

Of the four projects in which JCI catalysed the exploration of new areas, three can be described as Cognitive Science (CS) projects and one as HCI, i.e. none could be classified as projects aiming to combine the two areas (CS/HCI projects). This is not very encouraging, given Broadbent's original goal of bringing together people from both communities to address a perceived failure of communication. Projects combining Cognitive Science and HCI mainly allowed inter-disciplinary work to continue, or provided a means to pursue a career. It may well have been commendable to support this type of work, but it did not help fulfil the Initiative's aims. It is also telling that the researcher with the most negative experience of JCI was involved in a project which did attempt to use Cognitive Science to resolve problems in HCI. He felt, however, that this had damaged his career, that his credibility as a psychologist had suffered, and that there was little on-going support for anyone attempting to sustain a career in this sphere.

**Contacts**

Approximately one third of researchers had made contacts in new areas as a result of their involvement in the JCI. Most new contacts were formed as a result of participating in a project, rather than through other JCI programme activities (annual conferences etc.), and many of these contacts were with people associated with the application of the project, rather than with its theoretical development. One non-project-based contact involved a Grantholder who used the JCI list of contacts to approach people with expertise in areas in which he required guidance.

The consequences of making contact with people in other fields is difficult to assess. Although most of those making such contacts did not report a radical change in their career or research interests as a result of being involved with JCI, other more intangible or long term effects could still occur.

A few researchers said that they had made further contacts in areas in which they were already involved. It could well be that others did the same, but this type of contact is difficult to attribute to a single grant since researchers move in these circles even in the absence of initiatives such as JCI.

Three respondents said they had not made new contacts through the Initiative, but that they had been provided with an opportunity to work with people they already knew and to become better acquainted with the disciplines they represented.

The remaining third of respondents reported that they had not made any new contacts.

**Behaviour**

The majority of researchers (about two thirds) reported that involvement in JCI had not instigated any change in their behaviour in relation to publishing, attending conferences or applying for grants. The remaining third of respondents did report a change in behaviour, though two said they had reverted back to their original patterns due to disillusionment with the inter-disciplinary field with which they had become involved.

**Overall Impact on Individuals**

JCI appears to have had limited success in radically altering the careers and behaviour patterns of the individuals it supported. It provided the means for a certain number to stay in the inter-disciplinary areas into which they had already moved. More indirectly, it allowed some individuals to make new contacts and provided an introduction to new principles, but it is difficult to assess the long-term significance of these effects.

### 5.3.3 Impact on Institutions

- Most impact on departments holding several JCI grants
- Work in institutions holding single JCI grants was not redirected or challenged
- JCI played a critical role in establishing CSCW in some institutions
- Involvement in running Masters Courses had a greater impact on institutions than collaborating in projects

The JCI affected not only isolated individuals but also groups of research workers and the departments and institutions in which they were located. The questionnaire distributed to Grantholders asked respondents to comment on whether or not a particular project had led to a strengthening of the overall research capability of the teams involved in the project. This is a concern for the

institutions hosting the projects, as such research capability obviously has implications for the work of departments in more general terms.

From **Exhibit 44** it can be seen that

- 74% of respondents considered that there had been a very good or exemplary improvement in terms of scientific and technological capability
- Only one respondent gave a score of less than 3, indicating weak or no strengthening of capability

**Exhibit 44 Impact on Research Teams**

| Rating | Project Outcomes | Number | Percentage |
|---|---|---|---|
| 1 | Little or no strengthening likely | 1 | 2% |
| 2 | Weak improvement of scientific and technological capability | - | - |
| 3 | Modest improvement of scientific and technological capability | 11 | 23% |
| 4 | Very good improvement of scientific and technological capability | 28 | 58% |
| 5 | Exemplary improvement of scientific and technological capability | 8 | 17% |
| 6 | Unable to make a judgment | - | - |

During interviews, roughly two thirds of the projects were said to have had some significance for the department or institution in which they were carried out. Two researchers cited their project as an important factor in gaining more research funding from elsewhere. One project was significant for the University in that it was used to justify the setting up of a School of Informatics. A JCI project also played a significant part in the establishment of an ESRC Research Centre concerned with training, learning and education.

Large projects were sometimes significant for a department simply from a prestige point of view. In other departments, JCI projects did not have the same visibility because they constituted part of a broader portfolio of projects funded from a variety of sources. Perhaps unsurprisingly, the departments or institutions for which JCI had the most significance were those with several grants from the Initiative. This was very apparent in two cases. It may be that, when trying to foster a different kind of community, the issue of critical mass takes on a greater importance.

One researcher said that the JCI projects in his department provided an environment in which inter-disciplinary research could flourish. Another reported that the JCI project was very important from a collaborative point of view as it was the first grant to be held between the two departments involved. One project had been useful in setting up a collaboration with a group in the States. In another case, the grant allowed a prior collaboration to continue and develop. For four researchers, the Initiative had proved a valuable opportunity to bring good post-doctoral researchers into their departments / institutions.

Developments in a broader context can sometimes mask the influence of JCI projects on institutions. One researcher, who had increased his own computational skills throughout the JCI period, noted that his department (Phonetics & Linguistics) had also become more computational, but that this was the way the field in general had developed irrespective of JCI.

Other developments within departments themselves also influence events and make it difficult to ascertain the impact of JCI grants on departments. For example, one researcher said that a particular project had been important for a Computer Science Department, but reported that its effect was hard to distinguish from the impact of running a joint Cognitive Science course (non-JCI funded) with Psychology and sharing responsibility for some postgraduates between departments. At one of the institutions with a JCI-funded Master's course, a Grantholder thought that the course had had much more of an impact than the project. In another institution, links between Psychology and Sociology had increased, but this was probably due more to the JCI Training Fellow hosted between the two departments than to the project. A Training Fellow was important in bringing research teams together at another institution, and in another JCI studentships helped link research groups.

Projects also had an impact on training. One project had a noticeable effect at the doctoral level in its host institution, and in another institution impacts could be observed at both doctoral and post-doctoral levels. Although the impact of one project had been limited in terms of the dissemination of its results to a wider community (due primarily to the main researcher leaving the field), the work had formed part of a taught Master's course.

About a third of researchers did not think their projects had had much impact on their departments or on the broader institutional settings in which they were located. In one project, the researchers said they had gained individually but that their departments had not. Another department had turned away from HCI during the course of the project, so the project's impact was likely to be minimal. One project had little impact simply because the outputs from the project were themselves were limited, and in other cases it was too early to predict eventual impacts.

Some researchers had moved institutions, and in two cases their projects were of greater significance in their new settings. Two researchers felt obliged to leave because the HCI orientation of their work did not fit in with the work of their original departments, which is rather discouraging from the point of view of JCI goals.

Three projects in the Cognitive Science / HCI area were concerned with Computer Supported Co-operative Working (CSCW). JCI gave a significant boost to the establishment of work of this nature in the departments involved. It is a relatively new field and, although some researchers thought that it could have been better supported by JCI, the Initiative does seem to have played a critical role at a formative stage in the field's development.

**Overall Impact on Institutions**

Although the majority of projects were of some significance to the departments in which they were carried out, the extent of their influence was not marked. Only in a few instances did JCI appear significantly to redirect or even challenge the direction of a department's work.

### 5.3.4 Impact on the Research Community

- JCI funded good work across a wide range of areas
- Greatest impact on the Cognitive Science community, with some areas (e.g. connectionism) strengthened considerably
- Limited impact on the HCI community
- Limited success in terms of creating a new community of researchers applying Cognitive Science principles to HCI
- Possible negative impact in terms of rivalry for funding between the Cognitive Science and HCI communities

Through the work of the individuals involved, the JCI was expected to have its greatest impacts on theoretical developments in some of the many disciplines and sub-disciplines associated with Cognitive Science, on applications-oriented developments in HCI, on the corpus of knowledge at the nexus of Cognitive Science and HCI, and on the progress and direction of the research undertaken by the community of researchers operating at this juncture.

**Impact of Individual JCI Projects**

JCI Grantholders were very positive about their own achievements in terms of the scientific impacts of their projects. **Exhibit 45** has 61% of them claiming high or impressive achievements, and **Exhibit 46** shows the areas to which they claim to have made major and minor contributions. Most contributions of any kind (major and minor) were made in the field of memory, and twenty percent of respondents felt they had made important contributions to speech and language, followed by 17% claiming major contributions to cognitive activity in social, informational and physical systems. Least impacted areas were spatial behaviour, movement and action; the auditory system; and other sensory systems

Rapporteurs commenting on final reports also indicated the scientific fields to which projects had made a contribution. **Exhibit 47** shows the percentage of projects rated by at least one rapporteur as having made a minor or major contribution to a specific scientific field. In terms of the ranking of areas, the degree of congruence with Grantholders is noteworthy, though if anything the Rapporteurs are even more generous in their appraisal of the percentage of projects which had made major and minor contributions across the whole range of scientific fields.

## Exhibit 45 Grantholders' Assessments of Scientific Impact

| Score | Scientific Impact | Number | Percentage |
|---|---|---|---|
| 1 | Very low achievements and little value for money | - | - |
| 2 | Limited achievements. Not of great interest to peers | - | - |
| 3 | Modest achievements in terms of contribution to its own academic field or application area | 19 | 40% |
| 4 | High achievements. Important contribution to its own academic field or intended application area | 18 | 38% |
| 5 | Impressive achievements, with significant international impact in its own and other spheres | 11 | 23% |
| 6 | Unable to make a judgment | - | - |

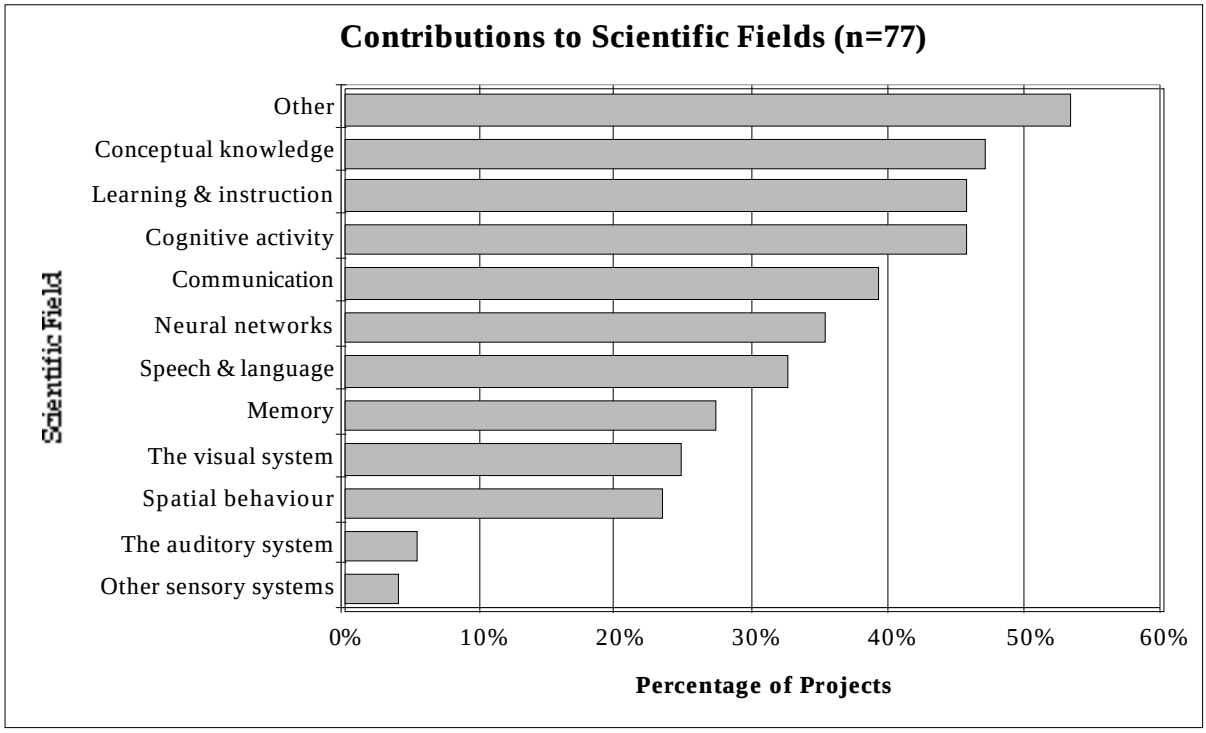
## Exhibit 46 Grantholders' Assessments of Contributions to Scientific Fields

| Scientific Field | Major Contribution | | Minor Contribution | | All Contributions | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | | |
| Memory | 5 | 12% | 9 | 22% | 14 | 34% |
| Speech and language | 8 | 20% | 5 | 12% | 13 | 32% |
| Cognitive activity in social, informational and physical systems | 7 | 17% | 6 | 15% | 13 | 32% |
| Conceptual knowledge | 3 | 7% | 10 | 24% | 13 | 31% |
| Neural networks and Connectionism | 6 | 15% | 6 | 15% | 12 | 30% |
| Learning and instruction | 6 | 15% | 6 | 15% | 12 | 30% |
| Communication | 4 | 10% | 7 | 17% | 11 | 27% |
| Other | 10 | 24% | 1 | 2% | 11 | 26% |
| The visual system | 6 | 15% | 1 | 2% | 7 | 17% |
| Spatial behaviour, movement and action | 2 | 5% | 2 | 5% | 4 | 10% |
| Other sensory systems | 1 | 2% | 1 | 2% | 2 | 4% |
| The auditory system | 1 | 2% | 1 | 2% | 2 | 4% |

'Other'

includes:
Architecture for intelligent agents
Computing science
Developmental disorders of cognition
HCI
Motor system
Non-linguistics / multi-media representation
Psychiatry
Socio-cognitive activities
Theories of insight and discovery
Visual interaction

**Exhibit 47 Rapporteurs' Assessments of Contributions to Scientific Fields**




In inter-disciplinary areas such as those covered by JCI, it is instructive to look not only at the scientific fields to which projects made contributions, but also at the number of fields to which they contributed. **Exhibit 48** shows the percentage of projects rated by at least one rapporteur as making contributions to multiple scientific fields.

- Almost 60% of the projects made a contribution to four or more scientific fields
- Just 3% of projects made a contribution to only one scientific field
- Analysis shows that there is a modest correlation between the number of scientific fields to which projects contributed and the overall project scores awarded by the Rapporteurs ($r_{obt} = 0.24$, $r_{crit} = 0.22$)

The fact that the majority of projects made a contribution to several scientific fields is encouraging for an inter-disciplinary Initiative such as the JCI. Achievements appear more modest, however, if we look at the percentage of projects rated by at least two Rapporteurs as making contributions to multiple scientific fields (see **Exhibit 49**). In this analysis

- Less than 20% of projects made a contribution to four or more scientific fields
- Almost a quarter of projects made a contribution to only one scientific field

Nevertheless, even this more modest perspective stills reveals that over 80% of projects made major or minor contributions to two or more scientific fields.

**Exhibit 48 Rapporteurs' Assessments of Number of Contributions to Scientific Fields (I)**

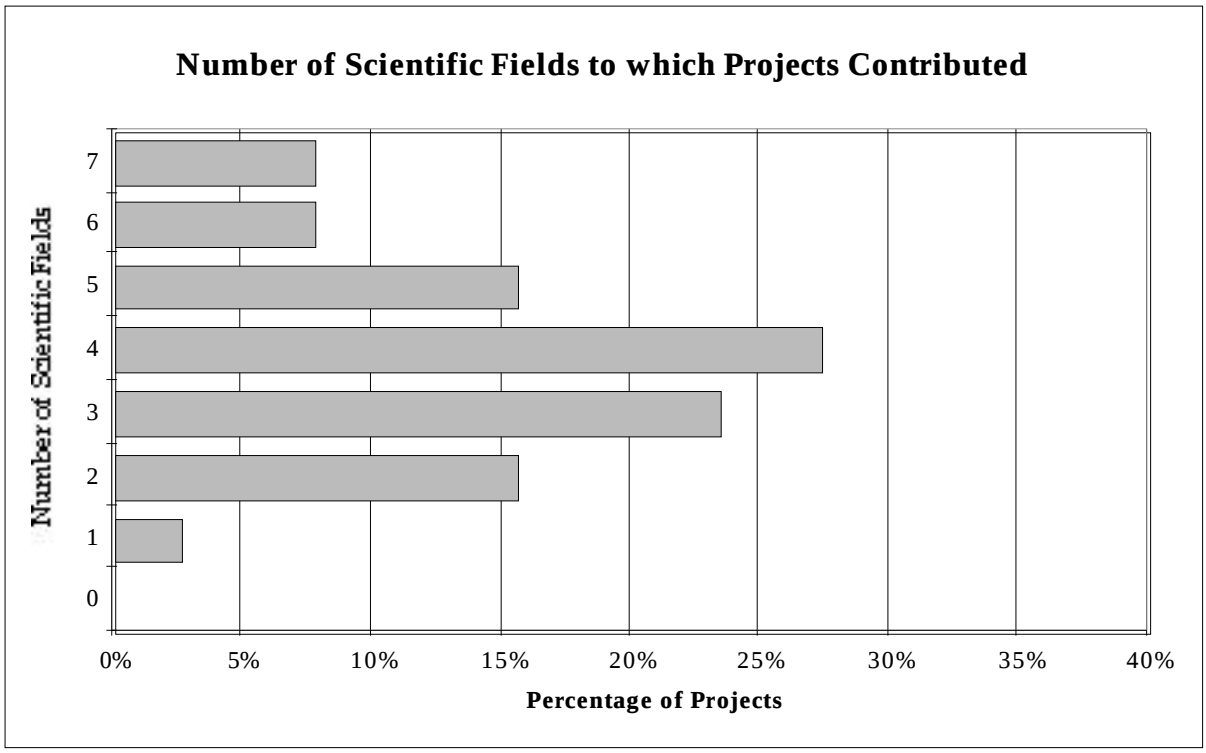
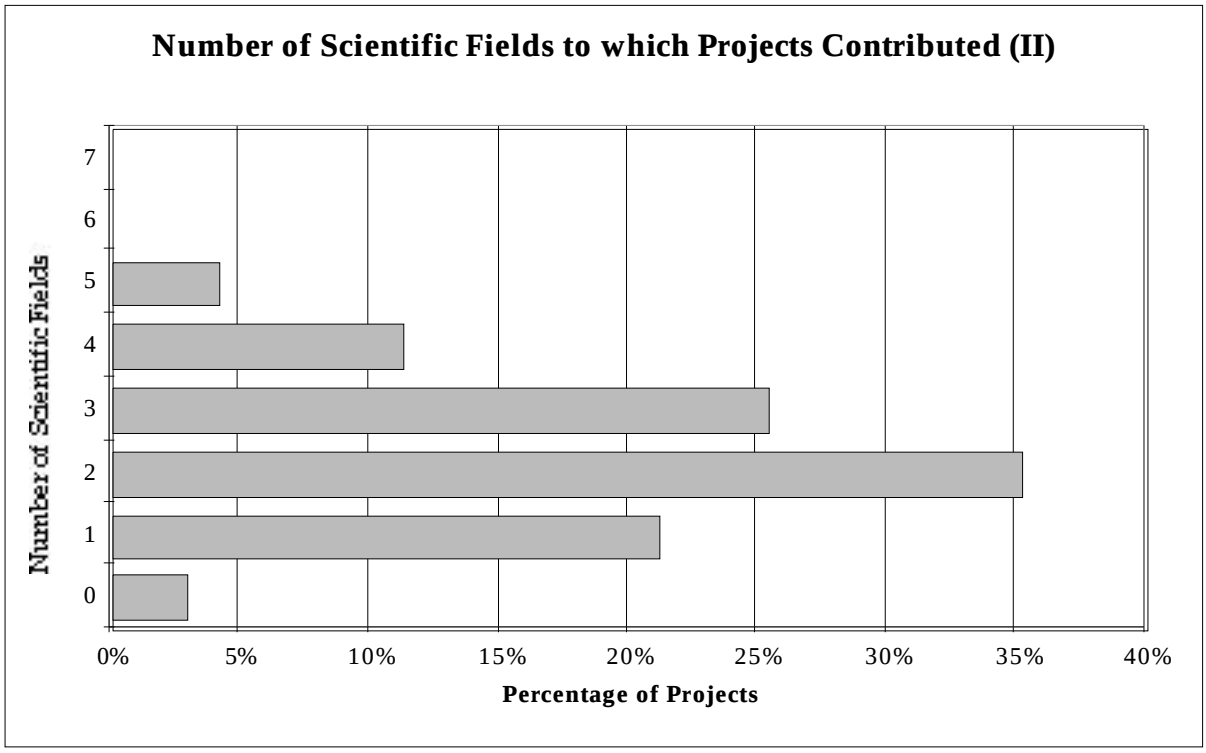



