

10 Corporate research and development

Introduction

10.1. In this chapter we examine AEA's arrangements for selecting and controlling corporate R&D projects, and the changes in these arrangements in the wake of the November 1990 report by ACOST. The chapter starts with a brief review of the arrangements for underlying research which existed prior to the SIP in 1989. We then describe the changes associated with the reorganisation in early 1990, including the first report by ACOST in March 1990. In subsequent paragraphs we summarise the findings and recommendations of the second ACOST review (November 1990) and then describe AEA's current arrangements. Our conclusions are at paragraphs 10.43 and 10.44.

Background

10.2. From 1954 AEA maintained a programme of fundamental research known as the underlying research programme. This was aimed at providing new expertise and scientific understanding relevant to AEA's future technical programmes and was oriented predominantly towards nuclear research.

10.3. Until 1986 and the change to a trading fund basis the underlying programme was directly vote-funded. The Government was concerned that the change in AEA's status should not adversely affect the underlying programme and that AEA should retain the right to determine its detailed content. To reflect these and other considerations a new funding arrangement for the programme was introduced by means of a specific levy on all contract work carried out by AEA (see Chapter 14).

10.4. Following the SIP and the change to a business-led structure (see Chapter 2), AEA took the decision to replace the underlying research programme by a new approach to CRAD.

10.5. Under the new arrangements the content of projects was to focus on technologies offering particular competitive advantages in relation to the businesses' target markets and products. Some existing projects were consolidated and redirected, while many new projects were introduced (in stages). Overall, the investment would include a greater proportion of shorter-term and non-nuclear- oriented activities, and would be more consolidated (for instance, in the larger New Business Investment Projects). For project control, the technical, commercial, financial and resource aspects of project management would be integrated within the standard departmental structure of the businesses to enable stronger co-ordination of teams and projects to be applied by senior management. Reflecting the changes in investment 'culture', all investment would be focused on commercial benefit, whether tangible (eg developing exploitable technologies) or intangible (eg enhancing expertise and maintaining a reputation for excellence).

10.6. The reduction in funding resulting from cuts in Government programmes, in combination with the impact of business prioritisation, led to the closure of a number of major facilities (particularly some unique, nuclear-related ones) and withdrawal from certain activities especially in basic research. In January 1990 following an exchange of letters between the Secretary of State and the Chairman of ACOST, a study was initiated by ACOST to address the following key issues:

- the changes in AEA's underlying programme and its reclassification into CRAD;
- the impact of these changes on the parts of the former underlying programme categorised as 'Basic Energy Science', particularly university co-operation;

- the potential loss to the United Kingdom of scientific expertise, equipment, training and research facilities;
- whether there were other reasons of national importance to justify retention of the facilities, such as safety, defence and industrial needs; and
- the impact on a wide range of possible users and the availability of alternative facilities.

10.7. In its first report, submitted in March 1990, ACOST concluded that the majority of programmes and facilities related to underlying research were initiated during a period when nuclear power was at an early stage of development. Nuclear power was now a mature industry and should decide for itself what research to fund. The report went on to say that:

The decisions made by AEA to discontinue certain areas of basic energy science and concentrate on a five year horizon reflect the evolution of their research programmes in a new commercial environment. We therefore see no compelling reason on grounds of national interest to change the management's decision to cease their own support for this work and to take the appropriate decisions in relation to the future use of these facilities. They must decide priorities and the appropriate balance between short, medium and long term research.

The second ACOST study

10.8. As described in Chapter 2, the new AEA structure came into effect in April 1990. The change from the underlying research programme to CRAD took place at the same time. In May 1990 the Secretary of State wrote to the Chairman of ACOST asking that the second phase of the study be undertaken and a report submitted during November 1990. This phase of the study was to examine the management of AEA's former underlying research programme and its transformation into CRAD. The main objective was to provide advice and guidance to assist the future development and management of these programmes within the new, more commercially-oriented operation.

