NATIONAL AUDIT OFFICE

Report by the
Comptroller and Auditor General

Natural Environment
Research Council

Construction of the Southampton Oceanography Centre

HC 494 Session 1997-98
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This report has been prepared under Section 6 of the National Audit Act 1983 for presentation to the House of Commons in accordance with Section 9 of the Act.

John Bourn
Comptroller and Auditor General

National Audit Office
13 January 1998

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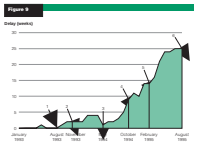

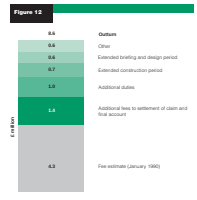

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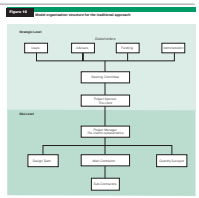


Summary and conclusions

1 The Oceanography Centre (the Centre) in Southampton provides a research and teaching facility. The Centre was completed in 1995, about 22 months later than originally planned, but by March 1997 the final cost had not been determined because of a dispute with Wimpey, the main contractor. If Wimpey were to pursue a claim against the Natural Environment Research Council (the Council) and were fully successful, the budget of £49 million could be exceeded by a substantial amount. Although the Centre is jointly funded by the Council and the University of Southampton, the Council took the lead in the construction project.

2 This report examines: how far the Centre meets the users' needs (Part 2); why the construction project was over time and budget (Parts 3 and 4); and how the Council managed the project (Part 5).

Conclusions

3 The project was a major event for the Council. They created a new type of facility and were faced with their largest ever capital construction project. The Council were aware of potential risks and took action to address them. They used an appropriate contract strategy, tried to complete the design before they went to tender, and limited client changes during the construction stage. They also undertook the work on the foundations separately in order to avoid delays. Initial indications are that the users are broadly content with the building. Nevertheless, despite the Council's efforts, there were significant time and cost overruns, caused primarily by poor project management.

4 The Oceanography Centre project illustrates many lessons which are important, especially for small organisations who are inexperienced in managing major construction projects. Although guidance on the management of construction projects has developed since the project first began in 1989, the Council should have foreseen and guarded against some of the problems which occurred by following existing good practice.

5 While some problems on this project remain outstanding, the Council have taken steps to improve their management of other capital schemes. As a result of recommendations by the Public Accounts Committee in December 1993, following the Committee's examination of the Council's management of capital projects, the Council issued guidance. Subsequently, in July 1995 the Council commissioned a post project evaluation of the Oceanography Centre project. This drew out a wide

range of recommendations for improved control of future projects. The Council have accepted these. We welcome the Council's actions, and make further recommendations in this report for improving project management.

How far the Centre meets the users' needs

6 Budget pressures during design led to cuts and reductions to the specification. As the objectives were not prioritised the Council could not easily take account of the relative importance of the changes they made to the specification. In addition many of the objectives for the building were not defined precisely in the brief and it is therefore difficult to assess how far they have been achieved. Nevertheless, the users are broadly content with the building, even though some of the facilities that they specified are not provided (paragraphs 2.13, 2.25, 2.26, 2.36, 2.37, Figures 5 and 6 and Appendix 4).

7 The brief specified a 125-year life for the structure. To this end the project team, after discussing alternatives, selected a design which provided for additional floors to help distribute mechanical and electrical services and thus provide flexibility in such services over the building's life. The team did not present alternative designs to senior management or users' groups, and gave them little information on the costs and benefits of the chosen design. Therefore senior management could not make informed choices. We noted that the Council paid up to £1.5 million for the additional floors to accommodate mechanical and electrical services which will provide flexibility in the future (paragraphs 2.16 to 2.18, 2.22 and 2.24).

8 The Council did not make use of sufficient professional assistance in the briefing and design stages. They used little outside advice in drawing up the brief, challenging users' requirements and assessing the brief or the design. Although they commissioned a value management review, it was too late to have a real impact on the cost or design (paragraphs 2.11, 2.12, 2.14, 2.15, 2.32 and 2.33).

9 We **recommend** that:

a) the Council should undertake a post-occupancy review to identify how far users' needs have been met, within the available resources, and whether the Centre is operated efficiently and effectively;

and, for the management of projects generally, that:

b) objectives in terms of time, cost and quality should be set at the start of a project, including their relative priorities;

c) relevant expertise should be used to compile the brief and to challenge the users' requirements; and

d) for larger projects, there should be alternative concept designs which reflect the different weightings attached to individual objectives and provide costings of different solutions.

Why the project took 22 months longer than originally planned

10 The Council extended the briefing, design and tender stages from 34 to 49 months. When they awarded the contract the construction period was one month longer than originally forecast. In the event, construction was completed six months beyond the contract date (paragraphs 3.4, 3.7, 3.10 and Figure 7).

11 The Council extended the pre-construction stages to refine the brief and to ensure that the design was complete and the budget was not exceeded. They considered the project's timely completion to be of a lower priority than meeting their objectives of cost and quality (paragraph 3.7).

12 As they had not made any consultant responsible for the timely delivery of the project, the Council's response to notifications of delay during construction was slow. However, when delays occurred, they reduced monthly payments and levied liquidated damages (paragraphs 3.13 to 3.18).

13 We **recommend** that departments should act quickly to minimise delays, by keeping in close contact with contractors, agreeing recovery plans, avoiding confrontation and, if these processes fail, applying sanctions.

Why the budget was exceeded by £2.7 million by March 1997

14 In our opinion the inadequacies of the budget, poor control over fees and areas of uncertainty in the design before awarding the construction contract were the main causes of the cost overrun.

15 The Council obtained provision in the 1988 Public Expenditure Survey for a new building. At that stage they had not developed their requirements for the building and their bid for funds contained no allowance for risk. The ideal requirements specified in 1990 exceeded the funding, available from the Council and expected from the University, of £48 million by between £17 million and

£25 million. From then on, a major factor in the development of the design was the need to contain the costs within the money available. Since there was no contingency for design development, any further cost increases had to be funded by making cuts to the project. Despite a series of such exercises, further design reductions had to be made after receipt of tenders (paragraphs 2.25, 2.26, 4.8 to 4.12, 4.14 to 4.16 and Figure 5).

16 In March 1992 when the Council went out to tender there were still areas of uncertainty in the design desite their efforts to avoid this. Because the Council did not act on early warning signs, and because of the payment terms in the contract, the extent of the resulting cost overruns was not identified until late in the project when the Council could not take effective remedial action (paragraphs 4.20, 4.21, 4.28, 4.29, 4.33, 4.34, 4.38 to 4.40 and Figure 13).