**Exhibit 49 Rapporteurs' Assessments of Number of Contributions to Scientific Fields (II)**



**Impact of the JCI on Research in the UK**

Very few researchers were prepared to, or felt that they were in a position to, comment on JCI as a whole. Of those who did volunteer an opinion, members of the Cognitive Science community were most appreciative of the Initiative, with five researchers in particular expressing very positive views. The most positive comments were that JCI has

- Strengthened computational modelling in the UK and contributed to the strength of basic Cognitive Science work
- Prompted the move towards computation and neuro-physiology
- Given a boost to connectionism in the UK
- Boosted computational modelling
- Increased the UK's general standing in Cognitive Science
- Led to the MRC being more open to computational research

One researcher, whose project involved both Cognitive Science and HCI, said that JCI had supported good work and had made the various communities visible to each other. A positive impact of the Initiative mentioned by one researcher was that it had funded the training of bright young people and brought them together.

Other comments were more neutral or negative. One researcher thought that the programme had funded some good work, but that this work would have been supported anyway. It was a useful source of funding, but was not of any strategic benefit to the areas involved. The JCI, it was claimed, had largely supported Cognitive Science rather than HCI-oriented work, but this area could have been funded via other mechanisms if this had been the primary aim.

Other researchers were concerned about the lack of impact on certain areas, due to limited support throughout the whole programme. One such area was that of social science research, in particular sociology, with three respondents involved in this area all agreeing with this sentiment. Four workers in HCI considered that their area had been underfunded. One team felt a great deal of concern that the crucial link to design was missing - a major goal of the Initiative. There was a general feeling in these fields that Cognitive Science had been funded at the expense of other areas, and that impacts could only thus be expected in Cognitive Science itself.

Even Cognitive Scientists were not entirely happy with the Initiative. One Grantholder thought that the programme had been good for Cognitive Science, strengthening computational modelling in the UK in particular, but that the inclusion of HCI in the programme had caused Cognitive Science to suffer by diverting funds away from the area. Another thought that the HCI research supported was not of sufficiently high quality, and that it was right that the funding should have been awarded to Cognitive Science projects. Yet another stated that there had been too much emphasis on applied work which, in his opinion, always led to second rate research. One researcher thought that the

Initiative should have solely supported Cognitive Science and not HCI, as the latter can, and should, receive money from industry. Another respondent did not comment on other areas, but felt that the impact on the Cognitive Science community had not been appreciable.

Although antithetical to its intentions, the programme may have created a rift between communities. The degree of resentment over certain areas being funded at the expense of others - apparent during the course of interviews with participants over the whole course of the evaluation - is worrying. Rather than acting as a bridge, there are some indications that the Initiative may have widened the Cognitive Science / Human-Computer Interaction divide between, for example, the Sociology and HCI communities involved in JCI on the one hand, and the 'straight' Cognitive Science community on the other.

Several researchers commented that their JCI funding was "just a grant to do a piece of research" i.e. the money could have come from anywhere. This has a bearing on one of the aims of the programme - the hope that the Initiative would foster a community of researchers. One Grantholder commented that the JCI had not persuaded people to go into different fields, and others thought that the wrong model had been used to achieve this end. For example, it was suggested that the money should have been given in small amounts over a longer period of time, to allow people to get to know each other more slowly, rather than forcing them to work together on short term, high profile projects.

One researcher was prepared to state categorically that JCI, while funding some good work, had failed to meet any of its objectives, in particular the nurturing of a joint Cognitive Science and HCI community. Only one respondent said that JCI had made the communities visible to each other. In fact, when asked about attendance at annual JCI conferences, several Grantholders admitted that these meetings had made them more aware of the activities of others, but this does not seem to have had a tangible impact on the communities involved.

Impact on funding patterns was an important issue amongst participants. One approved of the Initiative, but regretted the fact that it had not influenced the subsequent funding behaviour or orientation of any of the Research Councils. Continuation of funding was of concern to several Grantholders (three mentioned it directly). Although the JCI had produced good results, few felt that the long-term impact of the Initiative would be appreciable if funding for the area was not forthcoming in future. Even a Cognitive Scientist who had been most effusive about JCI stressed that it should have been continued, as the field still needed this type of Initiative.

The report of the Peer Review Panel (see **Appendix 1**) describes the work undertaken in the context of the JCI as interesting and important. The Cognitive Science projects examined in the review were considered by the Panel to have made a substantial contribution to the field of Cognitive Science. The Panel was much less impressed with the HCI projects it saw, however. Sources of weakness in these projects included

- Lack of **formative** evaluation and little involvement of real users and real tasks
- Lack of **summative** evaluation data capable of persuading designers of the importance of the work

Both these issues have important implications for the potential impact of this work. Several projects had not been followed up, and general lessons had not been made available to workers in other domains, again limiting potential project impacts.

Ten projects were identified by the Panel as having outcomes relevant to progress in Cognitive Science as a theoretical basis for HCI. They encompassed a fairly wide range of domains in both areas. Interestingly, the more successful of these projects addressed the original JCI aim of application to HCI design. On the whole, however, the Panel was disappointed with several of these projects because they did not take the link to design seriously.

**Overall Impact on the Research Community**

JCI funded good work across a wide range of areas. Impacts were greatest within the Cognitive Science community, with limited impact on the area of HCI. The aim of creating a new community of researchers committed to the application of Cognitive Science to HCI was not realised to any great extent. Indeed, there is some evidence that rivalry for funding between the two communities reinforced the divide between the two camps.

### 5.3.5 Impact on Industry

- Many projects had potential industrial implications, though most of these were considerably downstream
- A small number of projects were of interest to specific firms with existing links to the host institutions
- For most projects, the link to design was missing
- A small number of projects had strong links with health and education application areas

In **Section 3.2** we noted that the second successful bid to the ABRC expected JCI research to be basic or strategic, though industrial interest was welcomed. **Exhibit 9** in **Section 3.4** also lists the Initiative's objectives. Those specifically relevant to industry include the following

- To enhance our understanding of the general computational principles underlying natural and artificial forms of intelligence and their application in the design of systems involving Human-Computer Interaction (the main stated aim of the Initiative)

- To favour industrial and other applied links for the research, but without requiring a private funding contribution (sub-objective)
- To harmonise with European basic research, and to underpin the shorter-range UK Initiatives supported through the DTI and other sources (sub-objective)

In terms of industrial expectations, all projects were expected to have some implications in the long term for industrial development (and for developments in fields such as education, health and medicine), but the time-horizons involved were never expected to be short. It is possible, however, to differentiate between projects aimed at the use of computational principles to advance theoretical development within, for example, Cognitive Science, and those aimed at the use of Cognitive Science to help unravel applications-oriented problems in the design of systems involving HCI. The latter are of more obvious interest to industry, though anticipated time-horizons were still long.

When Grantholders were asked to classify the downstream impact of their work in a postal questionnaire (see **Exhibit 50**)

- The most frequent response (45%) was that their work would be of modest interest to the non-academic world
- One third were prepared to state that the research products were of no or limited interest
- Only 17% stated that their research was of high or exceptional interest

**Exhibit 50 Grantholders' Expectations of Downstream Impact**

| Rating | Downstream Impact | Number | Percentage |
|---|---|---|---|
| 1 | Research products of no interest or utility to any non-academics | 6 | 13% |
| 2 | Products of limited interest to a few non-academics | 9 | 19% |
| 3 | Products of modest interest to a modest number of non-academics | 21 | 45% |
| 4 | Products of high interest to many non-academics | 7 | 15% |
| 5 | Products of exceptional interest to most non-academics | 1 | 2% |
| 6 | Unable to make a judgment | 3 | 6% |

**Exhibit 51** describes the orientation of research carried out in the projects visited during the Exit Interview stage of the evaluation. It shows participants' estimates of the time-scales involved in developing applications in different spheres.

**Exhibit 51 Participants' Expectations of Application Time-scales (I)**

| | Pure Research | Industrial | Medical | Education | Total |
|---|---|---|---|---|---|
| **Present** | - | 10% | 8% | 5% | 23% |
| **Future** | - | 33% | 13% | 3% | 49% |
| **None** | 26% | 3% | - | - | 28% |
| **Total** | 26% | 46% | 21% | 8% | 100% |

Again a third of those interviewed said there were no industrial or other 'real-world' applications for their research. The work was described as basic research, with no foreseeable industrial applications. There were indirect links to industrial research, however, in that some Research Associates employed on projects had gone on to apply the skills and knowledge gained during the course of the research in industrial settings. One young researcher, for example, went on to exploit her knowledge of neural networks in an industrial research project.

The majority of respondents (72%) did foresee applications in industry (43%), medicine (21%) and education (8%), though these lay in the future (49%) rather than the present (23%). The time-scales involved were often also very long, though some were adamant that tools could be developed very quickly given the right circumstance: "it is just a question of industry taking an interest and putting up the money". When participants talked about present day applications, this usually meant either that their projects had already attracted industrial interest or, in their opinion, they merited industrial interest. Projects in which industry had shown an interest were usually situated in departments with strong existing industrial links.

Some participants had actively sought to interest industry in their findings but had failed. Several researchers were convinced that their work had implications for design, but that industry "did not want to know". One researcher could not see any possibility of his work being taken up because "the business is monopolised by Japanese companies who do not welcome foreign research".

One worrying feature is the limited likely impact on industry and elsewhere of HCI-oriented projects - those expected to be of more immediate relevance to industry than some of the 'straight' Cognitive Science projects because of their link to design. **Exhibits 52 and 53** indicate that approximately a third of HCI-oriented projects were classified as pure research with no foreseeable industrial or other applications.

**Exhibit 52 Participants' Expectations of Application Time-scales (II)**

| | Present | Future | None | Total |
|---|---|---|---|---|
| **Cognitive Science** | 12% | 27% | 18% | 58% |
| **HCI** | 3% | 9% | 3% | 15% |
| **Cognitive Science/HCI** | 6% | 9% | 12% | 27% |
| **Total** | 21% | 45% | 33% | 100% |

**Exhibit 53 Participants' Expectations of Application Time-scales (III)**

| | Pure Research | Industrial | Medical | Education | Total |
|---|---|---|---|---|---|
| **Cognitive Science** | 12% | 28% | 18% | 2% | 60% |
| **HCI** | 2% | 8% | 5% | 2% | 18% |
| **Cognitive Science/HCI** | 10% | 10% | - | 2% | 22% |
| **Total** | 25% | 45% | 22% | 8% | 100% |

The Peer Review Panel was asked to comment on downstream impact and to consider whether the research products (publications, patents, software etc.) were of interest or utility to audiences or users outside of the academic research community (e.g. industry, the health services, policy makers etc.).

For Cognitive Science projects in the Initiative, the Panel felt it was "too early to fully assess (JCI's) downstream impact on HCI research in the UK", but they were critical of projects they classified as HCI-only for lack of involvement with users and real-world tasks, and for insufficient consideration of the more general application of project results. The Panel felt that some of the projects attempting to apply Cognitive Science to HCI took design seriously, whereas others in this category were criticised for not doing so. One of the Panel's recommendations was that HCI research should involve collaboration with user organisations and, in some cases, suppliers. This would help ensure that applications are adequately understood.

**Overall Impact on Industry**

Many projects had potential industrial implications, although most of these were considerably downstream. The dearth of HCI-oriented projects with an appreciable link to design was regrettable in the context of the overall aims of the programme.

## 5.4 Efficiency

- The JCI employed a number of mechanisms to help shape developments in the sphere of Cognitive Science and HCI
- Selection procedures were insufficient to produce the required programme composition
- Stimulation activities were much appreciated by the community but also had a weak shaping effect on the composition of the programme
- The division of responsibilities between Councils worked at an operational level, though shared responsibility for overall financial management would have necessitated greater transparency and improved forward planning
- Naive spend management, cautious selection behaviour and grossly deficient financial information and support functions all combined to limit the extent the Initiative was able to shape current and future patterns of research and research support.

Whereas programme effectiveness is concerned with the extent to which programme goals have been achieved, discussions of programme efficiency focus more on how well a programme has been implemented. The concern here is with the procedures put in place to effect goal attainment. Were they adequate? Did they facilitate goal attainment or impede progress? The focus is on means rather than ends.

The JCI was an attempt to 'shape' developments in a particular sphere of academic research. In **Sections 5.2** and **5.3** we saw that operational goal attainment had been mixed and that overall impacts on the research community at large were modest. It is vital therefore to understand why this occurred, and to do this we need to home in on the mechanisms put in place to effect the desired 'shaping' of research and researchers in the areas of Cognitive Science and Human-Computer Interaction. These mechanisms included

- **Selection Procedures** The procedures used to select research projects for funding
- **Stimulation Activities** Attempts to stimulate proposals in certain areas
- **Sharing Responsibilities** Dividing responsibilities between the three Councils involved
- **Spend Management** Management of the budget at the Committee's disposal
- **Support Functions** The provision of support services to the Committee
- **Securing the Future** Attempts to plan ahead for the provision of adequate research support structures after the Initiative

**Selection** issues were dealt with in **Section 5.2.3** in connection with the effectiveness of the JCI in constructing a programme of the desired composition. **Stimulation** activities were noted in **Section 5.2.3** too, and are dealt with again in **Section 5.4.1**, when the role of the Coordinator in particular is discussed. **Section 5.4.2** deals briefly with the implications for implementation efficiency of the tripartite structure of JCI and the **sharing** of responsibilities between Research Councils. **Section 5.4.3** constitutes the core of the discussion concerning efficiency. It deals with **spend** management, the **support** provided to the Committee, and efforts made by the Committee to **secure** the future of funding for the JCI community. These issues are inextricably intertwined in the history of the JCI and are best dealt with via a chronological approach.

### 5.4.1 Stimulation Activities

- Concerted efforts were made to shape the Initiative via annual conferences, summer schools, newsletters, targeted calls etc.
- Many of these were much appreciated by the JCI community, though more needed to be done to encourage linkages and synergy between projects, research areas and research groups
- The Coordinator played a key role in all stimulation activities and constituted the strongest element of programme implementation
- The calibre, enthusiasm and drive of the individual in post helped maintain the credibility of the Initiative and promote its aims
- Despite all these efforts, however, enough projects of the desired type were not stimulated

In **Section 5.2.3** we described how the Committee sought to implement an 'equalisation' strategy to stimulate proposals in undersubscribed themes. This involved a number of so-called 'external' shaping mechanisms[38] such as restricted competitions and research workshops to encourage bids.

The main external shaping and stimulation activities were

- **Feedback and Liaison**
  - Feedback to prospective participants during the selection procedure
  - Feedback to unsuccessful applicants
  - Monitoring and feedback to participants during and after the project
  - Help-desk function and general liaison
- **Broadcasting**
  - Newsletters, annual reports and other publications
- **Events**
  - Conferences, seminars and summer schools
- **Targeting**
  - Targeted calls and visits
- **Intelligence**
  - Gathering intelligence on the JCI itself, on other initiatives, and on general developments in JCI research areas

**Feedback**

In **Appendix 1**, the Peer Review Panel recommends a selection process that provides feedback on initial submissions and asks for revisions to submitted plans. The JCI, it suggests, did not follow this route. This was not the case. Although many proposals were accepted without revision, decisions on many other 'borderline' cases (26) were deferred while applicants were asked either for further information or to restructure applications in line with the Initiative's aims (see **Exhibit 13** in **Section 4.1.4**). Of these 26, 11 were subsequently accepted and 15 rejected.

Feedback on individual projects to unsuccessful applicants had not been the practice of the MRC prior to the Initiative. It was only adopted by the JCI during the course of the programme. Project participants were generally enthusiastic about feedback, and those who had submitted unsuccessful proposals in the early days of the Initiative felt more feedback at that stage would have helped apropos of future submissions.