10.9. ACOST found that the development of the CRAD programmes for 1990/91 involved the creation of new systems, procedures and methods before the new business organisation was fully operational. As a result 1990/91 was a transitional year in which interim procedures were used. New systems and procedures were being devised but they had not been fully implemented or tested in practice. As a consequence the ACOST study group were not in a position to comment on the new systems and procedures on the basis of any historical data or experience.

10.10. The basis of the new system was that proposals were put forward by individual AEA businesses in two categories: CR, where tasks would normally be completed in two to five years, and AD, where the time-frame was up to two years. In each case proposals must have the explicit support of one of the businesses and there must be clear identification of at least one named commercial exploiter. ACOST reported that there was an extensive process for the discussion of proposals and for prioritising and selecting the programme. CR projects required the approval of the DCR (who is also the Chief Scientist) who also provided strategic guidance to the Authority on the balance between short (AD) and longer-term (CR) investment. At the time of the study CR accounted for about two-thirds of the programmes but new tasks were more strongly oriented towards applications.

10.11. The ACOST study group commended AEA on the considerable progress made between January and May 1990 in the transformation both of the formal systems for selecting, commissioning and controlling research programmes and in the development of its corporate culture and goals. ACOST found that the formal systems which had been introduced were in accordance with good modern practice, providing clear recognition of the customer/contractor relationship, formal controls to ensure an emphasis on responsiveness to commercial goals and a well-defined methodology for planning and control.

10.12. Following a detailed study of the proposed systems and procedures, the ACOST group made nine recommendations. These are set out below:

- (a) We recommend that senior management regularly monitor the speed, relevance and accuracy of data provided to project leaders both by monitoring the system performance itself and by obtaining feedback directly from those who use the data. Any deficiencies in the system which monitoring indicates should be remedied as rapidly as possible.
- (b) We recommend that the potential for the use of common software, techniques and environments for project management should be investigated.
- (c) We recommend that the Managing Director Businesses should consider the extent to which more frequent monitoring to predetermined milestones should be adopted in all business areas to supplement the annual reviews.
- (d) We therefore recommend that the AEA should undertake a review of its policies and procedures for dealing with IPR (Intellectual Property Rights) issues in the light of the changing requirements of the business as a whole.
- (e) We recommend that a review is made of the potential for the use of formal methods for portfolio management.
- (f) We recommend that senior management should keep under review the continuing relevance, balance and effectiveness of the decision making information they are receiving.
- (g) We recommend that senior management develop a regular monitor of key financial trends and ratios particularly in relation to overheads.
- (h) We recommend that the AEA board consider the possibility of introducing a modest budget for research under the direct control of the Chief Scientist at a later date when the commercial success of the organisation has been assured.
- (i) We recommend that senior management develop a cycle of planned review and improvement of the system to ensure that it is responsive to changing requirements and capable of achieving the best results.

AEA's current approach

10.13. As noted in the ACOST report, the arrangements for the year 1990/91 represented a transitional stage. Several changes were introduced for the year 1991/92, some of which reflected the ACOST recommendations. The programmes are now collectively known as Corporate Investment in Research and Exploitation (CIRE) and a third category has been added.

10.14. AEA told us that CIRE constituted corporately-directed investment in key technologies to create or strengthen sources of competitive advantage for itself, contributing to future profitability. It considered these activities essential because, to be successful within an environment of accelerating technological change, any R&D organisation such as AEA had to innovate more frequently or introduce more radical innovations than its competitors. Such investment had to provide for superior performance on features that were important to the target customers at a competitive cost. AEA added that the major themes of its policy on CIRE included:

- responsiveness to market requirements;
- consistency with the strategic vision for AEA and its individual business units; and
- building long-term advantages derived from core competencies which were common to several business units.