17 Fees doubled during the project, from £4.3 million to £8.6 million. This was due to the extension of the design period to accommodate fundamental changes, the delay in construction, and the consultants' claims for additional duties not covered in their terms and conditions (paragraphs 4.23 to 4.25 and Figure 12).

18 We **recommend** that:

a) early estimates of project cost should contain realistic allowances for contingencies. These sums should be reduced as the design is developed; and

b) expenditure on fees should be closely monitored and controlled. Consultants' terms and conditions should be drafted carefully to minimise claims for extra work; and their fee structure should give incentives for the timely completion of the project to cost and quality.

How the Council managed the project

19 The Council did not make one person responsible for ensuring the delivery of the project to time and within budget. They did not fully define and document the roles and responsibilities of those involved. Consequently, responsibility for project management fell on Council staff who lacked the necessary training and expertise. Although the Council made attempts to reduce the risks inherent in the project, they did not manage them in a concerted manner (paragraphs 5.5 to 5.9, 5.11 to 5.14, and 5.32 to 5.33).

20 The Council used a contract strategy that they had adopted on previous projects. They used standard government forms of contract, but two of their amendments to standard contract clauses caused management problems. The Council amended the clause for stage payments to the contractor. This led to delays early in the contract in identifying the cost of variations and contributed to the outstanding dispute over the contractor's final account. They also modified the services consultants' responsibilities for the co-ordination of the mechanical and electrical services' design (paragraphs 4.34 and 5.21 to 5.25).

21 When appointing some of their consultants, the Council limited their choice to firms who had worked for them in the past but on smaller projects. In our view they should have considered a wider range of firms (paragraph 5.27 and Figure 20).

22 We **recommend** that:

a) a single project manager should be made responsible for ensuring the delivery of a project to time and budget. For larger and more complex projects, departments without project management expertise should engage it from outside sources. We estimate that a project manager for the Oceanography Centre would have cost about £225,000;

b) the roles and responsibilities of all those involved in the project should be clearly defined;

c) the forms of contract should be selected at the outset and reviewed for adequacy;

d) standard contract conditions should not be amended without first identifying risks and potential impacts;

e) a shortlist of consultants and contractors should include those with relevant expertise and experience. In appointing their consultants for this project the Council should have considered a wider range of firms with experience of designing major research facilities;

f) qualitative criteria should be agreed before bids are evaluated. The results of the evaluation against the criteria should be fully recorded; and

g) a price and quality mechanism should be used to determine the tender offering the best value.

Southampton Oceanography Centre seen from across Empress Dock
Source: Tony Weller, Building Magazine

Key facts about the Centre

Figure 1

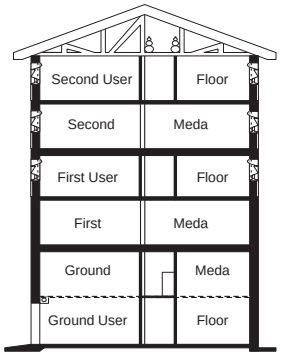
- budget: £48.9 million
- cost: £51.6 million in March 1997 (excluding settlement of claims)
- project length: 6.5 years (against planned duration of almost 5 years)

includes:

- 9,150 square metres of common areas, including main lecture theatre, restaurant, meeting rooms, toilets and corridors
- 6,500 square metres of laboratories
- 6,000 square metres of offices
- 1,750 square metres of stores
- 1,600 square metres of workshops
- national oceanographic library
- docking for research vessels

Figure 2 overleaf

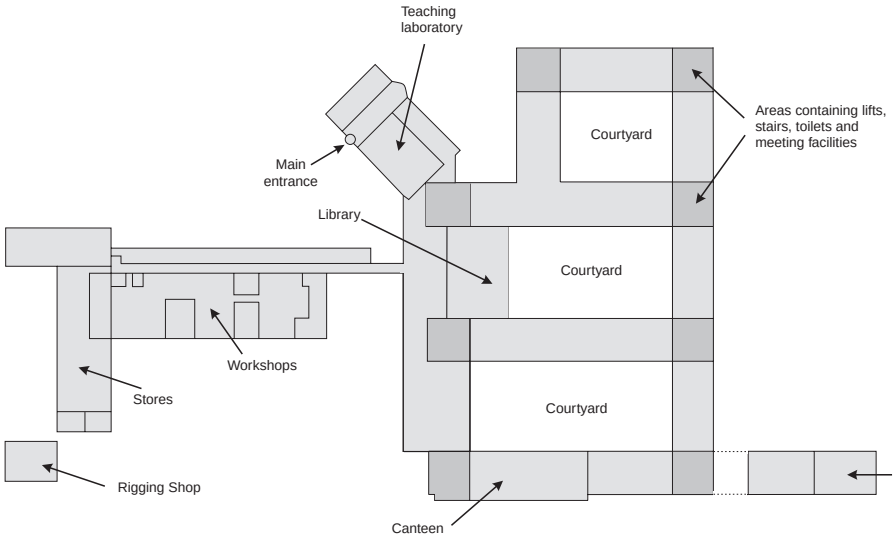
Figure 2 **Floorplan of the Southampton Oceanography Centre and key features of the building**



TYPICAL SECTION
(Not to scale)

Second Meda showing a lot of remaining capacity for additional services

Workshops



GROUND FLOOR PLAN

Courtyard and ventilation from fume cupboards

Ground Meda showing little remaining capacity for additional services

A teaching laboratory
Source: Tony Weller, Building Magazine

Part 1: Introduction

1.1 In April 1996 HRH the Duke of Edinburgh opened the Southampton Oceanography Centre at Empress Dock (Figure 1). The Centre provides a research and teaching facility for oceanography which is unique within the United Kingdom. Its staff undertake physical, biological, chemical and geological research on the oceans and seas and their boundaries with the air above and the rocks and sediments below, and also design, develop and operate the specialised equipment needed to examine the ocean depths. The scope of its work extends from coastal waters to the deep ocean floors. The building contains teaching space, laboratories, workshops, stores, and offices for scientists, engineers, and administrators, and berthing for research vessels. As Figure 2 shows, the building is arranged around three courtyards. It has six storeys including three intermediate floors to house the mechanical and electrical services.

1.2 In 1988, the Natural Environment Research Council (the Council) bid for funds for a research centre at Southampton. The building project was completed in August 1995. It was then 22 months late against its initial timetable. By March 1997 the final cost had not been determined because of a dispute with Wimpey, the main contractor, over their final account. Appendix 1 sets out the detailed chronology of the project.