Monitoring via the provision of annual reports was, not surprisingly, often regarded as a 'necessary evil' by participants, but feedback during and after projects was appreciated. In some instances, suggestions for 'reshaping' were made informally by the Coordinator, and many participants were full of praise for the liaison role she played. In line with another of the Peer Review Panel's recommendations, however, there was more scope for the proactive realignment

[38] As opposed to 'internal' mechanisms involving, for example, modifications to the Committee's own selection procedures.

of projects with overall programme goals. Suggestions for improving the links between Cognitive Science and HCI would have been particularly apposite.

**Broadcasting**

Mechanisms to broadcast information to the research community are an important part of 'shaping'. They are more than just sources of relevant information, or vehicles for calls for proposals. They also help a community to establish and consolidate an identity and a shared set of interests, values and goals. The JCI exploited regular newsletters, annual reports and a number of other publication strategies to foster this sense of community. All were appreciated by participants.

**Events**

Similarly, annual conferences and summer schools helped add substance to the concept of a JCI community, though more could perhaps have been done to encourage interchange and cross-fertilisation between the constituent groups of the community. Sessions often addressed either Cognitive Science or HCI themes, and a number of attendees at the annual conferences commented that they "only attended the sessions in their area". Events such as these form rare opportunities in the context of programmes and Initiatives for participants from different projects to gain an appreciation of how their work fits into the wider scheme of things, and how they relate to other projects and research themes. In the framework of an interdisciplinary programme such as the JCI, with its emphasis on the links between Cognitive Science and HCI, it is critically important to maximise the opportunity provided by annual conferences and the like to identify, build on and exploit linkages and synergies.

**Targeting**

As part of its 'equalisation' strategy, the JCI Committee set out to stimulate proposals in undersubscribed areas via 'weak' rather than 'strong' targeting tactics. In formulating calls for proposals, the tendency was to hint at preferences rather than to specify particular areas to the exclusion of others. A case in point is the call for proposals which had 26 July 1991 as the deadline.[39] A preference was expressed for proposals which could lead to exploitable results. The eleven themes of the Initiative were then described, and applicants were told that

> "Proposals in all themes will be considered, but the Committee will apply selective weighting to undersubscribed themes when selecting outlines for consideration as full proposals."

The call did not go on, however, to describe which areas were undersubscribed. They were described in a separate JCI Newsletter distributed concurrently, but this fact was not indicated in the Call for Proposals document. It was difficult, therefore, for targeted audiences to appreciate that they were actually being

[39] Call for Proposals, Undated, circa Spring 1991

targeted. There was certainly scope for improvement in the JCI's use of targeted calls to stimulate proposals in designated areas of interest.

More effective targeting took place informally via the proactive identification of particular groups and institutions working in designated areas. Informal approaches and visits by the Initiative Coordinator to discuss the opportunities presented by the JCI led in a number of instances to the submission of successful proposals.

**Intelligence**

In order to facilitate its shaping role, the Committee needed to be kept informed of developments both within the JCI community and elsewhere in other parts of the world. It also needed analyses of its own activities. The Coordinator was tasked to perform these functions. All were carried out in exemplary fashion and were of considerable import. In particular, her analyses of the evolving composition of the JCI alerted the Committee to problems of balance and strongly influenced discussions of relevance, fit with aims and targeting strategies. In many ways she performed an 'internal' monitoring and evaluation function to which programme management generally should aspire.[40]

**Role of the Coordinator**

From much of the above it should be obvious that the Coordinator played a critical role in the external shaping and stimulation activities of the JCI. A fuller list of her duties and responsibilities is given in **Section 4.4**. Her performance in each sphere is hard to fault. Overall, the calibre, enthusiasm and drive of the Coordinator helped maintain the credibility of the JCI and promote its aims. The significant contribution made by the Department of Computing, Imperial College, in terms of office space and support services should also be noted. Even more noteworthy is the fact that the Coordinator's post was only part-time, first two days a week and then three, and this raises an important issue. On this occasion the Research Councils obtained incredibly good value for money via the appointment of an exceptional individual, respected widely in the community for both her administrative skills and her scientific capability in the area. This points strongly to the need in future to appoint similarly qualified and motivated individuals, but it also points to the need to review the time commitments involved and upgrade the associated reward structures.

**Stimulation Reviewed**

Although the part played by the Coordinator in terms of shaping and stimulation was laudable, there are still doubts about the overall efficacy of the JCI's stimulation efforts. We saw from **Exhibit 12** in **Section 4.1.4** that the number of outline proposals submitted to the JCI tailed off alarmingly after the first 'official' call for proposals (Round 2 in the nomenclature adopted in **Section 4.1.4**), only to be revived in the penultimate and last rounds. A number of

[40] In so doing she not only helped the external evaluators enormously, she even preempted some of their planned activities.

explanations have been put forward for this pattern. The most plausible suggest that initial interest was high, but that applications dropped off because

- This initial interest was only triggered by the 'honey pot' effect of new money (the vast majority of rejected applicants in Round 2 made no further submissions over the remainder of the Initiative)
- Low acceptance rates (less than 10% in Round 2; under 5% in Round 3) deterred many from making further submissions
- The nature of the first tranche of projects funded (in Rounds 1 and 2) convinced many in the community (particularly those with a strong HCI orientation) that the Initiative was not geared towards their interests
- The JCI was late in appointing a Coordinator to oversee and orchestrate stimulation activities

Subsequently, applications towards the tail end of the Initiative rose because

- Some of the early successful applicants were in a position to apply for new projects
- Rumours surrounding the need to avoid underspend sparked off another 'honey pot' chase
- The stimulation efforts of the JCI, the Coordinator in particular, had revived interest in the Initiative and persuaded some of the disaffected members of the community to make renewed efforts

All of these factors probably had some influence on the fall and rise in applications to the JCI, and proactive stimulation played its part not only in terms of increasing the number of applications, but also in improving the quality of submissions. Nevertheless, as we saw in **Exhibit 29** in **Section 5.2.2,** neither the external stimulation activities nor the Committee's internal attempts to weight or otherwise amend selection procedures had any noticeable impact over the course of the Initiative on the balance between the various Themes of the Initiative. The Committee's 'equalisation' strategy failed. The stimulation activities of the JCI proved to be too little, too late.

### 5.4.2 Joint Council Structure

- The Councils responsible for different aspects of the Initiative (Research, Training and Evaluation) operated independently
- The Joint Council structure had few implications for the efficiency of implementation or the shaping function of the JCI
- Some mechanism allowing all the Councils to oversee financial administration was needed

One Research Council, the MRC, was given overall responsibility for the administration of the Research Programme, and for the Fellowships component of the Training Programme. The EPSRC had responsibility for Studentships, and

the ESRC administered the evaluation. In theory, the division of administrative responsibilities between these three Councils could have had an impact on the 'shaping' role of the JCI. Familiarity with the procedures of one Council could have favoured some candidates over others, and rigid application of inappropriate selection procedures and criteria, designed for certain types of project and not suitable for others, could have affected selection outcomes.

In the event, little evidence could be found to suggest that the division of responsibility had any significant implications for the efficiency of implementation of the Initiative or for its shaping function. As far as participants were concerned, the fact that it was the MRC handling the Research Programme had few implications for them (though one computer scientist did comment that his quote for a new mouse elicited the remark that laboratory animals could normally be acquired for much less). In terms of Committee procedures too, there was an element of flexibility which allowed the Committee to define many of its own procedures. Feedback to participants was an initial exception, but even this situation changed and feedback procedures were adopted later in the Initiative's lifetime.

There was one area, however, which could have benefited from different structural arrangements. As described in the next **Section**, the financial administration of the research component of the Initiative did not proceed smoothly. Although the MRC was responsible for the management and disbursement of the resources of all three Councils, neither the JCI Committee nor the other Councils were provided with sufficient information to keep adequate track of commitments and spend. Shared responsibility for overall financial management and more transparency would have improved forward planning and enabled all concerned to function more effectively.

### 5.4.3 Spend Management, Support Functions and Securing the Future

- Many elements of programme implementation were weak and limited the extent to which the JCI could shape future patterns of research
- Early flat allocation profiles conflicted with the shaping goal of the Initiative and led to early underspend and rescheduling of the Initiative
- Underspend fears were exacerbated by the quality driven parsimony of the Committee and declining numbers of proposals
- The Committee was poorly served in terms of adequate and up-to-date financial information. Erroneous information (due to a failure to take unrecoverable underspend and recent commitments into account) led to an additional call when, in fact, insufficient funds were left to commit
- The inadequate provision of financial information helped weaken the case for a follow-on Initiative or for other Joint Council arrangements
- Episodes such as acceptance letters sent to the authors of rejected proposals did little to enhance the credibility of the Initiative
- A more demanding Committee might have insisted on improvements in the administration and financial management of the Initiative

**Programme Management Concepts and Terminology**

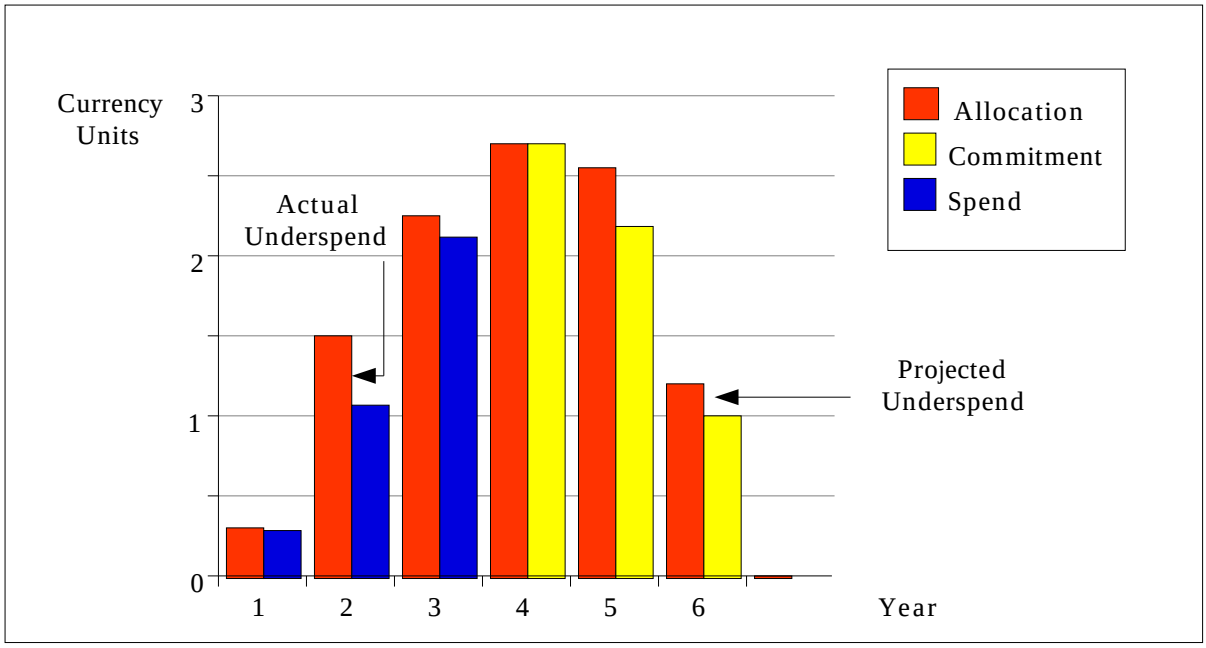
To understand fully the series of events surrounding the financial management of the JCI, and their implications for both the JCI and future support for the Cognitive Science and HCI research community, it is helpful to differentiate clearly between a number of 'programme accounting' terms and practices and to explain the significance of their inter-relationships. These include

- **Allocation Profile** The time profile of money allocated for spending in each year of the Initiative
- **Commitment Profile** The time profile of money committed in practice to be spent each year
- **Spend Profile** The time profile of money actually spent each year
- **Combined Commitment/Spend Profiles** The time profile at any one point in time during an Initiative of spend in the past and commitment in the future
- **Award Profile** The time profile of money awarded in each year for spend in that and subsequent years

Quite simply, the allocation profile simply says how much money is earmarked for each year of the Initiative, and the aim of sound programme management is to **award** money in such a way that the money **committed** and subsequently **spent** in each year matches the original **allocation** for each year.

**Exhibit 54** shows a combined **Commitment/Spend** profile compiled mid-way through an hypothetical Initiative and compares it with an **Allocation** profile.

**Exhibit 54 Hypothetical Allocation and Commitment/Spend Profiles**



Comparison of Allocation and Commitment/Spend profiles during the lifetime of an Initiative allows estimates of **underspend** to be calculated on an annual basis. Normal practice in the management of many research programmes is for annual allocations to be **fixed** and for actual underspend in any one financial year to be **unrecoverable**, i.e. not transferable to a future year for spending. It follows, therefore, that **matching commitment to the original allocation profile is imperative if overall spend is to be maximised**.

To ensure matching, it is also crucial to understand the relationship between **allocation** profiles and **award** profiles. Because research projects tend, for many sound historical and pragmatic reasons, to be of a 'fixed' length of three years, there is always a problem when making awards of 'fitting' these projects into allocation profiles of a longer duration. Specifically, there comes a point in an Initiative when it is no longer possible to fund three year projects because their second and third years fall outside the time-slot for which money has been allocated or earmarked. When there is money left commit, the only alternatives are to finance one or two year projects, to extend existing projects, to forfeit the money as underspend, or to restructure the funding via revised allocation profiles.

**Exhibit 55** shows an Allocation profile for an hypothetical six year Initiative and the type of Award profile which would have to be adopted to fit three year projects into the Allocation profile.[41] It shows clearly that, as one would expect, the last time money can be awarded for three year projects in the context of a six year initiative is at the very beginning of Year Four. **Exhibit 56** shows a six year Initiative into which it is impossible to fit only three year projects. Here the 'tail' of the Initiative comprises three, two and one year projects.

'Taming the tail' is a demanding task for programme management. In an ideal world, it is best approached at the initial planning stage via specification of a desirable award profile and calculation and adoption of the resulting allocation profile. In reality, however, allocation profiles are often decided prior to any consideration of the consequences for award profiles, and award profiles have to be calculated retrospectively. Almost invariably this leads to the need for a mix of extensions and shorter duration projects at the tail end end of initiatives or the forfeiture of budget via underspend unless revised allocation targets are negotiated.

[41] In calculating these profiles, it was assumed that three-year projects spend equal amounts annually; that all awards are made at the beginning of the financial year; and that projects start the day of the award. Project spend patterns which take into account different capital and labour spend patterns can easily be substituted, as can other 'real life' assumptions about the timing of awards and project starts. Normal practice is not to calculate award profiles on an annual basis, but to calculate how much money can be awarded at each award-granting meeting.

**Exhibit 55 Hypothetical Allocation and Award Profiles - Three Year Projects Only**

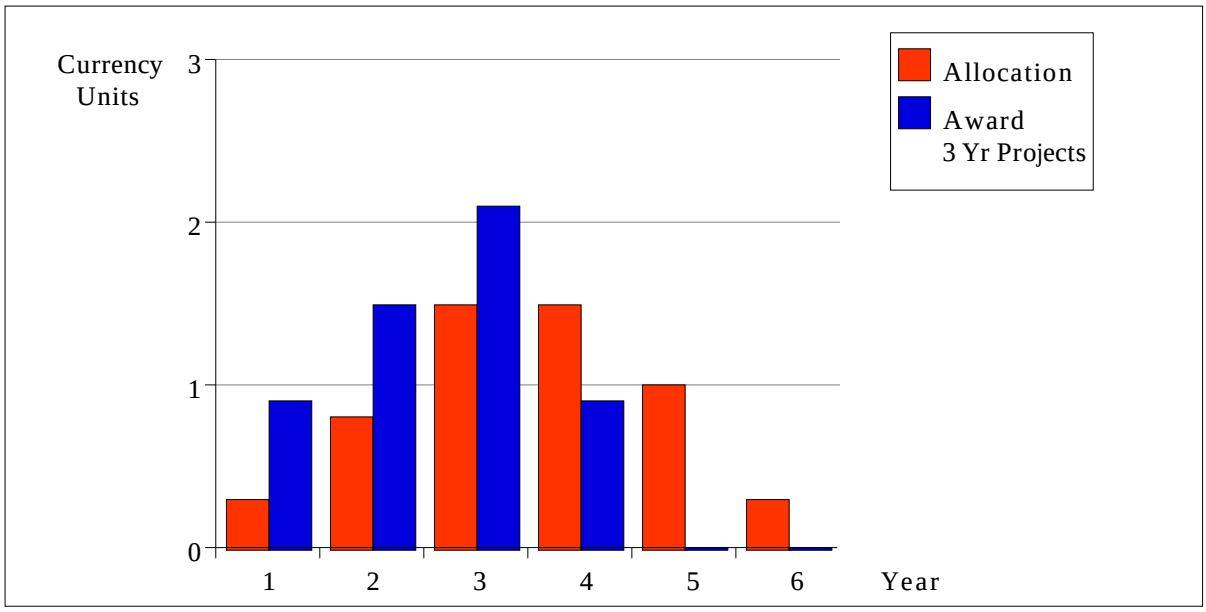
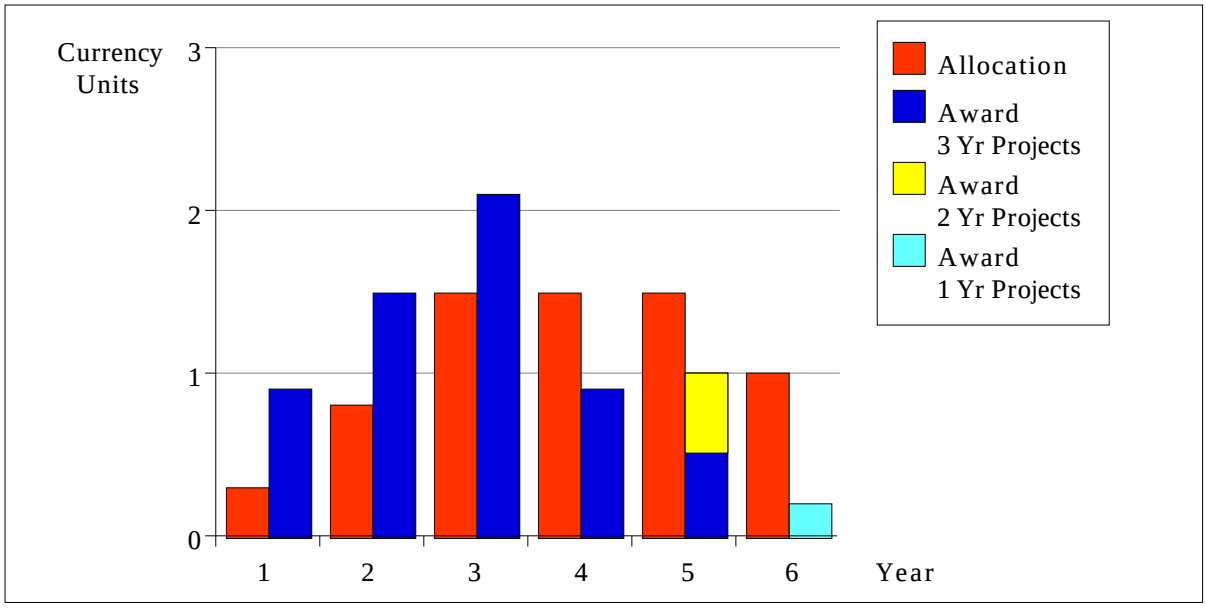