10.15. AEA defined the three categories of CIRE activity as:

- CR: longer-term research projects (typically two to five years), underpinning essential existing expertise or creating new capabilities (prior to targeted development/exploitation);
- applications development research (ADR): shorter-term research projects (typically six months to two years), focused on the development of products or services with a well-defined route for potential exploitation; and
- NBIPs: large technical investment projects promising large-scale returns according to a detailed business plan.

All projects involve technical research and may also include an element of associated business development.

10.16. The CIRE programme is corporately directed and appraised, but business-driven, managed and executed. Fund allocation is by a 'Benefit Investment' mechanism, which requires projects to gain the support of one or more business. AEA told us that this approach focused projects on to identified business needs, thereby stimulating commercially relevant activity. In addition, arrangements for project evaluation emphasised a requirement for high technical quality. A broad range of technologies was supported while corporate co-ordination and communication helped to identify the strong cross-business synergies, and potential for collaborative development.

10.17. The businesses are responsible for managing and executing CIRE projects, to an agreed specification, time and cost. The customer for CR projects is the DCR, while for ADR projects and NBIPs the businesses are accountable to the relevant Managing Director (for whom the DCR acts as the proxy customer, particularly on technical issues and administrative co-ordination). They are also responsible for the commercial exploitation of project output and have a role in proposal selection, in-year monitoring and post-project review, both for internal business purposes and in concert with corporate requirements.

10.18. Within the businesses the key staff involved in CIRE are the Task Leaders and their technical teams. The Task Leader is the identified scientist who manages the project workplan, controlling its direction, monitoring progress and ensuring quality on a day-to-day basis. The Task Leader is responsible through line management to his Research Manager for the expenditure profile and technical performance of the project, and must also satisfy the Research Managers of any other businesses which have contributed Benefit Investment funding. The Commercial Exploiters are identified technical and/or marketing staff in the benefiting business(es) who take responsibility for gaining commercial value by exploiting the project output.

10.19. The Research Manager of each business is responsible for:

- developing an investment strategy for the business which meets with the approval of the business Chief Executive, and for negotiating with the DCR for appropriate investment;
- assisting the business Chief Executive in selecting proposals for submission to the DCR and top management;
- ensuring a high quality of corporately-funded research in the business;
- ensuring that the work comes within budget and meets its objectives; and
- working with the DCR in supervising and corporately monitoring the CIRE programme.

Each Research Manager is accountable to his Chief Executive, and thence to the DCR and Managing Directors.

10.20. At corporate level responsibility for CIRE covers the following areas:

- (a) determining an AEA-wide investment strategy, including inter-business prioritisation, consistent with AEA's vision for its future development;

- (b) executive control of CIRE funding allocations;
- (c) technical co-ordination of the investment, identifying synergies and encouraging collaboration;
- (d) technical and commercial appraisal of projects (through selection, in-year monitoring and post-project review); and
- (e) monitoring and encouraging technical excellence.

10.21. As noted in paragraph 10.17, the DCR has executive responsibility for the content of the CR investment, and acts as proxy customer on ADR and NBIPs. Thus the DCR retains an overview of the programme in its entirety, in order to be able to advise the Managing Directors and AEA's Chief Executive. His activities include:

- (a) co-ordinating the selection of CIRE, developing an overall investment strategy for consideration by top management, and screening all proposals;
- (b) budgetary supervision and expenditure authorisation;
- (c) monitoring and reviewing progress and scientific quality; and
- (d) analysing and communicating investment content and performance.

10.22. The overall content and strategy of the proposed investment is scrutinised annually by the CR/AD Group (a small group chaired by the AEA Chief Executive). The allocation of funding to support the CIRE programme requires the endorsement of the AEM and final approval by the Authority Board.

10.23. The DCR chooses a number of AEA scientific staff as technical advisers who attend relevant project monitoring meetings and advise him on technical value and quality, drawing on their own specialist expertise. In his capacity as Chief Scientist the DCR chairs an advisory committee which seeks to ensure that AEA's core capabilities and key resources are 'appropriately sustained and nurtured'. In relation to CIRE the scientists who act as Heads of Technical Area on this committee seek to identify and encourage cross-business links, assess the state of health of technical capabilities, recommend investment priorities and identify opportunities for rationalisation and joint investment in facilities.