Why a Centre was needed

1.3 In December 1985 the House of Lords Select Committee on Science and Technology recommended, in their report on Marine Science and Technology, that there should be greater collaboration between the Council's research institutes and Higher Education Institutes. They also recommended that, in the long term, Council research institutes and Higher Education Institutes should be established on a common campus (Second Report 1985-86). The Government's response, in July 1986, supported the need for closer collaboration between the institutes and stated that positive steps were being taken to establish regional centres of marine expertise where the geography reasonably permitted it (Cmnd 9861).

1.4 In 1988 the Government increased the funding for research centres and the Council bid for funds for the Southampton Centre. The University of Southampton (the University) had been selected to partner the Council's Institute of Oceanographic Sciences Deacon Laboratory. The University Grants Committee

had recognised the University's Department of Oceanography as a centre of excellence and that Southampton had a deep harbour which would allow the berthing of research vessels.

Roles and responsibilities

1.5 The Council are a non-departmental public body established by Royal Charter. At the start of the project, the Council and the University were both funded and monitored by the former Department of Education and Science through a series of different committees. By the completion of the project, the Office of Science and Technology, who then monitored the Research Councils, had been transferred to the Department for Trade and Industry. Appendix 2 explains the changes in the administrative background in more detail.

1.6 During the project Research Council structure and responsibilities changed following the May 1993 White Paper "Realising our Potential" (Cmnd 2250) (Appendix 2). As a consequence, a new part-time Chairman and a new Chief Executive were appointed to the Council and in 1994 the Council made significant changes to the senior management of their research institutes.

1.7 The Oceanography Centre was a joint project between the Council and the University. It was overseen by a hierarchy of committees on which both these organisations were represented. However, the Council took the lead in project management and were the contracting party. Appendix 3 sets out the composition and roles of the project committees. Figure 3 sets out the consultants and contractors employed on the project.

Figure 3

The consultants and contractors employed by the Council

Culpin Partnership	Architect and contract administrator
Building Design Partnership	Design and cost consultancy for mechanical and electrical services
Gifford and Partners	Structural engineers
EC Harris and Partners	Quantity surveyor
EC Harris Project Management	Progress monitoring during construction
Matthew Hall	Mechanical and electrical services sub-contractor
Rose Project Services	Employer's agent
Wimpey Construction	Main contractor

The scope of the National Audit Office examination

1.8 We examined:

a) how far the Centre meets the users' needs (part 2);

b) why the project took 22 months longer than originally planned (part 3);

c) why the budget was overrun (part 4); and

d) how the Council managed the project (part 5).

1.9 We were assisted in our examination by a team of consultants led by Richmond Associates. Richmond Associates provided advice on quantity surveying and project management; they were supported by R W Gregory and Partners on mechanical and electrical engineering issues; and on building design by The Fairhursts Design Group.

1.10 We discussed the project with the Council and with their consultants and contractors. Together with our own consultants, we examined the key records held by the Council and their consultants and contractors.

1.11 In carrying out our examination, we noted that guidance on the management of construction projects, particularly that from the Treasury's Central Unit on Procurement*, had moved on since the project first began in 1989. However there are lessons to be learned from this project that the Council could reasonably have foreseen and guarded against. These lessons are important for all organisations inexperienced in major construction projects.

* From July 1997, the Central Unit on Procurement became Procurement Practice and Development.

Part 2: Meeting the users' needs

2.1 The building was designed and constructed to meet the needs of staff from the Council and the University. Since occupation of the building in the autumn of 1995, staff have been working in the Centre under a unified management structure.

2.2 To assess how far the building meets the users' needs, we examined whether the Council and the University managed the briefing and design process so as to identify and meet the users' requirements while providing value for money. We also examined whether the users were satisfied with the finished building.

Were the users' requirements properly identified?

Summary

2.3 The brief was compiled by a series of committees with users closely involved. The committees used little professional advice in drawing up their brief and, early on, they had no expert assistance to define the mechanical and electrical services requirements.

2.4 Time and cost objectives were not set until late in the process, and objectives were not prioritised to assist the committees in selecting between them. Although users' requirements were challenged by the Council's staff, they were not challenged during briefing by building professionals to ensure that they were reasonable and balanced against objectives of time and cost.

2.5 The brief specified a 125-year life for the structure, which led to a requirement for flexibility in the provision of services. This requirement for flexibility was not clearly defined, but it had a major impact on the design as it led to the provision of the MEDA floors which can accommodate the rearrangement of existing services.

2.6 A successful project requires a clear and complete brief defining the client's requirements. A Project Sponsor should be made responsible for developing the brief, with appropriate professional assistance. Objectives for time, cost and quality should be set at the start of the project and should be prioritised to avoid nugatory work. Users should be fully consulted and their requirements challenged for feasibility and reasonableness to ensure that they are balanced against the objectives of time and cost.

Compiling the brief

2.7 In 1988 the aim was to create a world-class centre for inter-disciplinary research and training in deep sea oceanography at a new dock-side campus of Southampton University. The new Centre would house:

a) the Council's Institute of Oceanographic Sciences Deacon Laboratory, previously at Wormley, Surrey;

b) the Council's Research Vessel Services, previously at Barry, South Wales;

c) the University of Southampton's departments of Oceanography and Geology, in whole or in part; and

d) a new Interdisciplinary Research Centre for ocean acoustics, optics and computing.