**Exhibit 56 Hypothetical Allocation and Award Profiles - Three Year, Two Year and One Year Projects in Tail**




**Flat Profiles**

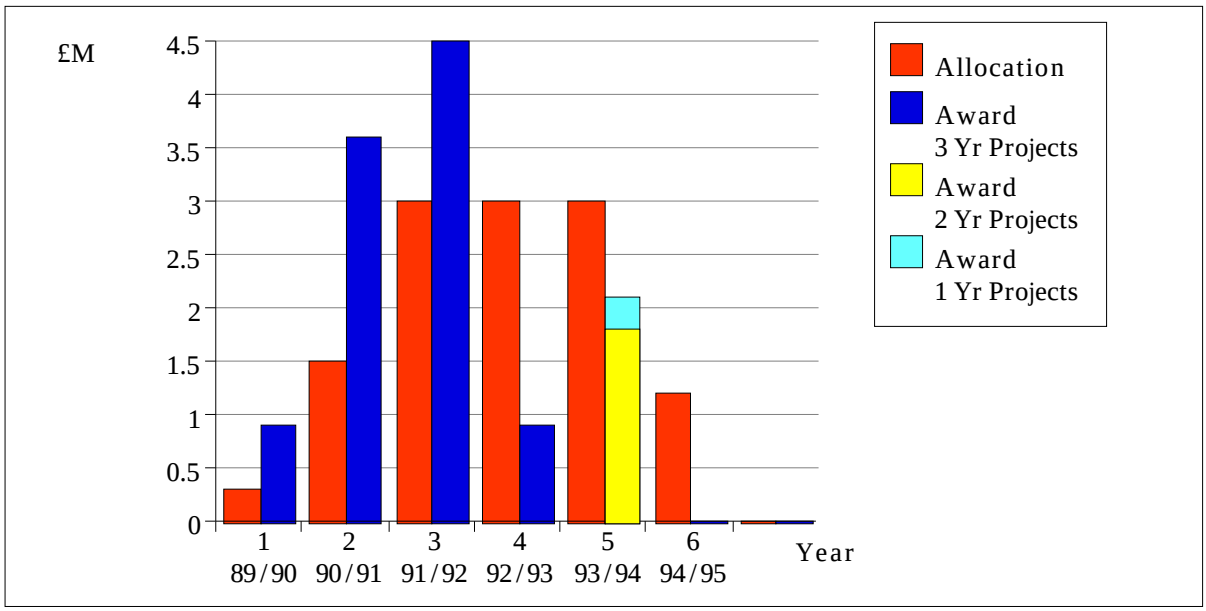
The allocation profile for the JCI was proposed to the ABRC in the second bid in 1988 (see **Section 2.6**, **Exhibit 7**) and confirmed when the Initiative was formally announced by the Secretary of State in February 1989. When it was initially proposed, the intention had been to have a flattened profile for as long as possible in order to maximise the proactive 'shaping' role of the Committee,

with only short ramp-up and ramp-down periods.[42] The Committee, however, presumed initially that this type of allocation profile implied a similar award profile, and that 'shaping' was maximised by **awarding** similar amounts each year over the whole course of the Initiative, as opposed to **spending** similar amounts. The amounts it was necessary to award in the first years of the Initiative in order to match expenditure to the allocation profile were not realised.

In fact, the implications of the allocation profile for the award profile took some time to sink in. It took until October 1990 for the Committee to comprehend that the last starting date for grants was scheduled for early 1992 (three years prior to the Initiative's scheduled end), and to recognise the urgency of planning for how the research community's continuing funding needs might be met after this date.[43]

**Exhibit 57** shows the original allocation profile and the type of award profile it necessitated if commitment was ever to match the allocation profile and avoid underspend.[44] The critical points to note are the heavy front loading and the need for a mix of project durations. (In this example one and two year projects are shown at the tail of the Initiative, though it would also have been possible to distribute them across the whole of the Initiative's duration).

**Exhibit 57 'Original' Allocation and 'Required' Award Profiles for JCI**




[42] Interview, Donald Broadbent, 24 January, 1991. See also 'Financial Profile of the Initiative: A Personal View as a Discussion Document', Donald Broadbent, December 1990, in which he states "the aim is to be roughly rectangular".

[43] Minutes of 22/23 October , 1990

[44] This 'required' award profile was calculated assuming even spend over a project's duration and the prioritisation of three, then two , then one year projects. It was also assumed that grants are awarded and projects start at the beginning of the financial year. The point here is to illustrate the need for front-loading rather than to mirror reality.

After the Committee realised that October 1991 was the last scheduled meeting at which it could award three year grants, two papers on financing and the future were prepared for discussion at the December 1990 meeting, one by the MRC Office[45] and a personal view by the Chairman.[46] By the time the need for front loading and a 'mixed tail' were discussed by the Committee in December 1990, however, the opportunity to indulge in the needed front loading had passed. Prior to the October 1990 meeting, quality driven parsimony had led to the award of only 33 out of the final total of 74 full project grants. More should have been funded by then for expenditure to match the allocation profile.

**Exhibit 58** shows the original allocation profile and the actual spend profile for the Initiative.[47] The degree of underspend in the first years of the JCI (and right through to Year 5[48] ) is marked. **Exhibit 59** also illustrates how the failure to award money in line with the required award profile was at the root of this phenomenon,[49] with the amounts awarded in 1990/91 in this example falling well below the necessary levels. A corollary of this is that awarding grants at a later date than indicated by the optimal award profile committed resources in the tail of the Initiative, thus creating 'tail management' problems in terms of the ability to fund additional three year projects - an issue of great subsequent vexation for the Committee.[50]

**Taming the Tail**

The papers prepared for the December 1990 meeting and the ensuing discussion also emphasised that front-loading was antithetical to the 'shaping' aim of the Initiative and its ability to assess the impact of the research it funded and apply any corrective measures deemed necessary. Accordingly, the Committee discussed the possibility of spreading the spend to permit fresh approaches for funds to be considered later in the life of the Initiative, and subsequently the three Councils were approached formally with a request to restructure the allocation profile via a one year extension. The intention was to ease 'tail management' problems by allowing further funding rounds for three year projects and thus minimise the prospect of continued underspend.

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45 Future of the Initiative, CSHCI: 90/2, MRC/JCI ,December 1990

46 Financial Profile of the Initiative: A Personal View as a Discussion Document, Donald Broadbent, December 1990

47 Final spend taken from the final reconciliation statement for the JCI, provided by the MRC on 22 October, 1996.

48 This and other aspects of the spend and allocation profiles are discussed in due course.

49 The 'real' award profile was calculated by working backwards from the actual spend profile and using the same assumptions as before, e.g. 'even spend', priority to three year projects, and awards at the beginning of each financial year . In theory, actual figures and dates could have been used, but the main purpose of the **Exhibit** is to illustrate a point, namely that the Committee did not award grants in sufficient numbers to match allocation profiles.

50 The implications of late commitment of resources for a time-bounded Initiative were not appreciated by the Committee. The minutes of the December 1990 meeting reflected the view that "it would be a mistake to try to spend too much too soon".

**Exhibit 58 Original Allocation and Actual Spend Profiles for JCI**

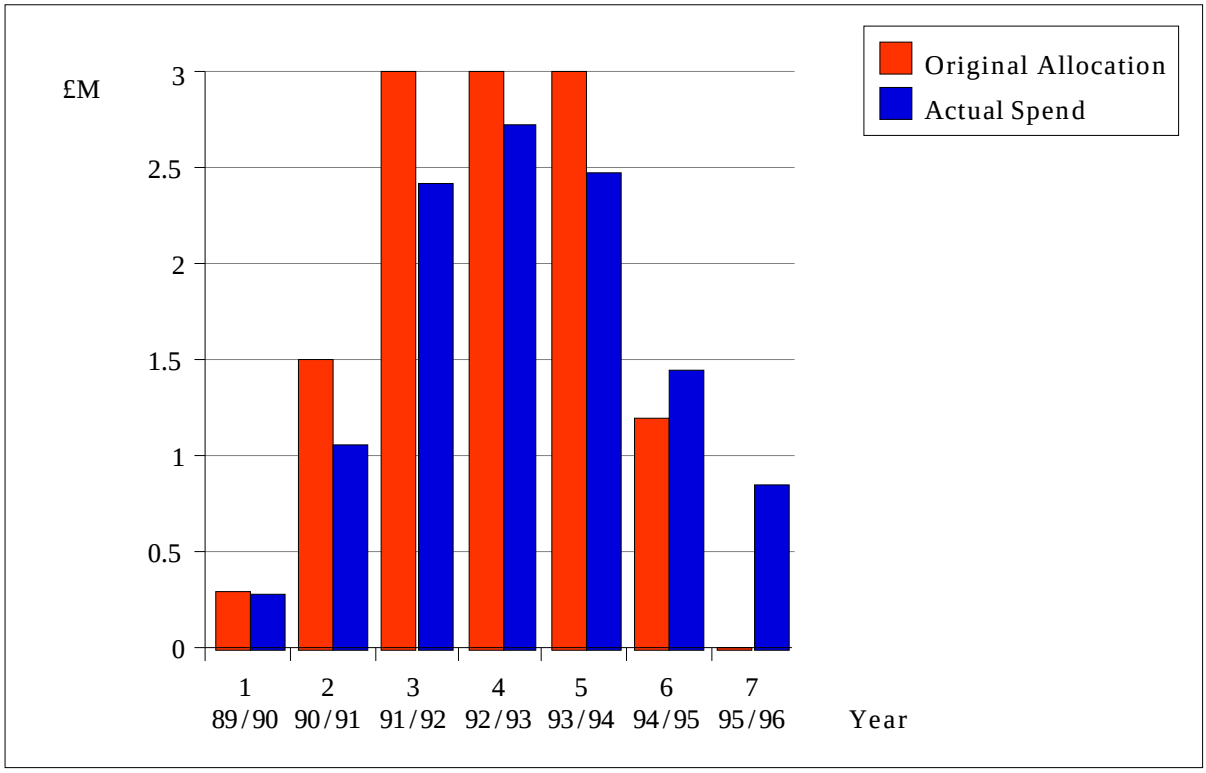
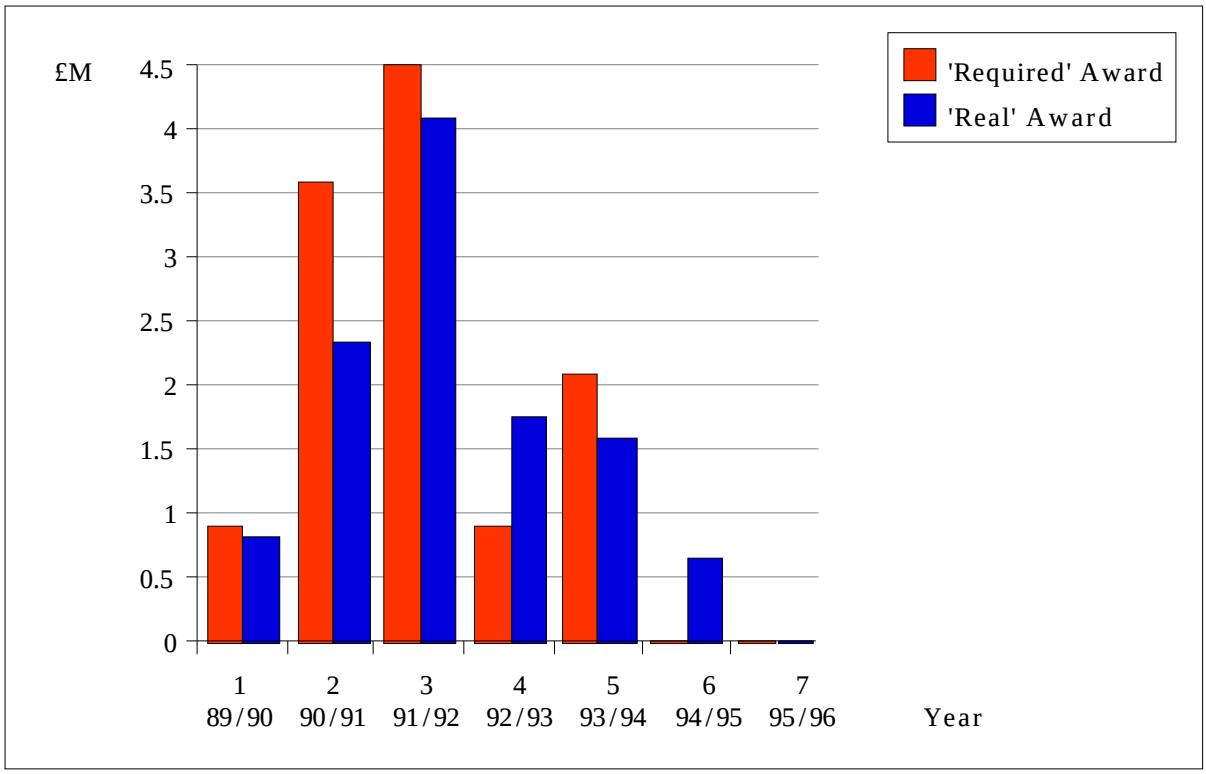



**Exhibit 59 'Required' Award and 'Real' Award Profiles for JCI**



By the March 1991 meeting of the Committee, the Councils were still considering the proposal to extend the Initiative by one year.[51] In the meantime, therefore, the Committee considered two 'tail management' options: the option of no additional rounds post February 1992; or an additional round allowing 12 month extensions to start in January 1993. In accord with its proactive role, the preference was for the latter.

The Councils eventually approved spend in an extra year sometime after the March meeting. A paper prepared by the MRC Office in September 1991 for discussion at the meeting of 22/23 October 1991 presented a financial profile of the Initiative which included provision for expenditure in 1995/96,[52] with new spending targets set for the October 1991 and May 1992 meetings.[53] The paper prepared by the MRC Office also pointed out for the first time that funding of three year projects would be allowable at the May 1992 meeting, though it also indicated that grants awarded at the subsequent meeting in the autumn of 1992 could only be for 1-2 years.

Concerning the availability of funds, the paper stated that, for research awards, "the total balance available for grant awards was £4.4m". It went on to suggest that £1.5m of this should be awarded at the October 1991 meeting, and £2.9m at the May 1992 meeting, but warned that if the Committee persisted in its past parsimonious practices

> "then appropriate measures will need to be taken to spend the remaining balances by 1995/96 at the latest. Assuming that the present trends in spending continue, it will not be possible for the Committee to spent (sic) all of its allocation of £10m for research"

Subsequently, at the next meeting on 12 December 1991, the MRC Office suggested an additional call for three year projects as a means of avoiding underspend, with final grant-awarding at the October 1992 Committee meeting. The full text of CSHCI 91/87[54] is reproduced in **Exhibit 60**.

At the start of the meeting of the Main Committee in May 1992, which went on to award grants to a further 11 JCI projects, it was announced that £3.5m remained uncommitted, but that due to 'tail management' constraints the maximum amount that could be awarded for 1992/93 was £834,000. The Committee was also told that it would not be possible to commit all of the uncommitted balance, though members were not told how much of the balance could be awarded. Plans for the next meeting remained unaffected, however.

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[51] In 'Future Spending Profile of the Initiative', CSHCI: 91/44, March 1991, past and future forecasts of expenditure did make provision for a small amount of expenditure in 1995/96, though the original allocation profile was maintained.

[52] Spending Profile of the Initiative, CSHCI 91/75, September 91

[53] Undated memorandum from the MRC to Gerald Gazdar entitled 'Briefing note on the Initiative's financial position', circa late September 1992

[54] Future options for committing the unspent funds, CSHCI: 91/87, MRC/JCI December 1991

**Exhibit 60 Future Options for Committing Unspent Funds, December 1991**

Future options for committing the unspent funds

1. Papers

Annex 1 - Final call for proposals - draft advertisement

2 Background

The Committee has to date made a total commitment of £6.3m on grants. The remaining sum available to the Committee for future commitments is therefore £3.7m.

The Initiative formally comes to an end on 31 March 1996. In principle the Committee can therefore make awards of 3 year grants at its meetings in May 1992 and October 1992, provided the call for the October meeting does not involve an outline stage. In order to avoid an overspill into the 1996/97 financial year, it would be necessary to ask for all grants to end by 31 December 1995 at the latest, i.e. all grants must begin by 1 January 1993.

3. Action required

(i) to consider and approve draft advertisement for final call for proposals; and
(ii) to discuss any other future options for committing the unspent funds.

The meeting in September 1992 was convened to allocate the additional round of grants suggested by the MRC Office in December 1991. The presentation of the financial statement by a representative of the MRC's Finance Section came as a bombshell. It was announced that only £1.2m remained uncommitted, and that unrecoverable underspend in earlier years and 'tail management' problems in the future would drastically limit the amount of money which could be awarded at the meeting to approximately £0.4 - £0.6m (enough for about 4 projects). This was much less than the Committee had anticipated and called into question the wisdom of having this last, additional round. These problems were subsequently exacerbated when 20 of the proposals considered by the Committee were alpha-rated.