10.24. All CIRE projects, both new and ongoing, are subject to annual selection. In addition, a small proportion of projects may stop or start in the course of the year, subject to the approval of the relevant Research Manager, of the DCR for CR projects, and of the relevant Managing Director for major developments in the ADR and NBIP categories. The selection procedure is arranged to tie in with AEA financial planning requirements.

10.25. The DCR formally initiates the selection process at the end of June by issuing a 'Call for Proposals for Tasks' to be funded in the following financial year. This includes guidance provided by the businesses on their technical and commercial priorities, in order to stimulate relevant innovation and to communicate opportunities for inter-business collaboration. Proposals are prepared by technical staff, initially in summary form, for screening by business senior management. The formulation of NBIPs is usually triggered by top-down business guidance.

10.26. Each proposal author must identify one or more benefiting businesses which want the work to be done, ie one or more Research Managers who will assign the proposal a high priority call on the limited corporate funding to be invested for their business's benefit. Thus the proposal may relate to activity in other non-benefiting businesses.

10.27. There are three stages in determining priorities in relation to funding:

- (a) *The size of the CIRE 'envelope'*. The Chief Executive's Strategy Group considers competing claims, and recommends allocations according to business criteria in the light of forecast income. The DCR presents the case for CIRE funding, based on his accumulated strategic view combined with business submissions of their parochial investment strategies and related funding bids.

- (b) *The CIRE 'envelope' allocation between businesses.* The CR/AD Group recommends a combined CR and ADR allocation as a planning target for each business, together with a corporate fund for NBIPs. The DCR again presents the initial proposal, building on strategic business input and preliminary NBIP submissions. There is no a priori segmentation of funding between CR and ADR categories; businesses are given the responsibility to judge the balance between shorter-term and longer-term investment most appropriate to their individual needs.
- (c) *The allocation of funds to individual proposals.* Research Managers co-ordinate the prioritisation of proposals within their own business, also identifying their funding support (Benefit Investment) for collaborative cross-business projects. The DCR assesses all proposals, with the Business Advisory Group focusing on the commercial appraisal of NBIPs. The DCR is responsible for the final selection of CR, and advises on ADR and NBIPs (including the balance of short- and long-term projects).

10.28. Following the analysis of consolidated business plans by the AEM (in January), the overall CIRE envelope, business allocations and proposal portfolios may be adjusted (by the CR/AD Group and the AEM), depending on revised income forecasts and proposal quality. Final approval of the CIRE budget is given by the Board in its consideration of the overall AEA budget.

10.29. CIRE projects are controlled at the business level, while supervisory oversight is maintained at the corporate level (with executive authority to intervene where appropriate). AEA told us that projects were integrated into business activities to ensure that no gaps emerged between corporately-funded research and the commercial environment, assisting the rapid recognition and exploitation of business opportunities. This policy was adopted deliberately when the CIRE system was set up, in preference to establishing separate teams and facilities dedicated to corporate R&D.

10.30. The DCR co-ordinates the adoption by the businesses of uniform arrangements for CIRE appraisal and documentation; a primary concern is to avoid inefficient duplication of managerial controls while satisfying the DCR's requirements to be informed (as customer or proxy customer). These arrangements include:

- (a) the specification of projects in detailed proposals (stating technical and commercial objectives, work content and exploitation scenarios);
- (b) the specification of milestones and deliverables against time and cost; and
- (c) an annual round of face-to-face monitoring meetings (involving the DCR and other personnel principally concerned).