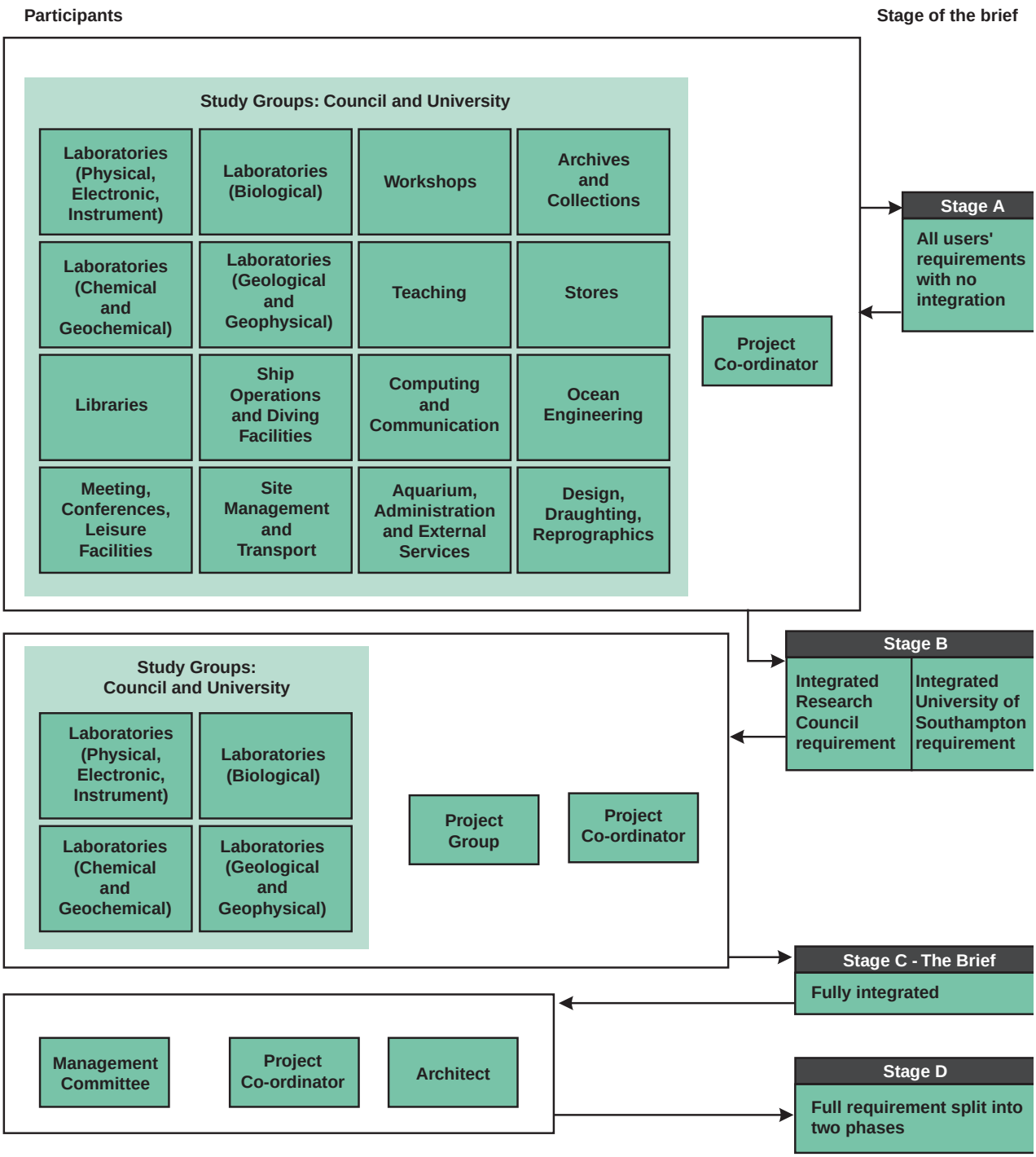
2.8 After 1988 there were some detailed changes to this statement of need. The Centre's remit is not restricted to the deep sea and now includes coastal work and some land-based geological studies. The whole of the University's Departments of Oceanography and Geology have relocated to the new Centre. The Council removed the requirement for the Interdisciplinary Research Centre from the project. However, the broad aim remained unaltered.

2.9 In January 1989 the Management Committee set up 16 Study Groups consisting of user representatives from all the participating organisations and disciplines. These groups met regularly to define their requirements, taking into account current and known future activities. Using the work of the Groups, the Council's Project Co-ordinator drew up the brief for the building in four stages, with increasing degrees of integration.

2.10 Integration was defined in the brief as bringing together the activities of the Council and the University in a common enterprise. The aim was to maximise intellectual interactions and eliminate duplication. Figure 4 overleaf shows how integration was carried out in stages during the briefing process.

Figure 4

Stages in the development of the brief



Source: National Audit Office analysis of Council records

The users were closely involved in the initial definition of requirements, via 16 study groups. The brief was developed in four stages, with increasing degrees of integration (paragraph 2.10). Stage C constituted the final brief, but was split into two phases because of budget constraints.

2.11 The Council appointed the Culpin Partnership as architects in July 1989, six months after briefing started. Culpin Partnership saw their role as helping the Project Co-ordinator to structure the final brief. They were not involved in defining the detailed requirements, because they did not seek this role on their own initiative and the Council did not specifically require this of them.

2.12 The Council did not appoint Building Design Partnership as services engineers until March 1990, when the brief was nearing completion. As a result, the mechanical and electrical services requirements in the brief were incomplete at the time. It was not until early 1991 that the services requirements were fully established, following interviews with the users about the detailed room specifications.

Setting and prioritising objectives

2.13 The time and cost objectives of the project were not set at the start of briefing. The Council told us that they had decided to determine users' perceived needs before setting the budget and then bring the scale of requirements down to that which was affordable. The Project Board set the target budget in January 1990, a year after briefing began. The Management Committee, therefore, split the project into two phases, with Phase 1 to be built within the target budget. The Management Committee finalised the brief in June 1990. This set out a number of objectives for the project (Figure 6) but did not prioritise them, except in so far as to make most of them subject to the constraints of the budget.

Challenging the users' requirements

2.14 We found little evidence that users' requirements were seriously challenged by the Council's professional advisers. Although the terms of appointment of Culpin Partnership as architects could reasonably be expected to entail challenging the users' requirements, they did not do so. Culpin Partnership only helped to structure the brief and the Council did not require them to challenge the users when it became evident that they were not doing so.

2.15 Some limited challenging was done by Council staff but, although they had some experience of building works management, they were not building specialists. For example, the Project Coordinator and a representative from the Council's Building Services attended user group meetings and questioned requirements using their experience of other Council research facilities.

Design life

2.16 The brief specified a life expectancy of 125 years for the structural fabric of the laboratory and office buildings and 60 years for stores, workshop and ancillary buildings. The brief did not specify to which elements of the building fabric these design lives should apply. In practice the foundations and main frame can achieve 125 years, but some major elements have relatively short lives. For example, the roof covering on the main building has a life of 30 years, and the cladding on the workshops and stores a life of 40 years with appropriate maintenance. The Council told us that the rationale for these lengthy design lives was the requirement to establish a permanent centre of excellence in oceanography to meet the long term needs of the United Kingdom as a maritime nation. However, the Council did not consider ways of meeting the requirement other than by a new building with a lengthy design life.

2.17 The 125 year design life called for much flexibility, but this was not clearly defined by the client. The brief stated that flexibility was required for phased development, expansion beyond the first two phases, and changes in science, the majority of which could not be foreseen at the outset.