It was suggested at the meeting that restructuring the allocation profile might enable 8-10 proposals to be supported, and the Committee asked Council representatives to seek approval from their respective Finance Sections. Subsequently, after concerted efforts by all the Research Councils, restructuring

did take place later the same month, though this only allowed eight of the 20 alpha-funded projects to be funded by the JCI.

**Exhibit 61** shows the 'revised' allocation profile of September 1992 and the actual spend profile for the JCI. Comparison with **Exhibit 58** shows that the readjustment effectively 'rescued' some (but not all) of the 'unrecoverable underspend' and 'transferred' it to later years, including the extension year. **Exhibit 62**, however, shows that the award profile needed to satisfy this 'revised' allocation profile was still more front-loaded than the 'real' grant-awarding behaviour of the Committee. All in all, the restructuring was insufficient to resolve the problems caused by the Committee's parsimonious selection practices and its desire to prolong its 'shaping' role. Neither was it capable of catering for the unfunded alphas selected in the last round, nor of compensating for the ill feeling generated both within the Committee and elsewhere in the wider community by the debacle of the last round.

**Exhibit 61 Revised Allocation and Actual Spend Profiles for JCI**

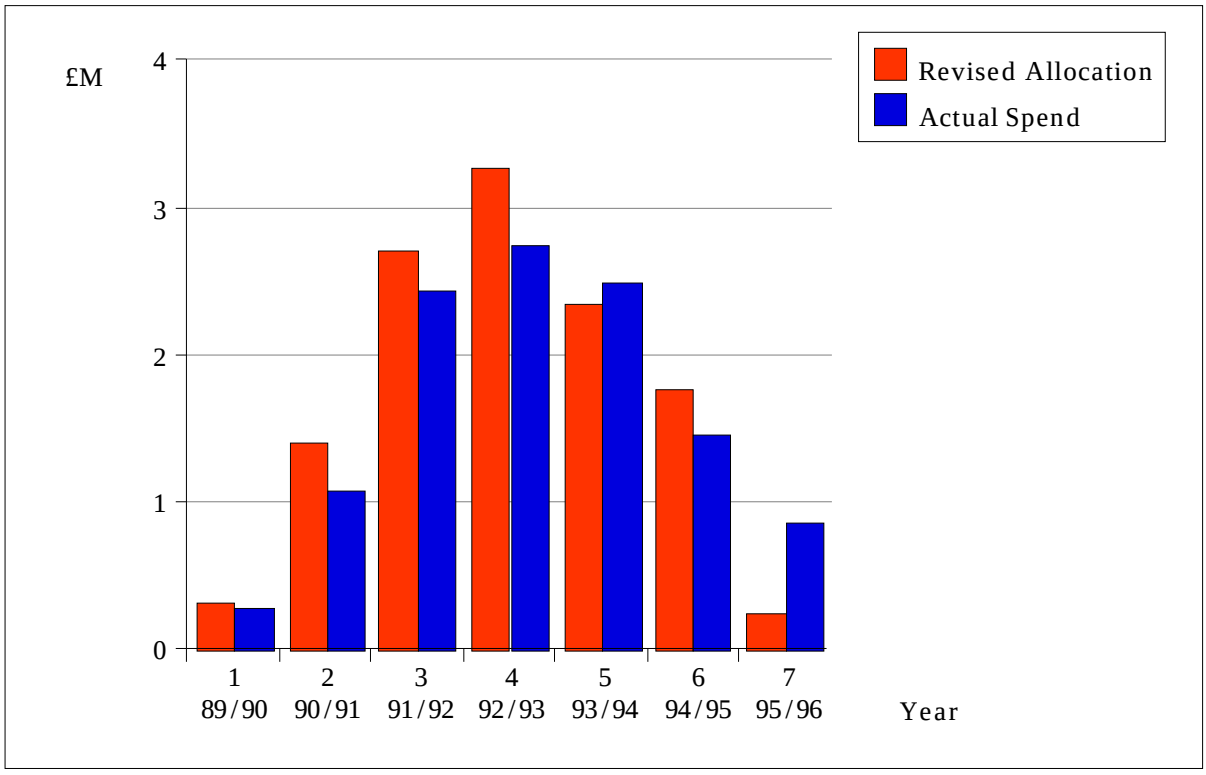
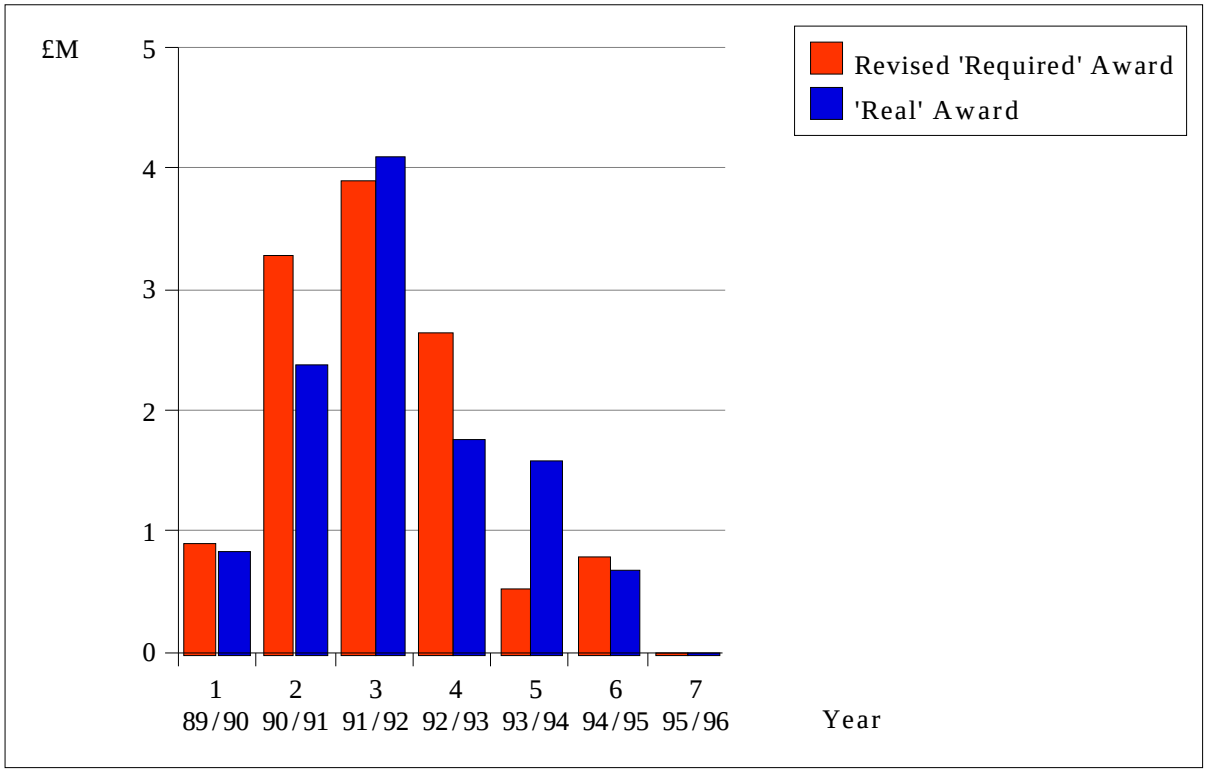


**Exhibit 62 Revised 'Required' Award and 'Real' Award Profiles for JCI**




## Inadequate Support

How did all of this come about? According to one representative of the MRC, the Committee was unable to absorb pertinent information.[55]

> "By November 1991 it was clear that the proposed expenditure of £12m would not be achieved without further extensions to the Initiative, which would be very difficult to justify.
>
> This message did not get across clearly to the Committee, and at meetings in December 1991 and May 1992, they (sic) assumed that they could spend up to the £12m. Indeed, they were told at the May meeting that they had another £3.5m to spend. At the December meeting it was decided to hold a meeting in Autumn 1992 to spend the last of the funds. There were not enough funds earmarked for 1995 to allow three-year awards to be made late in 1992, but this question seems not to have been raised."

It is vital to note, however, that the quality and extent of the information and direction provided by the MRC Officers to the Committee contributed greatly to the failure of messages to be absorbed.

[55] Undated memorandum from the MRC to Gerald Gazdar entitled 'Briefing note on the Initiative's financial position', circa September 1992

At the October 1991 meeting, for example, the Committee was told that the total balance available for grant awards was £4.4m, and that £1.5m of this should be awarded at the October 1991 meeting, and £2.9m at the May 1992 meeting.[56] The Committee took these figures at face value, but closer examination reveals they were suspect. In the first instance, the figure of £4.4m took no account of unrecoverable underspend in the first two years of the Initiative, calculated in the same paper to be £0.5m using the original allocation figures for those years. Secondly, the figures provided in Table 1 of the paper, entitled 'JCI Main Budget - Commitments', do not sum correctly. Specifically, the uncommitted funds actually sum to £4.6m, not £4.4m. Thirdly, the line for uncommitted funds in Table 2 bears little resemblance to the equivalent line in Table 1, other than that the total balance is again £4.4m. Fourthly, and most importantly, it is apparent from a comparison of the Commitment/Spend profiles for March 91 and September 91 that the figures presented to the Committee in CSHCI 91/75 at the October meeting made no allowance for commitments made at the March 91 meeting, at which six full projects were sanctioned. This meant that target figures for awards at the October 1991 and May 1992 meetings were overestimated by approximately £0.5 - £1.0m.

These figures, it will be recalled, formed the basis for the MRC's estimate that the JCI would grossly underspend.

The way in which the MRC established the viability of an additional round is also unclear. The allocation profile presented at the October 1991 meeting - the original allocation profile - indicated zero allocation for 1995/96 and a modest commitment of £83,437. On the basis of these figures, it was impossible to consider any further commitment for 1995/96 without restructuring the allocation profile. If this was done, however, the Committee was not adequately briefed, either at the October meeting or subsequently in December when the MRC Officers suggested a further round for decision in October 1992.

Indeed, there is a great deal of confusion surrounding the issue of restructuring around this time. As we noted earlier, in 1991 the Councils approved spend in an extra year and, according to one MRC source,[57]

> "The spending plan was revised in September 1991: the funds were not restructured, but new spending targets were set for the September and May meetings to take account of the low level of awards over the previous six months. The revised plan did not allow for any three year awards after May 1991."

This is in marked contrast to the version of events presented to the Committee in September 1992. According to verbatim records kept by the evaluation team at the September 1992 meeting, an MRC representative stated that the Initiative's

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[56] Spending Profile of the Initiative, CSHCI 91/75, September 1991

[57] Undated memorandum from the MRC to Gerald Gazdar entitled 'Briefing note on the Initiative's financial position', circa September 1992

funding had been restructured in the autumn of 1991 to help resolve the initial underspend problem.[58]

The confusion over restructuring in 1991 is perhaps symptomatic of the quality of financial management at the time. The important point to note, however, is that data and calculations of a suspect nature were used to bolster the incorrect impression of extravagant underspend and to justify the existence of an additional round of spurious utility.

The way in which financial data were presented to the Committee is also a matter of some concern. At the meeting of the Main Committee in May 1992, for example, the inadequate provision of financial information to the Committee was marked. The financial statement agenda item was listed as 'oral', with no paper sent out in advance. Even the paper 'tabled' at the meeting[59] was only presented to the Chairman and not distributed to the other members of the Committee. Similarly, at the September 1992 meeting, the financial statement was again listed on the agenda as 'oral', and the paper on which it was based was only presented to the Chairman one hour before the meeting.

Financial data for programme management purposes require clear presentation, consistent formats and regular and timely distribution to Committee members. These were features conspicuous by their absence. In such circumstances, the Committee had little choice but to trust the accuracy of the summary figures presented to them by the MRC Officers and to accept the viability of their suggested options.

By September 1992, however, the Committee had clearly had enough. The minutes of the September 1992 meeting record the Committee's regret that financial mismanagement had occurred and their concern that adequate financial information had not been provided at earlier meetings.[60] A more forceful Committee might have demanded better provision of financial data on a more timely and regular basis, but this does not excuse the weak support it was given.

The frustrations of the Committee were evident in a letter from the Chairman to the Secretary of the MRC.[61]

> "Regrettably, MRC has not been managing the Initiative in a satisfactory manner during my chairmanship, nor did MRC's senior officers provide the Committee with sound financial advice during the period September 1991 to September 1992. During this period we were repeatedly told that the JCI would end up with a large

[58] The MRC representative noted that it was not possible within the MRC to transfer funds backwards or forwards over year-end, but sometimes it was possible to carry funds forward by spending the surplus money elsewhere in one year and cutting expenditure somewhere else in the next. This, the Committee was told, had occurred in the autumn of 1991.

[59] ES9192.cog

[60] Minutes of 2/3 September 1990

[61] Letter to the Secretary of the MRC from Gerald Gazdar, 18 November 1992

> underspend and that there was no likelihood that we would run the risk of over-committing ourselves in any of the remaining grant rounds if we continued to award grants with the quality driven parsimony that had characterised the Committee's behaviour in earlier rounds. We were told in December 1991 that £3.7m remained "available to the Committee for future commitments". In fact, the amount actually available was about £1m less than this. We were advised by MRC officers that we could reasonably hold a call for three year grants with a decision at the September 1992 JCI meeting. The initiative for this call came from the office - it was not suggested by the Committee. This advice was calamitous. The call resulted in about 80 proposals of which 20 scored alpha or better .....The Committee was then told, at the September meeting, that the distribution of the remaining funds would only allow four of these 20 proposals to be funded. Clearly, this call for three year proposals should never have been made. A great deal of time was wasted by those who wrote the proposals and those who refereed them. And the failure to fund many excellent proposals in the Initiative's final round has led to anger and frustration in the community of researchers that the JCI was set up to create and to serve. The unhappy outcome of the September meeting compounded a much less serious, but nonetheless damaging, sequel to the meeting of May 1992 when half a dozen applicants were sent award letters, only to be phoned 24 hours later and told that they had not got grants after all (this was a clerical error - but it was probably symptomatic of the quality of management at the time).
>
> Proper financial information regarding the state of the Initiative was not provided to the Committee during the period September 1991 to September 1992. Financial statement agenda items were listed as 'oral' with no paper sent out in advance. The papers that were tabled at meetings had been prepared at the last minute and served only to confuse members of the Committee ( as the Minutes of the meeting of 29th May indicate). When the Committee was told how much it had left to spend, prior to September 1992, the figures given were grossly misleading."

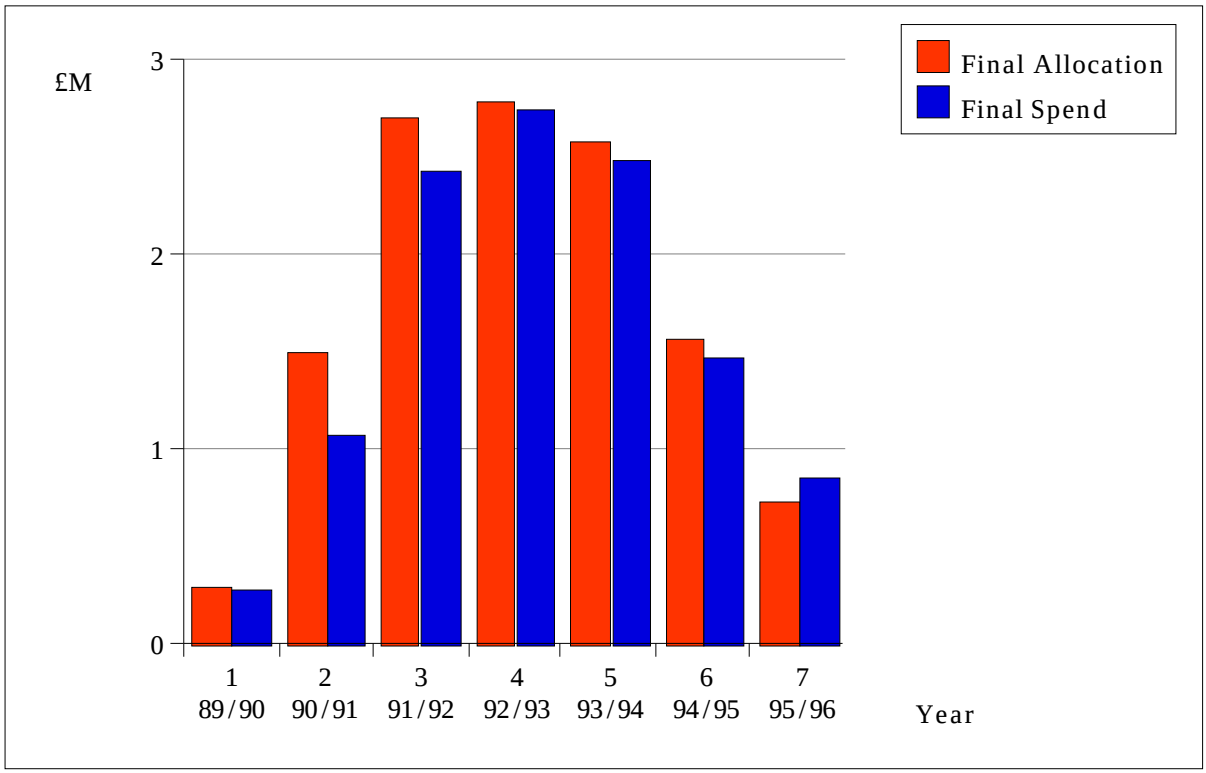
In his reply, the Secretary of the MRC accepted the charge of 'misinformation'.[62]

> "I do acknowledge your concerns regarding the provision of financial information to the JCI Committee, and am very sorry that the Committee was misinformed concerning the Initiative. I am, however, satisfied that the resources set aside for the Initiative were not mismanaged; in fact, some considerable efforts were made to make full use of the allocated funds."

[62] Letter from the Secretary of the MRC to Gerald Gazdar, 10 December 1992.