10.31. At the end of the financial year written project reports (covering technical performance, the return on investment, and future prospects) are evaluated within the businesses and by the DCR and the Chief Scientist's Committee. CIRE documentation is collected corporately to provide a database for future post-project evaluation. Since the time-scale for exploiting R&D projects is typically substantially longer than one year, the elapsed time since CIRE was established is too short to be able to demonstrate significant returns on the investment as yet.

10.32. Once the projects are approved at a corporate level, each business receives CIRE funds for the projects which it will carry out; these will not necessarily be for its own benefit. Table 10.1 identifies the distribution of total CIRE expenditure with reference to benefiting businesses in the financial year 1991/92. Corporate benefit relates to activities which are perceived to benefit AEA as a whole rather than any particular business; they also cover contractual commitments inherited from the former underlying research programme.

TABLE 10.1 CIRE 1991/92: distribution by benefiting businesses (cash of year, as at 1 April 1991)

Business	£'000			
	NBIP	ADR	CR	Total
RS	1,050	1,310	2,258	4,618

FS	350	445	355	1,150
D&R	240	705	545	1,490
FUS	121	121	148	390
APS	0	1,115	695	1,810
S&R	0	540	460	1,000
E&E	260	584	886	1,730
InTec	2,510	2,608	3,181	8,299
Corporate benefit	<u>0</u>	<u>0</u>	<u>1,013</u>	<u>1,013</u>
	4,531	7,428	9,541	21,500

Source: AEA.

10.33. The forecast distribution of the activity spend between the businesses for the same year is shown in Table 10.2. This indicates the cross-business links on CIRE projects, with technical resources in some businesses being directed towards market opportunities in others. The InTec and RS businesses are the major net providers of technical capability to other businesses.

TABLE 10.2 **CIRE 1991/92: distribution by business undertaking work and benefiting business (cash of year, as at 1 April 1991)**

£'000

<i>Business</i>	<i>Activity spend</i>	<i>Benefit investment</i>
RS	4,911	4,618
FS	1,177	1,150
D&R	1,505	1,490
FUS	165	390
APS	1,617	1,810
S&R	1,051	1,000
E&E	1,351	1,730
InTec	9,039	8,299
Corporate benefit	<u>684</u>	<u>1,013</u>
	21,500	21,500

Source: AEA.

Note: Corporate benefit spend outside the business covers:

- CR Directorate and AEA Chief Scientist costs;
- unassigned contingency funds; and
- £200,000 contribution to the UK Co-ordinating Committee for Cancer Research.

10.34. For 1991/92 the CIRE programme included a total of 270 projects. In terms of expenditure these ranged from £3,000 to £770,000, with a mean of £78,000. Of the total, 127 projects cost less than £50,000 and 60 over £100,000.

10.35. Table 10.3 sets out the past, present and future expenditure on CR. For the years 1988/89 and 1989/90 the figures relate to the former underlying research programme which had different objectives and technical content from CIRE. The figure of £22.9 million for 1990/91 was affected by a carry forward of £1 million from the previous year as unspent levy, a mechanism no longer available. Furthermore charges of £1.15 million were incurred to increase the provision for radioactive waste liabilities associated with the underlying programme.

TABLE 10.3 **Underlying research (pre-April 1990) and CIRE (post-April 1990): expenditure out-turns and budget plans (cash of year)**

Financial year	£ million		
	Expenditure out-turn	Budget	Forecast budget
1988/89 (ULR)	26.1		
1989/90 (ULR)	24.8		
1990/91 (CIRE)	22.9		
1991/92 (CIRE)		21.5	
1992/93 (CIRE)			22.7
1993/94 (CIRE)			23.2
1994/95 (CIRE)			23.2

Source: AEA.

Notes:

1. ULR = underlying research.
2. The forecast budget for CIRE in future financial years assumes a constant percentage (4.7 per cent) of the turnover projection for the period of the current AEA Corporate Plan (1991 to 1995).