2.18 The design allows for Phase 2 facilities to be added when more funding is available; any expansion beyond the first two phases would need additional land or off-site facilities. The major influence on the design was the need for flexibility in services, to cope with changes in science. The brief stated that the building should be flexible in services within the constraints of the budget, but elaborated no further. The design team interpreted this to mean a need for non-disruptive changes to services over the 125-year life of the structure. Consequently, the design team provided for MEDA (Mechanical and Electrical Distribution Area) floors throughout the building. These are separate intermediate floors, 2.2 metres high, provided exclusively for the distribution of mechanical and electrical services to the user floors (see Figure 2). The MEDA floors provide a high degree of flexibility because they can accommodate the rearrangement of existing services.

Was the building designed to match users' requirements?

Summary

2.19 No alternative design proposals were presented to senior management or user groups. The project team selected a design concept which involved paying a premium for MEDA floors to allow for flexibility in the provision of services. Little information was made available to senior management or users on either the costs or the benefits of this design concept.

2.20 A major factor in the development of the design was the need to contain capital costs within budget. As the objectives in the brief were not prioritised, choices could not easily take account of their relative importance.

2.21 There are a number of possible solutions to meet any brief. Users should be offered alternatives at the start of design so they can select the option that they consider would best meet their objectives. During design, the users and design team should make choices on a fully informed basis.

Alternative design solutions

2.22 Design work did not begin until March 1990, only two months before the target date for approval of the outline design. There was thus little time for preliminary design work on alternative schemes. During April 1990 the design team and representatives from the Council's Building Services considered various design concepts but these were little more than ideas. In May 1990 the design team presented to the Project Board a design proposal based on a single concept. They did not develop or present any other design proposals.

2.23 The Project Board approved the design concept and agreed that, after consultation with the users, the design should be developed. The users were invited to comment on matters of detail, but were not invited to query the design concept.

2.24 A major feature of the design concept was the provision of MEDA floors (paragraph 2.18). However, MEDA floors result in additional building costs, which cannot be easily quantified without working up alternative designs. We could not determine whether any estimate of the additional cost was provided to the Project Board when they approved the outline design since little discussion of cost or advantages is recorded. The Council's quantity surveyors prepared estimates of this extra cost from time to time, which varied from £500,000 to £1.5 million.

Much of the variation may reflect the increase in the height of the MEDA floors between outline and scheme design, from 1.8 to 2.2 metres, a difference which increased the estimated cost by £750,000.

The value for money of the design adopted

2.25 Throughout the briefing and design stages there was pressure to keep within the target budget. This led to a series of cuts and reductions in order to reduce building costs. Figure 5 sets out the major decisions taken by the Management Committee between the setting of the target budget in January 1990 and the award of the contract in November 1992.

2.26 In making the cuts, the Management Committee were hampered in their selection because the relative priorities of the project's objectives had not been previously assigned. Initially, the Committee excluded discrete entities which could be reinstated later if funding allowed. Later they made across-the-board space reductions, and reductions to services specifications and to finishes and fittings. Although the MEDA floors had increased the cost of the building, their removal at a late stage would have entailed a complete and expensive redesign.

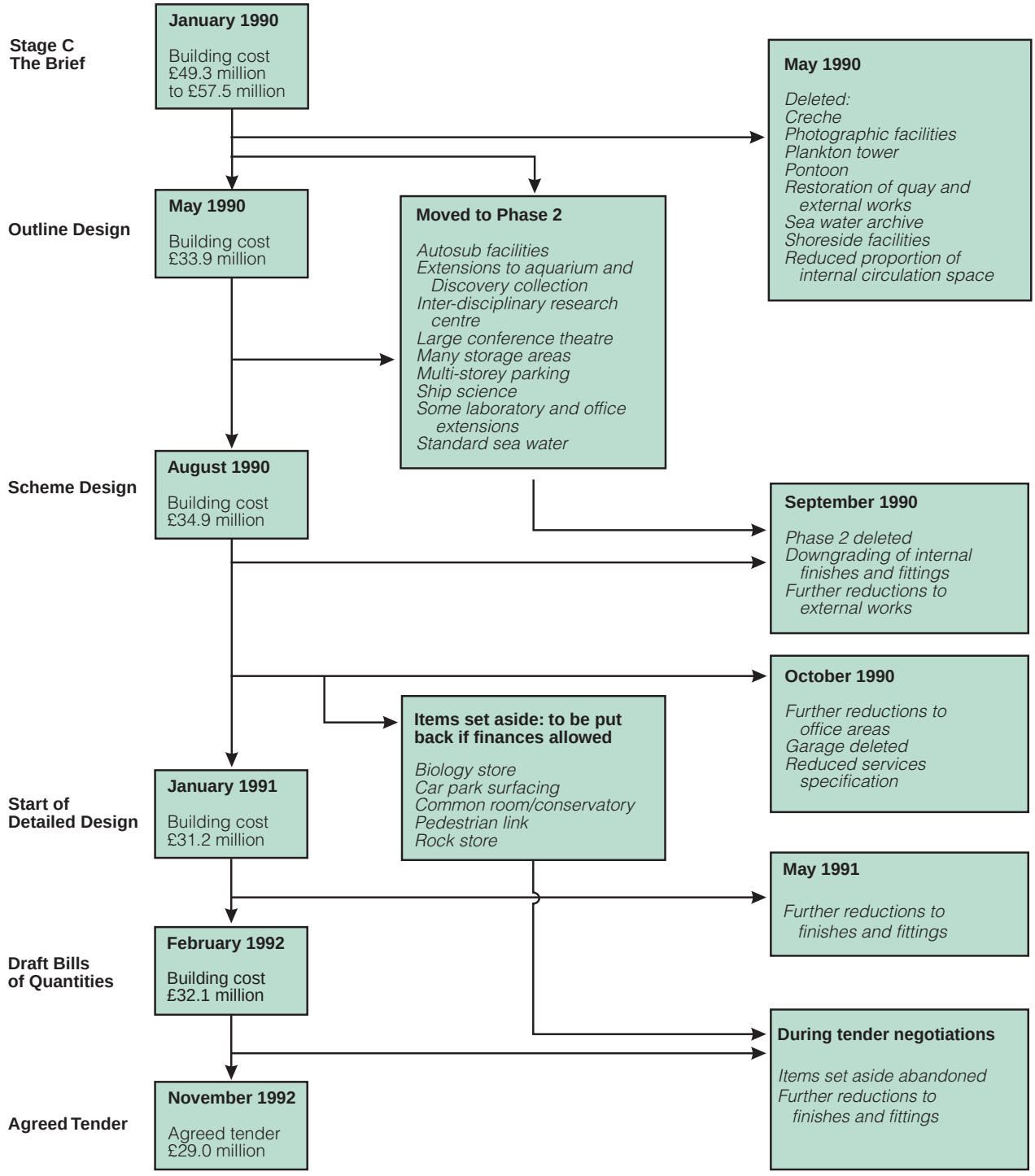
2.27 The initial capital cost of a building typically represents only a small proportion (10-20 per cent) of the total cost of ownership. True value for money can only be assessed by taking account of the total costs over the life of an asset. However, the Management Committee did not commission any life-cycle cost analysis of the whole design or of any alternatives. During the detailed design stage they received formal reports on life-cycle costs on only two topics: on energy supply options and on alternative materials.