**Exhibit 63** shows the allocation and spend profiles given in the final reconciliation statement for the JCI.[63] Further readjustment of the allocation profile via UFC transfers of £1.5m spread over 1992/3, 1994/5 and 1995/96 allowed under- and overspend in the latter years of the Initiative to be minimised. In this picture, 'tail management' appears exemplary, and total underspend is only £0.7m - primarily as a consequence of early underspend. In reality, however, it took a good deal of *post hoc* restructuring to effect the match between allocation and spend profiles post-1991/92.

**Exhibit 63 Final Allocation and Actual Spend Profiles for JCI**




## Securing the Future

The difficulties encountered in managing programme spend had important repercussions for the Committee's attempts to secure the future of research funding in the area of Cognitive Science and HCI.

Securing the future became a pressing issue when the Committee first realised in late 1990 that awarding its last batch of grants in early 1992 would create a twelve month hiatus before any possible continuation funding (in the form of a JCI Mark II) could be secured via the Public Expenditure Survey (PES) bid procedure. The possibility of an extra year for the Initiative allowed contemplation of grants being awarded until April 1993, which in turn allowed the possibility of continuity if a bid of this nature was successful. Continuity was important because the Committee was concerned that its efforts to nurture a community would be to no avail if adequate support mechanisms were withdrawn

[63] Communication from MRC to the evaluators, 22 October 1996

prematurely, even if the aim of the Initiative was to carry applicants in the area to the point where they could compete confidently against applicants in other fields in the normal peer review competition.[64] Although the Committee noted that additional funds had been included in each of the three Councils' baselines to provide for the needs of JCI investigators once the Initiative came to an end, it felt the need to explore the case for additional support mechanisms. These included a successor to the JCI and other mechanisms designed to ensure that projects of interest to all three Councils did not fall through the net.

To this end, the Committee agreed at its meeting of 15 March 1991 to establish a small group to discuss the future of the Initiative, firstly in terms of the management of the end of the Initiative, and secondly in terms either of a continuation Initiative or the transition back to individual Committees and Councils.

This group held its first meeting on 11 September 1991. It agreed to examine the case for a new Initiative and to discuss this with the Main Committee in October 1991. If the Committee so decided, this would allow the preparation of a detailed argument which the Committee could present to the Councils in early 1992. The group also considered various alternatives to another Initiative, including a Tri-Council Committee to advise on proposals spanning the interests of the three Councils.

The Committee considered the group's paper[65] at the meeting of 12 December 1991. The Committee subsequently accepted a broadened version of the group's recommendation, namely that it should develop a case for

- Permanent provision by the three Councils for the funding of all areas currently supported by the JCI
- An Initiative in the area of Cognitive Engineering, with ring-fenced time-bounded funding, albeit on a reduced scale compared to the current JCI

However, in an amendment to the minutes of the meeting of 12 December 1991,[66] the MRC representative

> "concluded that the Committee clearly had to make recommendations as it thought scientifically appropriate. However, she had to point out that the MRC was likely to have difficulty with a proposal which involved ring-fencing or the award of money outside of the normal Council processes. Furthermore, in considering any bid for further funds, the Council would be bound to take account of the predicted under-funding on the present Initiative."

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64 Future of the Initiative, CSHCI: 90/2, MRC/JCI December 1990

65 Research Council Support for Cognitive Science and the HCI after the End of the Present Joint Council Initiative, CSHCI 91/95, December 1991

66 Noted in the minutes of the meeting held on 2 April 1992

This echoed a similar sentiment expressed shortly before the December meeting to one of the members of the Working Group on the future of the Initiative.[67]

> "There is at present some £3.7m of the original £12m as yet uncommitted...given that the period over which these funds could be disbursed has already been extended by a year to 1996, it does seem to us that it would be difficult to develop a convincing case for further money for a new Initiative."

The same dubious calculations which led the MRC to suggest a superfluous last funding round underpinned the estimates of underspend which dictated its stance on future funding arrangements for the area.

The Working Group on the future of the Initiative presented their next paper[68] to the meeting of the Main Committee on 2 April 1992. The paper noted that

- The area posed problems for science vote funding
- Certain sub-areas appeared outside the remit of any Research Council
- The area was very difficult for existing Boards to assess
- Re-routed applications rarely succeeded
- Proposals aimed at single research Councils tended not to emphasise inter-disciplinarity

The Working Group examined five models for the future of funding of research falling under the general rubric of Cognitive Science and Engineering and concluded that the case for another 5/6 year initiative was weak. It argued instead for longer term provision for the area capable of supporting and maintaining the interdisciplinary research community created via the JCI kick-start mechanism. It thus recommended the establishment of a Tri-Council Standing Committee, with members representing the interests of all three Councils, which would have an agreed baseline budget and primary responsibility for the on-going funding of research and research training in Cognitive Science and Cognitive Engineering. The Working Group noted that this model was consistent with the concept of ring-fenced funding, but also consistent with other funding bases. It recommended a baseline budget (ring-fencing money already in the baseline funds of the Councils) and an opportunity for the Committee to bid annually to its parent councils for additional funds.

In the discussion which ensued, some members expressed the view that, as a result of JCI, some parts of the field were sufficiently mature to be self-sustaining in open competition, and that normal responsive mode funding arrangements would be adequate. The Committee nevertheless endorsed the paper subject to minor amendments,[69] and recommended the setting up of a Sub-Committee to advise the Research Councils and the JCI community on the appropriate 'home' for applications hitherto considered by the JCI. This endorsement was despite

[67] Letter from MRC representative to Tim Shallice, 5 December 1991

[68] The Funding of Cognitive Science and Cognitive Engineering After the Joint Council Initiative, No reference number, 2 April 1992

[69] The revised paper was subsequently fully endorsed at the meeting of 29 May 1992.

recognition by the Committee that, in the light of the MRC's known position vis-à-vis underspend, the MRC Neurosciences Board was thought unlikely to support the ring-fencing of Cognitive Science and Cognitive Engineering.

The paper was subsequently considered in parallel by the three parent Research Councils. At the meeting of 2/3 September 1992 it was reported that

- The Neurosciences and Mental Health Board of the MRC could not find a case for the provision of a baseline budget for a permanent Tri-Council Committee
- The Systems Engineering Committee of SERC and DTI said that its current general policy was to manage the interface between areas such as Cognitive Science and HCI without setting up separate bodies
- The Human Behaviour and Development Group of the ESRC recognised that without the backing of all three Councils the proposal for a permanent Tri-Council Committee was not a likely option

Although there were undoubtedly many other reasons why the Research Councils held these views, the exaggerated impression of underspend created and promulgated by MRC officials radically undermined any prospects for future Tri-Council support arrangements for Cognitive Science and HCI.

**Shaping Constrained**

The JCI sought to shape developments in Cognitive Science and HCI. It sought to do this via continuous funding over a five year period. The original application to the ABRC should thus have asked for a flat five year award profile and an eight year lifetime for the Initiative. Instead it asked for a flattened allocation profile, which implied all three year grants had to be awarded by the end of the second year. This limited the ability of the JCI to act proactively. It also set the scene for complex tail management problems.

The JCI was thus handicapped even before it got to the starting gate. Failure to realise the imperative nature of front-loading was then exacerbated by its own parsimony in selecting projects. Underspend was the result. A one year extension and the promise of restructuring were the relief. Support to the Committee concerning budgetary matters then proved woefully inadequate, leading to serious mismanagement of the tail of the Initiative, rescued only by financial reshuffles involving all three Councils.

To add insult to injury, misinformation concerning the extent of underspend helped undermine the case for a new Initiative, or for any support mechanism involving all three Councils.

To summarise, naive spend management, cautious selection behaviour and grossly deficient financial information and support functions all combined to limit the extent the Initiative was able to shape current and future patterns of research and research support.

## 5.5 Appropriateness

### 5.5.1 Initial Appropriateness

- Initial Appropriateness
  - The aims of the Initiative and the mechanisms chosen to attain the aims appeared consistent with needs (desirability) and constraints (feasibility), though initial estimates of the real demand for the Initiative and the willingness and ability of the research community to respond to it were optimistic

The initial appropriateness of a policy initiative is usually judged retrospectively in terms of how well its aims matched real needs and whether or not the chosen delivery mechanisms appeared capable of achieving these aims.

The JCI was based on a number of fundamental premises

- There was an urgent need to improve the scientific basis of developments in HCI
- Cognitive Science was a suitable 'feedstock' for HCI
- Many of the constituent disciplines within Cognitive Science would benefit from a computational approach
- High quality proposals at the nexus of Cognitive Science and HCI were falling through the gaps at the edge of each Research Council's area of responsibility
- There were sufficient of these to warrant some form of remedial action
- Growing an identifiable community in the area was necessary to ensure long-term interest
- An Initiative constituted the most effective way of catalysing, consolidating and supporting a community until it could fend for itself in the normal competition for research support
- A proactive approach to programme management was needed ensure the balanced development of the fledgling area

When the JCI was first contemplated, there was general agreement that HCI was in need of a scientific underpinning, that Cognitive Science appeared capable of providing this, and that computational approaches held promise for areas such as neuroscience and psychology. There was also a sound case to be made for a proactive programmatic intervention at the time, in that responsive mode funding had not led to a strong corpus of work in the area, and initial estimates of the potential members of a JCI 'community' showed that it was distributed across many different centres and departments rather than clustered in a particular handful which would have been eligible for 'centre of excellence' support. The Cognitive Science and HCI area was also likely to remain an area of strategic need for some time and would therefore benefit from concerted efforts to alter and redirect work and to establish a vibrant community. Directed

programmes, first established by SERC in the 1970s in the area of polymer engineering, appeared capable of delivering on these aims.

There is more doubt concerning the strength of interest in the area, the quality of the field, the number of proposals falling through gaps and the willingness of potential participants to become members of a new 'community'. There had been a wide consultation exercise during the preparation of the Bide report, and different parts of the research community had discussed the type of work which might be supported in the context of directed programmes, but by the time of the first bid to the ABRC in June of 1987 there had been no widespread discussion of the viability of a directed programme at the interface of Cognitive Science and HCI. This was rectified to some extent before the second successful bid via a call for outline proposals and a seminar in Oxford. These at least gave an indication of the strength of interest in the area and, via scrutiny of the outline proposals, some idea of the quality of the field, but there was still little evidence that proposals actually were falling through gaps or that researchers were committed to forging a community rather than simply exploiting a new funding source. Initial estimates of the real demand for the Initiative and the willingness and ability of the research community to respond to it were subsequently optimistic.

### 5.5.2 Appropriateness Revisited

- Appropriateness Revisited
  - The aims of the Initiative remain broadly relevant to current needs, i.e. there is still a need to provide a theoretical underpinning for HCI, though there is more contemporary debate concerning the range of theoretical inputs likely to inform developments in HCI
  - Hindsight casts doubt on the appropriateness of the chosen policy and implementation mechanisms

The continuing relevance of programme aims both testifies to the correctness of initial assumptions and suggests that they remain to be attained. For the JCI, the view is still generally held that HCI could benefit from a stronger scientific base, and that it has much to gain from its association with Cognitive Science. Certainly this is the opinion of the Peer Review Panel (see **Appendix 1**). Contemporary debate, however, places more emphasis on HCI drawing on a wider 'science' base and Cognitive Science feeding into broader 'engineering' application areas. This conception takes nothing away from the original presumption of 'need', but it does suggest that the task of satisfying needs was broader and more complex than originally anticipated, and that the JCI 'boundaries' were perhaps drawn too narrowly.

With hindsight, there are grounds for supposing that the extent and nature of 'need' were misjudged. There were many reasons why applications to JCI for funding declined markedly over the first three years of its lifetime (see **Section 5.4.1**), but all combine to suggest that the area at the nexus of Cognitive Science

and HCI was too narrowly drawn and perhaps not ripe enough to sustain the continued interest of a substantial number of researchers capable of generating high quality and relevant research proposals.

There are also grounds for thinking that the problem of 'interstitial' projects was overestimated. There is little doubt that projects of potential interest to a number of Councils did exist, but there is less evidence that these were falling by the wayside in sufficient numbers to warrant remedial action in the form of a directed programme. In **Section 5.2.2** we noted that members of the JCI community had been very successful in attaining funds from single Councils prior to the Initiative. We should note too that representatives of each of the Research Councils also considered that most JCI projects could have been funded by single Councils.[70]

> "58 JCI applications funded up to January 1992, and all considered at the meeting in May 1992 were surveyed. Officers were surprised that most applications could be assigned to one Research Council without difficulty. Certain themes appeared to "belong" to one Research Council, e.g. models of cognition and neural networks - MRC; support of programming - SERC; and intelligent tutoring - ESRC.
>
> Officers also noted that several proposals which had proposed developments - e.g. of new algorithms - appeared to fall within the remit of SERC; but that later application of these developments might fall within the remit of the other Research Councils e.g. MRC - application of the algorithm to network models of cognition - or the ESRC - testing programmes in a learning or business environment.
>
> A small number of applications appeared to be unassignable by Council officers (5%)."

Perhaps of most concern, however, is the appropriateness of the mechanisms chosen to attain the JCI aims, specifically the use of a directed programme and the tactics it used to shape and stimulate the research community. The programme did support high quality work of a multi- and inter-disciplinary nature, but it did not support sufficient numbers of 'bridging' projects linking Cognitive Science and HCI, and achievements were correspondingly lower than anticipated in terms of outputs and impacts on individuals, institutions and research communities. Although the JCI supported around 400 individuals via grants, studentships and fellowships, this remained a largely heterogeneous and even polarised community.

In the next **Section** we examine and summarise why the tactics of the JCI proved inappropriate, and in the final **Section** we consider the strategic choice of a directed programme.

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[70] Note of the JCI Meeting of Officers held at MRC Head Office, CSHCI 92/40, 15 July 1992.

### 5.5.3 Policy and Implementation Mechanisms

- Why were mechanisms inappropriate?
- Inadequate *ex ante* evaluation failed to reveal the limited capacity of the research community to respond
- Profile planning was lax
- Selection mechanisms were inadequately conceived and implemented
  - Aims and selection criteria were poorly communicated and shared across the Committee
  - Differentiated selection rules were needed for different project clusters
- Support systems were inadequate
- External shaping, linking and community-building strategies were overemphasised
  - They facilitated 'networking' but were unable to build sufficient bridges to allow the JCI community to coalesce
  - Annual Conferences and similar events were useful community-building devices for CS/HCI researchers, but of much more limited utility for linking separate CS and HCI communities
  - Greater emphasis on more effective selection mechanisms was needed

All the evidence in earlier **Sections** points to a number of tactical choices and actions which weakened the appropriateness of the JCI support mechanism.

**Inadequate *ex ante* evaluation failed to reveal the limited capacity of the research community to respond**. More careful and considered *ex ante* appraisal mechanisms would have helped not only to build the case for the Initiative but also to select the most appropriate shaping mechanisms for utilisation during its lifetime. The trawl procedures which were adopted did establish that there was interest in receiving grants, and that some of the suggested research projects were likely to be of a high quality and relevant to the aims of the Initiative, but there were no systematic or comprehensive attempts either to identify appropriate target audiences (addressing invitations to university registrars for redirection to interested parties leaves much to be desired) or to appreciate the strengths, weaknesses, needs and aspirations of these audiences.

**Profile planning was lax**. A certain degree of confusion seems to have existed concerning the most appropriate allocation and award profiles for the Initiative, and little thought was consequently given at an early enough stage to 'opening' and 'end-game' strategies. The Councils themselves suggested the 'flattened' allocation profile to the ABRC,[71] but the first Chairman of the Committee confused allocation with award profiles and presumed in the first instance that money would be awarded in line with this profile over the whole of the lifetime of the Initiative.[72]

[71] Interview with David Worsnip, SERC, 11 December 1990

[72] Interview with Donald Broadbent, 24 January 1991

The allocation profile that the Committee had to live with ramped up to a flat profile and then ramped down towards the end. The Committee presumed that awards therefore needed to ramp up and ramp down in a similar fashion. By the time enlightenment came, the opportunity to front-load in line with the requirements of the actual allocation profile had passed. Similarly, lack of appreciation of the 'tail management' problems which come with 'flattened' allocation profiles meant that adequate consideration was not given at an early enough stage to 'end-game' strategies.

The Committee did not adopt adequate 'opening' and 'end-game' strategies because of its naive appreciation of the differences between allocation and award profiles. This is perhaps excusable in academics unused to programme management. It is not excusable within research administration circles. The Committee should have been much better briefed and advised.

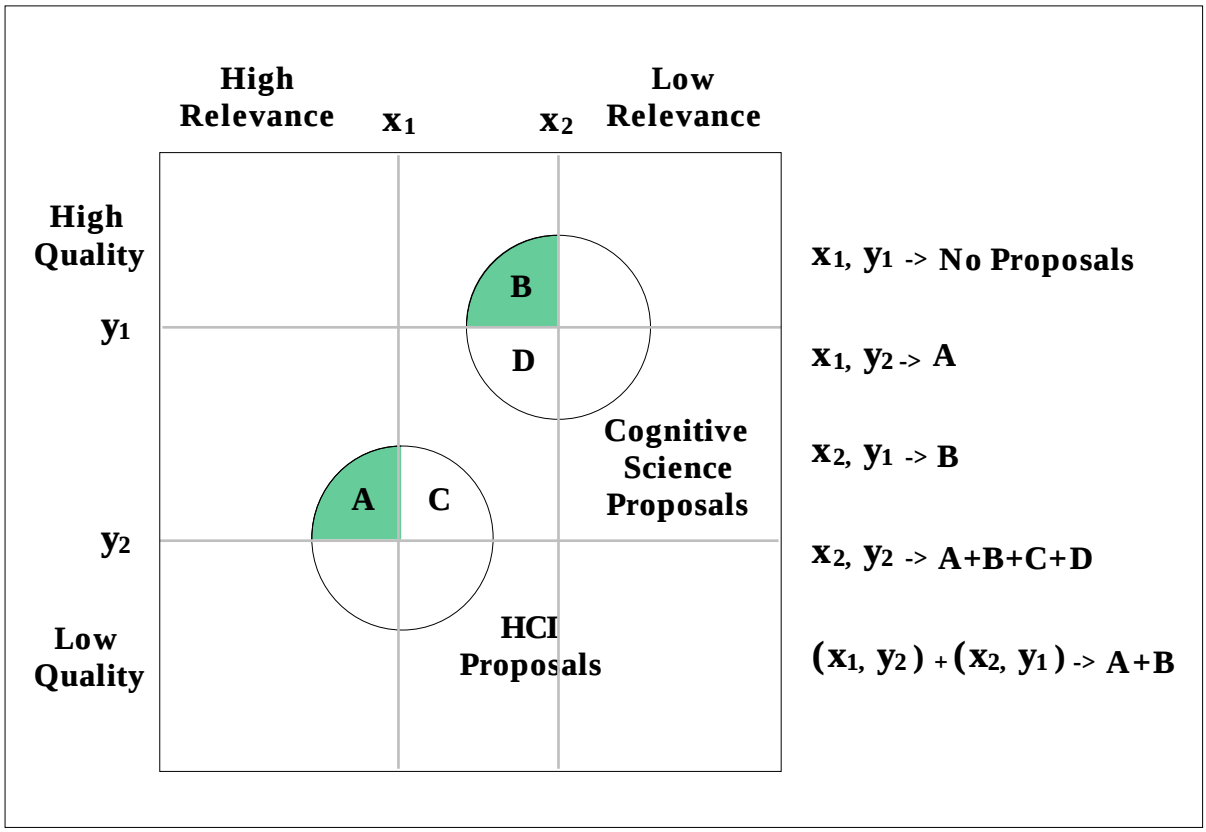
**Selection mechanisms were inadequately conceived and implemented**. The selection procedures adopted by the Committee failed to achieve the desired 'balanced development' and the focus on high quality exacerbated the problems caused by the need to front-load. Aims and selection criteria were poorly communicated and shared across the Committee, and differentiated selection rules were needed for different project clusters.