10.36. The CIRE budget for future years will be determined by the Board on the basis of the quality and potential return on investment indicated by proposals matched against requirements and by the availability of funds within AEA's margin. AEA told us that precise expenditure plans for future CIRE were not available. An indicative forecast for the next four years is given in Table 10.3 by assuming a constant percentage of turnover. However, these figures represent neither a planning target nor an expectation of investment levels. The demand for CIRE funds, as indicated by the business bids being formulated for 1992/93, is substantially higher. Although the CIRE budget will be determined by the Board, the availability of funds will be influenced in particular by major customers continuing to accept that the margin allowed as part of the contract price should include a reasonable element for R&D purposes (see Chapter 14).

Response to ACOST recommendations

10.37. AEA told us that its response to the first three ACOST recommendations (paragraph 10.12(a), (b) and (c)) had wider implications than CIRE alone. A new FIS was being introduced in April 1992 (see Chapter 5) while steps had been taken to improve project management skills and systems (see Chapter 12).

10.38. In addition, a feedback and review process was now in place based primarily on internal assessment and liaison meetings with Research Managers in the business. This was aimed at improving the corporately determined aspects of CIRE management and ensuring responsiveness to changing requirements. Areas which had already seen changes were:

- the clarification and formal definition of responsibilities/accountabilities;
- the sequencing and timetabling of the project selection procedure (to tie in with the AEA planning system and business needs);
- the organisation of monitoring meetings; and
- documentation (refining formats and instructions to improve effectiveness and remove redundancy).

10.39. AEA told us that other corporate level actions planned or taken were as follows:

- (a) quality assurance (QA) procedures were scheduled for introduction by April 1992;
- (b) information systems of increasing sophistication were being developed within the Corporate Research Directorate;

- (c) liaison with the FIS project team was being maintained to ensure that the corporate overview of the CIRE spend would be achieved effectively (including enforcement of expenditure limits) within the new FIS system post-April 1992;
- (d) a methodology was to be developed for post-project review, based on the existing provisions for collecting documentation;
- (e) the DCR's investment strategy would be developed further, building on inputs such as the core competence study; and
- (f) the content and presentation of the Annual and Highlights Reports were being refined to improve their effectiveness for communication and publicity purposes.

10.40. AEA also told us that the DCR was in the process of developing a systematic investment strategy and associated portfolio selection methodologies. This task included the core competence analysis and examination of best practice in external organisations; the DCR in his role as AEA Chief Scientist belonged to the CBI Research and Manufacturing Committee, the Energy Industries Research Liaison Group and the SERC Materials Commission, and had numerous other contacts with R&D operations outside AEA.

10.41. The review process described in paragraph 10.38 involved formal meetings with Research Managers and internal appraisal by the DCR and Programme Secretary as part of the annual planning/financial cycle. This built on informal feedback, for example from monitoring meetings, the Chief Scientist's Committee and routine meetings of AEA senior management. All CIRE documentation had been revised to some extent since the ACOST study.

10.42. ACOST recommended (recommendation (h)) that the Authority consider the possibility of introducing a modest budget for research under the direct control of the Chief Scientist at a later date when the commercial success of the organisation had been assured. While the purpose of this recommendation was appreciated, AEA told us that both the Chief Executive and the Chief Scientist considered such a scheme inappropriate at present while AEA was concentrating on establishing its commercial success. The issue would, however, be considered at a later date.

Conclusions

10.43. Since the second ACOST report in November 1990, AEA has introduced a number of changes in the procedures for selecting, approving, controlling and monitoring R&D projects related to new products and business opportunities. These changes took account of each of the ACOST recommendations except that relating to provision of a fund for projects initiated by the Chief Scientist, which was dependent on AEA's commercial success. We conclude that AEA has effectively implemented the ACOST recommendations.

10.44. All projects included in the new arrangements are proposed by the businesses and assessed on both their technical merit and their commercial prospects. Most of the current budget of £21.5 million has been allocated to projects sponsored by the industrial businesses. As we conclude in Chapter 14, we believe that the overall level of funding is about right.