2.28 In January 1991 the Building Design Partnership analysed site energy supply options and a combined heat and power system gave the lowest life-cycle cost. It showed a net present cost over 120 years of £7.67 million, compared with an on-site boiler and purchased electricity, at a net present cost of £9.29 million. The approved design and its cost estimate assumed the latter option. This was the most expensive of the four options considered, but required no additional capital costs. The combined heat and power system would have required an additional initial cost of £667,000. As there was no additional capital available the Project Board chose the on-site boiler option.

2.29 Building Design Partnership re-examined energy supply options in June 1992. A combined heat and power system would still provide savings, with a net present cost of £6.75 million compared with £7.53 million for an on site boiler

Figure 5

Cuts and reductions to the project



Source: National Audit Office analysis of Council papers

As the design developed, the estimated building cost increased and the Management Committee and the Project Group had to make cuts and reductions to keep within the target budget.

and purchased electricity. The additional initial cost was estimated at £509,000 but the Council again rejected the combined heat and power option because of lack of capital funds.

2.30 In January 1991, EC Harris did a lifecycle evaluation of alternative construction materials over 120 years. They recommended no changes to the materials already selected on the grounds that the benefits of more expensive materials would not be achieved for at least 15-20 years. The Project Board accepted this advice. We note that the materials actually used differ in some cases from those specified in 1991, but found no corresponding reworking of the life-cycle cost analysis.

Were the brief and design assessed independently to maximise value for money?

Summary

2.31 The Council had no professional project manager to help them assess the brief or the design. Although they commissioned a value management review, it was too late to have much impact on the cost or design.

2.32 The Project Board received proposals from the Management Committee for approval at each stage of the briefing and design process. All proposals had been reviewed by the Management Committee with input on building issues from the Council's Building Services team and from the University's estates staff. However, the Council had no professional project manager to give them independent expert advice on the brief and design.

2.33 Value management is a process used in the construction industry to maximise project value. It aims to provide the required quality at optimum cost, by eliminating unnecessary costs without loss of function. It includes reviews at key stages. For these reviews to have most impact they need to be undertaken in the early stages of design. In May 1991, BCP Project Management recommended that the Council should consider commissioning a value management review by independent experts. However, no such exercise was done until March 1993, two months after the start of the main construction contract. It identified potential savings of £300,000.

Are the users satisfied with the building?

Summary

2.34 As many of the objectives for the building were not defined precisely it is difficult to assess how far they have been achieved. The Centre does not provide everything the users originally specified. However, although it is too early to make a final assessment, the users are broadly content with the building and consider that it is proving to be a pleasant and effective working environment.

2.35 We examined how far the users' requirements, as set out in the brief, had been met. We also discussed the project with the Centre's Director and departmental heads.

The users' initial requirements

2.36 The brief set out a number of objectives for the project, but few of these were defined in full (Figure 6). It is therefore difficult to assess how far they have been achieved. The numerous cuts and reductions made during briefing and design mean that the building does not provide everything users specified (paragraphs 2.13, 2.26 and Figure 5).

Figure 6

Comparison of the main objectives and final provision

Objective	Achievement
Cost of £48 million	The budget was increased to £48.9 million following an increase in the rate of VAT but expenditure has reached £51.6 million to March 1997
Integration[1]	Although it is early to judge how far this will be achieved, the users consider this is already being demonstrated
Phased development	Only the first phase was built
Flexibility	Not clearly defined (paragraphs 2.17 to 2.18)
Low energy usage	Not clearly defined or quantified
Low maintenance costs	Not clearly defined or quantified
Long life expectancy	Not clearly defined and seemingly not fully achieved (paragraph 2.16)

Note: 1. Integration was defined as bringing together the components of the Council and the University in a common enterprise to maximise intellectual interactions and eliminate duplication.

Source: National Audit Office analysis of the brief dated June 1990

Many of the objectives in the brief were defined imprecisely. Therefore it is difficult to assess how far they have been achieved. However it is clear that they have not all been met.

The users' early perceptions of the building

2.37 In spring 1996 we interviewed the heads of departments at the Centre to obtain their early impressions of the building. While they were broadly content, they had some concerns about the costs of operating the building. They considered that the Centre was already acting as a national focus for oceanography. Appendix 4 gives more detail of the interviews.

2.38 In March 1997, the Director of the Centre reported to the Council's Chief Executive and to the University's Vice-Chancellor that the new building was working very well and was proving to be a pleasant and effective working environment. In particular the common areas such as the library, lecture theatre and meeting rooms were functioning very successfully and were, as intended, providing the necessary opportunities for interactions among staff.

2.39 Notwithstanding the users' general satisfaction with the building, there has been a significant problem concerning the provision of fume cupboards. These cupboards are separately ventilated to the rest of the laboratory in which they are situated and thus provide a safe environment for experiments that produce noxious fumes. Because corrosive chemicals are sometimes used, for example to analyse rock samples, the fume cupboards in some laboratories could not have metal components. The need for non-metallic components had not been fully identified during the briefing process; more significantly the users were not involved in agreeing the final specification. As a result the problem was not identified until May 1995 when the users saw the cupboards provided. To ensure the safety and quality of scientific work, 31 out of 60 fume cupboards had to be replaced at a cost of £383,000. The users' programme of scientific work was disrupted for eight months until replacement cupboards were installed. The Council expect to recover some of the costs from the sale of the rejected cupboards.

Part 3: Overrun on time

3.1 The original planned completion date for the Centre had been October 1993. In fact it was completed in August 1995, 22 months later (Figure 7 overleaf). Although this left little time to fit out and occupy the building before the start of the University term in October 1995, staff started to move in in September 1995 and the first students were admitted at the beginning of October.