There was a basic 'and/or' ambiguity in the expressed goals of the Initiative, and indeed in the title of the Initiative itself, which led to a lack of consensus amongst Committee members (and elsewhere within the community) concerning 'allowable' projects. Put simply, some members thought that the Initiative could contain both 'Cognitive Science' and separate 'HCI' projects, while others thought it should only contain 'Cognitive Science and HCI' projects linking the two spheres of interest. This confusion contributed to an overall programme composition out of line with initial aims. Considerable effort was put into the articulation of the goals at the proposal writing stage and subsequently (see **Section 3.4** and **Exhibit 9** in particular), but it was not enough simply to set down a series of 'glosses and finishes'. Goals have to be translated into clear selection criteria and protocols and communicated in an unambiguous fashion to Committee members, preferably with simple, clear reminders prior to actual selection decisions. Not enough effort was devoted to these tasks in the early days of the Initiative.

One other aspect of the lack of clear protocols deserves mention. Committee members were asked to consider both relevance and scientific excellence criteria in their selection decisions. The Outline stage weeded out most non-relevant and low quality proposals, and relevance and excellence were discussed at the Full Proposal stage prior to a secret vote. Committee members were not required to weight relevance and scientific excellence criteria, however, and we noted in **Section 5.2.3** that scientific excellence was probably emphasised over and above relevance. It was also noted in **Section 5.2.3** that this tended to favour Cognitive Science projects over HCI-oriented projects because of the nature of the work undertaken in these areas (discussed in terms of a basic/applied polarity in the

Peer Review Report, **Appendix 1**). A procedure which asked for Committee members to score projects on separate relevance and excellence scales would have allowed the Committee to discuss final selection in terms of the 'strategic need' and 'unrewarded excellence' arguments discussed in **Section 5.2.3**. It would even have allowed the use of different selection cut-off points along both dimensions for projects emanating from different quarters of the research community, each with its own norms, practices, standards and interests. **Exhibit 64** indicates how different sets of cut-off points along the two dimensions of relevance and quality can be combined to select the most appropriate projects from different research spheres and communities.

**Exhibit 64 Variable Selection Cut-off Points for Proposals from Different Quarters**




**Support systems were inadequate**. There were many aspects of the support given to the Committee which were admirable, particularly at junior and clerical staff levels. At a higher level, financial management and control was severely lacking in terms of adequate forward planning, simple book-keeping and the transmission and presentation of timely, clear and correct information to the Committee. The priority given to these programme management and accounting elements was inappropriate. When a Committee is expected to seek balanced development, to fine-tune selection criteria and to award money such that the money committed and subsequently spent matches allocations, it needs to feel secure about the integrity of the financial data and advice that is being proffered.

**External shaping, linking and community-building strategies were over-emphasised**. Two issues dominate discussion of the appropriateness of 'external' shaping mechanisms such as Newsletters, Annual Conferences, targeted calls etc. The first is the effectiveness and utility of the external mechanisms adopted. Second is the balance between 'external' mechanisms and 'internal' shaping mechanisms (e.g. selection procedures).

In terms of the former, Newsletters, Annual Conferences and similar events were useful community-building devices for participants involved in 'Cognitive Science and HCI' projects i.e. those specifically formulated to build bridges between the science base and application areas. Participants had a shared interest in meeting, exchanging views and establishing a common identity, all activities which help marginal groups to coalesce and consolidate. In contrast, events such as Annual Conferences have to be constructed with great care if they are truly to stimulate interchange, cross-fertilisation and a sense of shared identity between groupings as disparate as those involved in 'Cognitive Science' and 'HCI' projects respectively. The norm was for members of these separate communities only to attend sessions of direct rather than peripheral interest. The JCI Annual Conferences were thus of limited utility in linking the separate communities served by the JCI. More could have been done to facilitate interchange between the different groups.

Inevitably, however, even though 'networking' activities are an important part of community building, direct involvement in projects is generally acknowledged as the most effective way of encouraging interchange. The JCI would thus have benefited from a greater emphasis on more effective 'internal' as opposed to 'external shaping mechanisms, i.e. on selection mechanisms capable of leading to more conjoint 'Cognitive Science and HCI' projects. Stronger targeted call mechanisms were also needed.

### 5.5.4 Alternative Mechanisms

- The arguments against a relatively short-term directed programme are persuasive. The alternatives are for more or less
- The arguments for less
  - The capacity of the community to respond to the Initiative was limited
  - Responsive mode funding would have catered for much of the work
  - There is some evidence that the Initiative was counterproductive in its attempts to forge a CS-HCI community
- The arguments for more
  - Tweaking selection mechanisms and community-building strategies would have led to a better focus and a more cohesive community
  - More sustained effort over a longer period of time was needed to change behaviour and nurture a community in an area of strategic need
  - The strategic need was real
- The optimal solution was for bigger and better

The strategic choice of a proactive directed programme appeared reasonable in 1987/88. With hindsight, however, the wisdom of using a relatively short-term kick-start mechanism is questionable. Goal attainment was limited and efficiency of implementation was weak. This always casts doubt on the appropriateness of a policy mechanism.

It is possible to argue that other, lower profile mechanisms would have catered for the needs of the JCI community. Conversely, it is also possible to argue that a better targeted, more efficiently organised, longer-term Initiative would have been more effective and ultimately more appropriate.

Lower profile or 'weaker' support mechanisms could have included the *status quo* option, i.e. normal responsive mode funding; Tri-Council or even single Council screening mechanisms for 'interstitial' projects, with or without ring-fenced budgets; or 'research stimulation' exercises such as workshops and mini-grants to generate project proposals in designated areas.

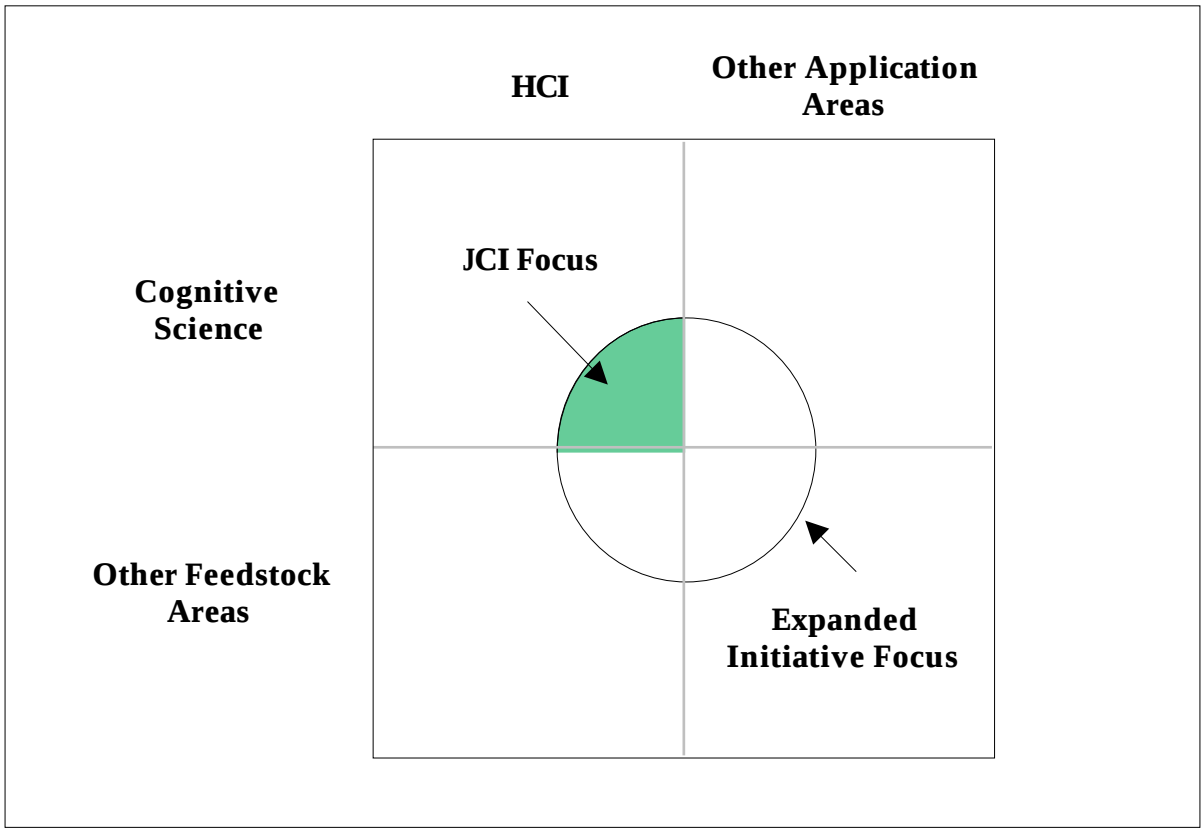
The arguments for 'weaker' support mechanisms are relatively straightforward. There was not enough evidence to suggest that the community either desired or was able to respond to an Initiative. Certainly the desire for research support was there, but not necessarily in the form of an Initiative. Much of the work eventually funded could have been catered for by responsive mode funding, and fears concerning the scale of any 'interstitial' problem could not be substantiated and could probably have been dealt with via modest screening mechanisms. There is even some evidence to suggest that the Initiative, as implemented, may have been counterproductive in its efforts to meld together disparate research communities, and that more subtle exhortations and stimuli to encourage the production of interdisciplinary research proposals might have been more productive.

However, the arguments for a more substantial and better organised Initiative are also cogent. Enhanced profile management, improved selection mechanisms, superior targeting and a richer set of community-building strategies would undoubtedly have led to a better mix of projects, more in line with the Initiative's aims and more likely to attain them. It is also arguable that more time was needed to establish a true community of researchers at the interface of Cognitive Science and HCI. JCI researchers operating at this interface said that subsequent research proposals to single Councils had placed less emphasis on interface issues. Of the 34% of researchers who did reorient their work within the JCI, more than half refocused back on their pre-JCI concerns afterwards. More time was needed for researchers to enhance interdisciplinary competence levels to such an extent that they felt able to compete effectively in open competition for resources.

The main argument for an expanded Initiative, however, remains one of strategic need. The need for some form of interaction between 'feedstock' areas such as Cognitive Science and 'application' areas such as HCI was very real. As **Exhibit 65** attempts to depict, however, the scope for interaction was broader than

defined in the original ABRC bids. An Initiative which targeted an expanded set of related 'feedstock' and 'application' domains would still have satisfied the 'market demand' and 'intellectual opportunity' elements of the JCI rationale (see **Section 3.1**), but it would also have stood a better chance of attracting a critical mass of researchers into the expanded arena of interest.

**Exhibit 65 The Focus of an Expanded Initiative**




To summarise, the choice of more appropriate strategies eventually boils down to considerations of need. Researcher-driven needs could have been catered for via 'weak' support mechanisms. Satisfying society-driven needs required a 'bigger and better' approach. If JCI was driven primarily by societal needs to enhance our understanding of human-computer interactions, then 'society' deserved 'bigger and better'.

# 6.0 Training Programme

To complement its research activities, the JCI also included a training component. As noted in **Section 3.3**, the bids to the ABRC recognised staff shortages in the HCI area and the difficulties involved in rectifying this situation. Many of these stemmed from the shortage of opportunities in the UK to pursue multi-disciplinary options at post-graduate and post-doctoral levels. This recognition led to a desire to provide for training at these levels. Populating the area with young researchers with a multi-disciplinary background was seen as an an important element of the JCI's shaping function, and the structure, organisation and composition of the resulting Training Programme are described in **Section 4.2**.

The allocation for the Training Programme element of the JCI was £2m out of the total £12m budget. The main focus of the evaluation effort, therefore, was on the Research Programme. A number of exercises were nevertheless carried out. After its appointment, the evaluation team attended all meetings of the Training Panel, and a series of interviews and questionnaires explored the impacts of the various elements which comprised the Training Programme. The Coordinator of the Initiative also monitored progress and produced evaluation reports on the Training Programme.[73] All of these activities allow commentary on the evaluation issues of effectiveness, efficiency of implementation and appropriateness.

## 6.1 Effectiveness

- The Initiative was reasonably successful in increasing the supply of multi-disciplinary trained researchers in the areas covered by the Initiative
- Non-tagging of grants represented a missed opportunity in terms of establishing a JCI community
- Half of the interviewees involved in Masters courses went on to conduct research in Cognitive Science and HCI areas
- Most of the Masters students not entering academic research entered industry or commerce, but did not exploit the skills acquired
- Half of the PhD interviewees entered academic teaching or research, but only a quarter of these continued to work in JCI areas
- The Initiative only funded a handful of Post-doctoral Fellows
- The Summer Schools were appreciated as a forum for interaction but did not create an identifiable community of researchers

[73] e.g. Elizabeth Pollitzer, Overview of the Training Programme, October 1992

The main goal of the Training Programme was to increase the supply of multi-disciplinary trained researchers in the areas covered by the Initiative. This headline aim was to be achieved via the provision of awards made at three levels

- **Advanced Course Studentships** By awarding these, the JCI hoped to support and expand MSc courses capable of taking graduates from one of the disciplines covered by the Initiative and equipping them in one or more of the others
- **Research Studentships** The aim here was to fund doctoral degrees involving cross-disciplinary training
- **Post-doctoral Fellowships** These were designed to assist established researchers in one discipline to gain experience of techniques from another discipline

The JCI also sponsored **Summer Schools** during its existence.

### 6.1.1 Goal Attainment

As intended, the JCI training element did support young researchers at all three levels. The numbers of awards planned and actually made were as follows

| | | |
|---|---|---|
| • Advanced Course Studentships | 60 planned | 70 awarded |
| • Research Studentships | 80 planned | 55 awarded |
| • Post-doctoral Fellowships | 12 planned | 7 awarded |

Although the number of awards made at each level did not exactly match the planned number, out of a maximum allocation of £2m (which included administration costs), £1.87 was spent on awards and Summer Schools, 90% of which went on awards. Of the 132 awards made, all apart from five Research Studentships were taken up. Limited demand for the Post-doctoral Fellowships constrained the number awarded.

Furthermore, in accord with the requirement that all awards should cover the JCI research areas and have a strong multi-disciplinary component, inspection of the disciplinary areas covered by the MSc courses and the research plans of the PhD students shows that these requirements were clearly met.

In terms of implementation, therefore, the Training Programme did increase the supply of multi-disciplinary trained researchers in the areas covered by the Initiative.

In the next **Sections** we look more closely at achievements at each award level, particularly in terms of the consequences for those in receipt of awards and for the JCI research community in general.

### 6.1.2 Advanced Course Studentships

Advanced Course Studentships were awarded for five MSc courses in Birmingham, London, Manchester, Sussex and Warwick (see **Exhibit 20** in **Section 4.2.4**). As part of the evaluation of the training component, destination details were collected for SERC-funded students attending the courses at Birmingham University and Queen Mary and Westfield College (QMWC), London (the two courses with the highest allocation of JCI Advanced Course Studentships). Telephone interviews were also conducted with 17 students from the Birmingham, London and Manchester courses.

SERC did not 'tag' awards with a JCI label, and students in receipt of Advanced Course Studentships were not generally aware that they had 'JCI' awards. As far as they were concerned, they had 'SERC' awards. It was not therefore possible to track and interview 'JCI' students, only those known to have received SERC awards. This made life difficult for the evaluators, but it had far more important implications for the JCI itself. It represents a missed opportunity in terms of community-building. Tagging grants would have allowed students to identify more with the JCI, the values it promoted and the research community it served.

Of the 17 students interviewed, two had completed the course at Manchester University, six at QMWC and nine at Birmingham University. Just over half had a first degree in computer science and the rest had a first degree in psychology / philosophy. When asked about their motivation for doing the course, five said that they were looking for a change in career direction, seven said that they were motivated by interest in the subject area, and three saw the MSc as a pathway to a PhD (although two of them subsequently went into industry). Fourteen out of the 17 were men, and most were in their early to mid-twenties.

Interviewees were asked about the positive and negative aspects of their courses. Overall opinion concerning the Birmingham course was positive. It was 'crammed' but good nevertheless. Some did comment, however, that it would have been more useful if members of staff had had a broader overview of the Cognitive Science and HCI areas. In comparison, there was more disenchantment with the course at QMWC. It was not as vocational as some people had been led to believe, though several students commented that it had been useful to carry out a research project as part of the course.

The destinations of SERC-funded students at Birmingham and QMWC from 1989 / 90 to 1993 / 94 (when JCI-funded places on Masters courses were available) are shown in **Exhibit 66**.