3.2 To assess the reasons for the overrun on time, we examined the slippage and the measures the Council took to reduce the delays before and during construction.

Did the Council ensure the timely completion of the pre-construction stages?

Summary

3.3 During the briefing, design and tender stages the planned completion date was revised several times as the timetable was extended. The Council had no independent project manager to challenge the timetable and the revisions. They considered the project's timely completion to be of a lower priority than meeting their objectives of cost and quality. Therefore they agreed to extend the timetable with the aim of ensuring that the costs did not exceed the budget and the design was complete.

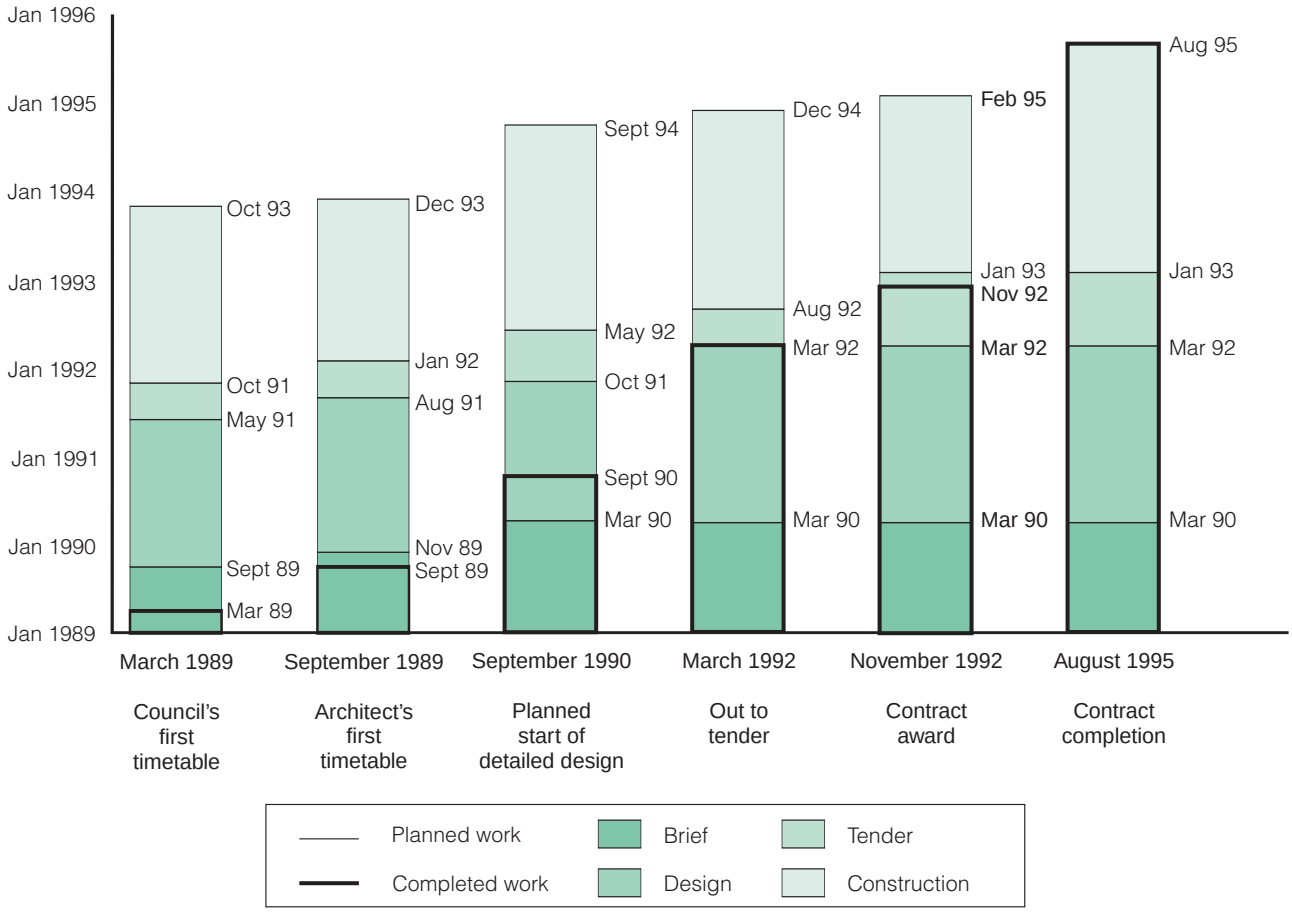
3.4 Construction started in January 1993, 15 months later than originally planned (Figure 7). Figure 8, on page 23, shows the reasons for the delay. In assessing these reasons, we focused on the Council's control over the project's progress during the pre-construction stages.

3.5 The Council produced the first timetable for the project in March 1989 which forecast completion in October 1993 (Figure 7). On their appointment as architects in July 1989, Culpin Partnership took over responsibility for programming the work. They produced a number of revised timetables following the problems given in Figure 8.

3.6 The Council did not possess independent expertise to review or challenge the feasibility of Culpin Partnership's timetables. For example, in 1991 an experienced project manager, on reviewing the slow progress in completing design information, may have proposed more realistic revised dates for the tender exercise.

Figure 7

Changes to the timetable



Source: National Audit Office analysis of Council papers

Figure 7 shows the project's progress against timetables broken down into the formal stages of brief, design, tender and construction. On this project the separation is at times arbitrary since, from March to June 1990, briefing and design work overlapped. Also, design work continued after the invitation to tender had been issued and then into the construction phase.

3.7 Although the Council monitored the project's progress, they considered that meeting the completion date was of a lower priority than the other objectives set out in the brief (paragraph 2.36). They extended the briefing period, mainly to deal with the late setting of the project budget. They sanctioned further extensions to the timetable at the design and tender stages, as they tried to ensure that the costs did not exceed the budget and that the design was complete. Extending the timetable contributed to an increase in professional fees.