**Exhibit 66 The Destinations of SERC-funded MSc Students**

| | Academic | Industrial/ Commercial | Other | Total |
|---|---|---|---|---|
| **Birmingham** | 18 | 10 | 8 | 36 |
| **QMWC** | 13 | 12 | 1 | 26 |
| **Total** | 31 | 22 | 9 | 62 |

For both courses, half the students went into academic employment of some kind. The institutions concerned were unable to say whether or not these posts were in areas relevant to JCI, but telephone interviews threw some light on the topic. Half of those interviewed had stayed in academic research and most of these were pursuing subjects that were in some way related to Cognitive Science and HCI . Research subjects included virtual reality, neural networks, linguistics and psychology.

The remaining half were employed in industry or commerce. Although most of these jobs were in some way related to computing, not all of them utilised the subjects that had been taught on the Masters courses.

Only one person was in employment unrelated to the subject matter of her course. She was, however, intending to go back into academic research to conduct a PhD in clinical psychology. Although this was effectively going back to her original discipline, she felt she had gained a broader understanding of the subject as a result of the Masters course.

Most people moving into industry or commerce were motivated by financial considerations. Some said they did not want a career in research, and one said that industry, rather than academia, was at the 'cutting edge' of his subject area.

Two of the seven with jobs in the industrial/commercial sector said that they could have got them without their MSc qualification, and neither were using skills acquired during the course. Both of them, however, had first degrees in Computer Science. The remaining five could not have got their first jobs without the Masters degree. For those qualifying some time ago, the Masters degree was becoming less relevant as employers were naturally more interested in their subsequent work experience. The comment was made, however, that having the Masters Degree helped in getting interviews.

Only one person employed in the industrial/commercial sector said that he could not perform his job without the skills acquired during his Masters degree. He was employed as an applications software designer and exploited skills in computer science, psychology and HCI. His first degree had been in Psychology. For one or two others, the skills acquired on the course had given them a broader outlook which had proved helpful in their work. Two people mentioned that the course had been significant because it had introduced them to a whole new area. In turn this had helped them to decide what they wanted to do in their careers. One person, as a result of being interviewed, realised that he was not

using the training he had undertaken on the Masters course. He then resolved to look for work more closely associated with the knowledge and skills he had gained.

To summarise

- The Initiative was reasonably successful in increasing the supply of multi-disciplinary trained researchers in the areas covered by the Initiative
- Half of the interviewees involved in Masters courses went on to conduct research in Cognitive Science and HCI areas
- Most of the Masters students not entering academic research entered industry or commerce, but did not exploit the skills acquired
- Some entering industry / commerce said they had gained a broader perspective on problem solving as a result of the Masters course
- Most interviewed were satisfied with their courses, although more staff with a multi-disciplinary overview would have been appreciated
- Not labelling grants with a JCI tag represented a missed opportunity in terms of community-building

### 6.1.3 Research Studentships

Fifty-five Research Studentships were awarded in 26 departments[74] at 16 institutions (see **Exhibit 21** in **Section 4.2.4**). At least half went into academic employment; only a small number went into industry; and there was no information available on the remainder. Fifteen out of the fifty-five PhD students were traced and interviewed by telephone. Given tracking difficulties, this sample was biased towards those in academic employment.

Nearly all of the fifteen students interviewed started their Doctoral programme in 1990 or 1991 and most were in their early twenties at the start of the programme. Eight were male and seven female. Nine out of the fifteen had previously taken a Master's course, seven in the area of Cognitive Science and HCI and two in Computing.

Seven of the fifteen said they had been motivated by their interest in the subject area. Three of the seven said that their work continued or grew out of their work at MSc level. The remaining eight were primarily motivated by their desire to get a PhD or to enter academic research.

**Exhibit 67** lists the academic disciplines spanned by their theses. The extent of multi-disciplinarity is obvious. Subjects in **bold** represent 'added value' disciplines, i.e. those in which experience had been first gained during the course of the PhD. Those in *italics* are of some use in their present employment.

[74] N.B. Some studentships were shared across departments, though in practice they were largely based in just one of them.

**Exhibit 67 Disciplines Represented in PhD Theses**

- Psychology, Biology, Cognitive Science, Mathematics
- ***Linguistics, Logic***, Computer Science
- **HCI**, *Psychology*, Physiology
- Cognitive Science, *Cognitive Psychology, Educational Technology, HCI*
- **Cognitive Science, Linguistics**, *Psychology*
- ***Cognitive Science, Psychology, Computing,* Linguistics**
- Artificial Intelligence, HCI, **Psychology**, *Computer Science*
- *Linguistics,* Computing
- *Psychology, Computer Science*
- *Artificial Intelligence, Psychology, Cognitive Science*
- *Computer Science,* Cognitive Psychology, **Medicine**
- ***Computer Science***, *Clinical Psychology*
- *Psychology*, ***Linguistics, Computer Science***
- Psychology, ***Linguistics, Phonetics, Speech Engineering,* Computer Science, *Cognitive Science*, HCI**
- **Social Theories**, Sociological Theory, HCI

Students gaining the most 'added value' in terms of extra disciplines were those starting Doctorates without previously acquiring a Masters degree. Most students completing a Masters course in the Cognitive Science and/or HCI area tended not to add extra disciplines by undertaking a PhD. Many said, however, that the PhDs had allowed them to deepen knowledge and understanding in subject areas studied during their Masters programmes. The PhDs also involved inter-disciplinary research, i.e. several disciplines were used to investigate a single research topic. PhDs were more effective in promoting inter-disciplinarity, i.e. the merging of disciplines, rather than simple multi-disciplinarity, i.e. the addition of new disciplines.

Thirteen of the fifteen students interviewed were in academic employment. Eight were in research positions and five held lecturing posts. Research interests spanned human demography, IT and learning support, reading abilities, parallel software components, object naming, visual motion sensors and applied aspects of cognitive modelling. Of the two who were not in academic employment, one was a dictionary editor (in the process of setting up a collaborative research project between his employer and his former department) and one was a psychologist working in the NHS.

Five of those in academic employment had returned to the discipline of their first degree. For most this had always remained their primary focus. They had nevertheless developed a much broader perspective on their subject.

Ten interviewees said that they would not have obtained their present employment without a PhD; one was still completing on a self-financed basis; and four said that they had not needed them. Two of the latter were employed outside the academic sector in jobs not directly connected to Cognitive Science or

HCI. They both, however, felt that the work completed during their PhDs had helped them in their jobs.

All of those in employment said that they could not carry out the tasks involved in their present job without the skills, knowledge and awareness acquired during their PhDs. These were not always exclusive to Cognitive Science or HCI, however. Research methodology and statistical analysis in particular had proved extremely useful.

In summary

- Virtually all the awards granted to departments were taken up by suitable candidates
- Half the JCI funded PhD students went into academic teaching or research
- PhD studentships allowed people from single discipline backgrounds to 'add' more disciplines and to become multi-disciplinary
- PhDs undertaken after a Masters course in Cognitive Science / HCI deepened understanding in an area rather than increased an individual's range of disciplines. They added inter-disciplinarity to multi-disciplinarity
- Half the students interviewed were motivated by a desire to obtain a PhD, rather than by a strong desire to pursue a particular JCI-related topic
- Half the students entering academia went into JCI-related areas, and half returned to their original discipline (though with an improved awareness of other disciplines)
- All those interviewed said the skills, knowledge and awareness acquired during their PhDs were of use in their current occupations

### 6.1.4 Post-doctoral Fellowships

There were only 17 applications for the 12 posts on offer, and only seven of these were awarded. Understanding why demand was so limited is difficult to determine. The most commonly encountered perspective was that inter-disciplinary research at this level is risky in terms of securing a career in a mono-disciplinary academic environment. JCI set out to rectify this type of situation, but obviously it did not wholly succeed. Securing a foot in the door is a priority at this stage of an academic career, and for many the door presented by the JCI Fellowships must have appeared to open outwards rather than inwards.

Two of the seven award holders were interviewed by the evaluation team. Both were very appreciative of the opportunities presented by the awards to add additional strings to their bows. One added psychology to a background in IT, computer science and cognitive modelling. The other learned techniques drawn from physiology which added to his maths, physics and AI background and allowed him, amongst other things, to explore the role of trophic factors in the formation of thalomo-cortical connections. Both subsequently took up academic positions and continued to exploit their new-found skills and know-how in their research. Both, however, found it necessary to leave the UK in their search for suitable positions.

In summary

- The Initiative only funded a handful of Post-doctoral Fellows
- Low demand for places may have been limited by the high risk of pursuing inter-disciplinary careers in the UK

### 6.1.5 Summer Schools

Summer schools emphasising different themes took place in

- Heriot Watt University (1990)
- Aberdeen University (1990)
- Queen Mary and Westfield College (1991)
- Nottingham University (1992)
- Edinburgh University (1993)

Initially themes focused separately on HCI (Heriot Watt) and Cognitive Science (Aberdeen), but subsequent schools attempted a more integrative approach, e.g. Effective Multi-disciplinary Research in Cognitive Science and HCI (Nottingham), and Theories and Methodologies of Cognitive Science Applied to HCI (QMWC). Attendance was normally between 30 and 40 students, most of which were JCI-funded PhD students.

Recipients of Research Studentships were quizzed about Summer Schools. Many appreciated the opportunity to discuss ideas with other researchers. One student also mentioned the immense value of discussions with some of the 'big names' in the field. There were mixed opinions, however, on the issue of whether the Summer Schools had helped create a community of researchers in the field of Cognitive Science and HCI. Some were still in contact with people they had met at the Summer School, but most were not. Some did feel that these contacts could be revived if necessary, however.

In summary

- The Summer Schools were highly valued by all students for the opportunity they presented to discuss ideas with other students and with speakers
- There was no clear evidence that the Summer Schools had created a community of researchers in the area of Cognitive Science and HCI

## 6.2 Efficiency

- All the Masters and virtually all the PhD grants were taken up
- Committee selection procedures for Post-doctoral Fellowships were well specified and communicated to Panel members
- There were no obvious problems with the administration of the grants
- Adequate monitoring arrangements were put in place to oversee the implementation of courses in academic institutions

The evaluation load vis-à-vis efficiency of implementation was light. Progress was monitored by the Coordinator and attendance by the evaluators at Training Panel meetings and selection interviews for Post-doctoral Fellowships allowed some insight into the efficacy of the procedures adopted.

Allocation of the awards for which the Training Panel was responsible proceeded smoothly. As noted earlier, resources were expended in line with the original allocation, most planned Research Studentships were awarded and taken up, and the number of planned Advanced Course Studentships was exceeded. The number of Post-doctoral Fellowships was limited, but this was due to lack of suitable demand rather than to any quirk in the selection procedures.

In terms of the conduct of Panel meetings and selection interviews, the procedures adopted were exemplary. Selection criteria in particular were clearly articulated and communicated to Panel members prior to the selection interviews, and subsequent discussions concerning eligibility and suitability were very much couched in terms of these criteria.

The Training Panel also has to be complemented for the procedures it put in place to monitor the administration of grants and the implementation of MSc courses in the five institutions responsible for running them. Site visits allowed progress to be reviewed, and the monitoring and evaluation reports written by the Coordinator facilitated forward planning.

## 6.3 Appropriateness

- Certainly an appropriate mechanism to establish a cadre of young researchers with an interest in JCI research areas
- Insufficient scale and duration to establish a critical mass

The major appropriateness issues concerning the Training Programme revolve around

- The wisdom of having a Training Programme

- The desirability of running the training and research components in parallel under the same Initiative
- The scale and duration of any training effort

The prime responsibility of the JCI was to stimulate research in an area of strategic importance. In itself this did not necessitate a complementary training component, but the long term viability of continued research in the area did require additional efforts to stabilise and populate the domain. A research component was needed to attract people into the no-mans land between Cognitive Science and HCI. The hope was that this 'first wave' of settlers would put down roots and attract others into the territory. The Training Programme was part of this long-term population strategy. Although constrained in time, it delivered a set of potential recruits for the 'second wave' and helped establish the infrastructure and supply lines for the future.

The wisdom of having an associated Training Programme is not in doubt. It was also prudent for it to run alongside the Research Programme and for it to be steered by a sub-group of the main JCI Committee. This enhanced planning and coordination and complemented the community-building tasks of the Main Committee.

The issues of scale and duration are more contentious. The scale of skill shortages in the HCI area generally, in both academia and industry, would seem to demand a much larger training effort than witnessed in JCI. Matching supply with demand, however, is a tricky business which takes time and careful planning. There is no point in hastily training large numbers of people if subsequent career paths in which they can exploit their skills are limited. There may be an urgent need for skilled multi-disciplinary researchers, but the ability of the demand side to absorb these people is itself imperfect. In the case of the JCI, some absorption did occur, but the demand side did not prove to be an infinite sink. The small scale of the the JCI training effort was thus an appropriate first step in the process of satisfying latent demand. It did not produce the critical mass needed to ensure the continued stability and growth of the population in the 'new territories', but this is a longer term task requiring further effort. Without follow-on efforts to build on the achievements of the Training Programme, the training element has to be judged inappropriate. With them, the combination of training and research components makes sense. The JCI Training Panel and the Main Committee recognised this and are to be congratulated for making the continuation of the training element one of the main planks of their suggestions for the future of the area at the interface of Cognitive Science and HCI.

# 7.0 Recommendations to Guide Future Policy

The JCI was an ambitious policy intervention aimed at shaping the course of developments in an interdisciplinary area of great strategic relevance. It constituted a response to a perceived need and was premised on the belief that know-how in one 'feedstock' area, Cognitive Science, could provide the intellectual underpinning for developments in another 'application' area, Human Computer Interaction.

In many ways the JCI was an experiment which promised much in terms of lessons for future practice, both within the specific domains of Cognitive Science and HCI and in terms of support mechanisms for scientific research more generally. In particular, it was expected to demonstrate whether or not

- Cognitive Science could underpin the development of HCI
- Programmatic interventions combining research and training components are suitable mechanisms for stimulating research in multi-/inter-disciplinary areas of interest to a number of Research Councils

Although the JCI did support high quality work, its overall impact on the research communities involved was limited and it achieved few of its 'bridging' and 'nurturing' aims - largely because it came to consist primarily of Cognitive Science projects rather than projects genuinely 'bridging' Cognitive Science and HCI. At first sight, therefore, the JCI experience seems to suggest that programmatic interventions aimed at bridging different domains may not be appropriate policy mechanisms. Such a conclusion would be unfair, however. The JCI suffered from

- Weakly articulated and poorly communicated goals
- Selection criteria and processes out of alignment with programme objectives
- Flawed programme management, administration and support

Weak programme implementation helped undermine goal attainment, and the case for or against the use of programmatic interventions to stimulate the development of inter-disciplinary areas remains unproven.

The main lessons for the Research Councils involved in the JCI relate not to the desirability or appropriateness of particular policy mechanisms in certain settings, but to the critical importance of adequate and appropriate implementation procedures. The way the JCI experiment was conducted meant not only that the experiment itself was only a limited success, but that lessons for future practice were largely restricted to the sphere of programme implementation. These largely relate to

- Establishing and communicating aims and objectives
- The choice of appropriate shaping mechanisms
- Ensuring adequate and efficient management procedures are in place

Drawing on the evaluation findings contained in **Sections 5** and **6** and presented in a more concise form in the **Executive Summary** at the start of this report, the **main lessons for future practice** can themselves be summarised as follows

- **Initiative aims and objectives have to flow from a sound rationale, which in turn calls for an appreciable investment in *ex ante* appraisals of indigenous strengths, weaknesses, needs and aspirations**

- **Programme goals have to be clearly and unambiguously specified at an early stage and communicated to Committee members and targeted research communities**

- **Programme goals and selection criteria are worth reiterating at each project selection meeting, especially if membership of Committees varies over time**

- **Project selection criteria and procedures have to flow from the logic of programme goals and lead to the selection of projects capable of realising these goals**

- **Quality criteria should not be allowed to dominate during the project selection process when relevance to other programme goals is considered of equal or greater importance**

- **Attempts to encourage the balanced development of a field need to distinguish between 'equalisation' strategies which attempt to select similar numbers of projects in a given number of sub-fields, and 'substitution' strategies which drop and add sub-fields in line with proposal pressure. The choice of which type of strategy to adopt should depend largely on the results of initial *ex ante* appraisals**

- **'External' shaping mechanisms designed to stimulate proposals in specific fields are useful complements to, but inadequate substitutes for, strong 'internal' shaping mechanisms, i.e. adequate project selection procedures**

- **The success of 'external' shaping mechanisms depends critically on the calibre of an Initiative's Coordinator, which in turn is a function of attractive remuneration and reward structures**

- **Parallel training components have merit as 'community building' devices, though the time-scales involved ought to be longer than those for research initiatives if they are to be truly complementary**

- **Programme Committees composed of working academics cannot be expected to be thoroughly familiar with programme management concepts such as allocation, award and spend/commitment profiles. If Committees are to function effectively, they have to be briefed adequately**

- **In particular, Programme Committees have to be made aware at an early stage of the need to front-load commitment if 'tail management' problems are to be avoided**

- **The whole problem of 'unrecoverable underspend' can be minimised by careful planning, but there is surely scope for additional, transparent mechanisms to facilitate smooth transfers across year-ends**

- **Programme Committees cannot be expected to make sound selection decisions in the absence of adequate and timely financial information concerning the state of an Initiative's resources**

- **There is scope for much more sophisticated, real-time analysis and feedback of Committee selection decisions and behaviour at the tail-end of Committee meetings. A modest amount of preparation prior to these meetings would allow Committee scores and selection decisions to be analysed on the spot and discussed in terms of budgetary implications, the consequences for programme composition and fit with programme goals. Readjustments could then be made to ensure Initiatives stay on track**

# Appendices

## Appendix 1
**Report of the Peer Review Panel on the Joint Council Initiative in Computer Science and Human-Computer Interaction**

## Appendix 2
**JCI Project List**

## Appendix 3
**Exit Interview Checklist**

## Appendix 4
**Exit Questionnaire and Survey Data**

## Appendix 5
**Rapporteur and Committee Scores for JCI Projects**

## Appendix 6
**Published Outputs of JCI Projects**