Causes of delay in the pre-construction stages

Figure 8

Briefing: delay 6 months

- The compilation of the brief in four stages extended the duration of this stage
- Uncertainty over the University's bid for funding from the Universities Funding Council delayed their input into the brief
- Amendments to the brief were necessary when the Council set the project budget of £48 million in January 1990, 12 months after the start of briefing

Design: delay 4 months (design work continued during the tender stage after the formal completion of the design stage)

- The uncertainty over the University's bid for funding continued during the early part of the design stage.
- The design was amended to produce savings to meet the Council's new requirement in September 1990 for a £2 million reserve within the budget of £48 million, delaying work on the detailed design
- Client changes arising from the detailed interviews with users about room specifications in the first quarter of 1991 delayed the work of the Design Team
- The Design Team were slow to produce design information in 1991

Tender: delay 5 months

- The Council delayed the issue of the tenders for the works contract to give the Design Team time to complete the design. They issued the tenders for the services sub-contract four weeks after that for the works contract
- The Council held post-tender negotiations in 1992 with Wimpey as the initial tender sum exceeded their estimate
- The Council delayed the contract award by a month while they awaited the Chancellor's Autumn Statement in 1992

Note: On this project the separation into the formal stages of briefing, design and tendering is at times arbitrary since briefing and design work overlapped from March 1990 to June 1990, and design work continued after the invitation to tender had been issued

The Council extended the briefing period, mainly to deal with the late setting of the budget. They agreed further extensions to the timetable for the design and tender stages, with the aim of ensuring that the design was complete and the estimated costs were within budget.

Source: National Audit Office analysis of Council documentation

Did the Council ensure the timely completion of construction?

Summary

3.8 The Council did not allocate responsibility to any of their consultants for reviewing the programme when it was revised in March 1994, or Wimpey's plans for recovering the delay. Also, as they did not make any consultant responsible for the timely delivery of the project, the Council's response to Wimpey's notifications of delay was slow.

3.9 However, the Council reduced monthly payments to Wimpey when delays occurred, and levied liquidated damages of £2 million for the six month delay in completing construction.

3.10 The construction was completed in August 1995, six months later than provided for in the contract (Figure 7). Figure 9 shows the forecast delays during construction and the major reasons for these. In 1995 Wimpey submitted a claim for the extension of the contractual completion date to August 1995, which the Council have rejected. Wimpey have disagreed with the Council's decision and, in May 1997, intended to make a further claim.

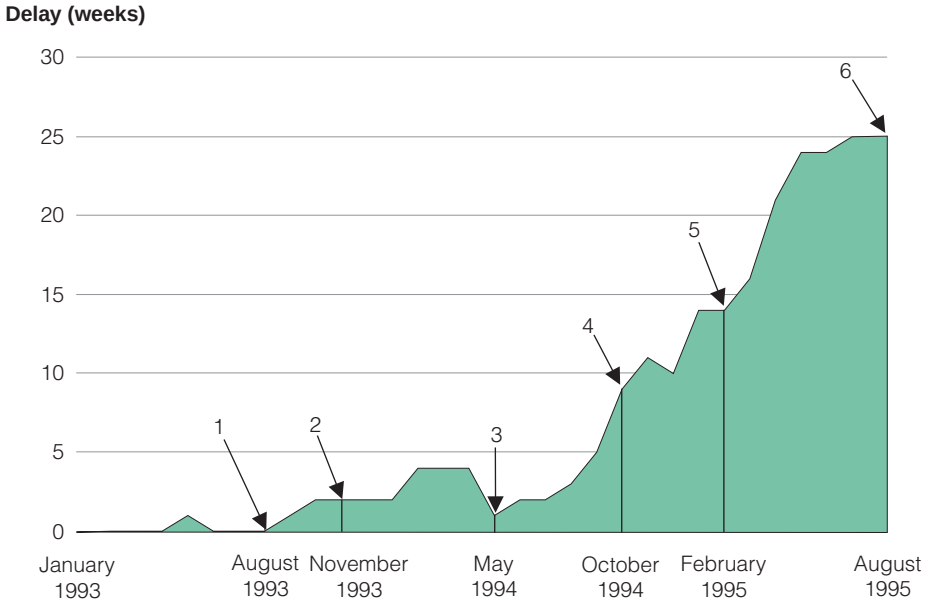
3.11 In assessing the reasons for the overrun during construction, we focused on: the planning of the work; the actions of the Council and their consultants; and the financial measures the Council took.

Programming of work during construction

3.12 During construction, the Council monitored progress against a programme which scheduled the work to the project's completion. Wimpey prepared the programme and the Council's design team reviewed those parts where they had the appropriate expertise; for example, the structural engineer reviewed the planned rate for the daily pouring of concrete. In December 1992 the Council appointed EC Harris Project Management, for a fee of £26,400, to review the initial programme and assess Wimpey's progress against it. Such duties are usually allocated to the contract administrator, in this case Culpin Partnership, the architect. Delegating one of the central contract administration duties to another consultant was not an effective allocation of responsibilities. All the contract administration duties are usually carried out by the project manager as part of his wider role in controlling the whole project.

Forecast delays to the construction completion date

Figure 9



Notes:

1. Wimpey notified prolongation and disruption on the building works in connection with services. In the end, there were major delays in this area. The Council and Wimpey are currently in dispute over the reasons for the delay, including a dispute over the responsibility for the design information.
2. Wimpey notified prolongation and disruption on brickwork. In the end the work finished about three months late. The reasons for this delay are in dispute. Factors involved include inclement weather, a shortage of labour, design development and variations.
3. From May 1994 the Council measured the delay against the revised programme issued in March 1994.
4. Wimpey admitted that they would not finish on time in February 1995 and submitted a claim for an extension to the contractual completion date.
5. The contractual date for the completion of construction was February 1995.
6. The building was completed in August 1995, 25 weeks later than the construction contract date.

Source: National Audit Office analysis of the Council's papers

This figure shows the cumulative effect of problems associated with the construction of the Centre.

3.13 By March 1994, construction was four weeks behind programme. Wimpey revised the programme and forecast that construction would still finish on time. The Council's consultants and Rose Project Services, the Employer's Agent, considered that the programme was very tight, but agreed that completion by February 1995 was still achievable. They were not required to examine the revised programme in-depth.

Action taken to ensure the timely completion of construction

3.14 The Council's contract with Wimpey specified a completion date of February 1995 for the project. Until September 1994 the Council's consultants had considered that the delays could be recovered and that the building would be finished on time if Wimpey provided the necessary resources. However in September 1994 the consultants warned that the building's completion would be delayed. In October 1994 Wimpey asked for an extension to the contractual completion date, thereby acknowledging for the first time that the building would not be finished on time.

3.15 None of the consultants had responsibility for reviewing Wimpey's plans for resourcing the work to recover the delays. In November 1993 and August 1994, Rose Project Services, the Employer's Agent, advocated such reviews. However, Culpin Partnership, the architect and contract administrator, advised against any action that would diminish Wimpey's responsibility to decide how to construct the building, which included a duty to programme and adequately resource the work.

3.16 None of the consultants was made responsible for ensuring the timely completion of the project. By September 1994, the consultants had met Wimpey to discuss only one of the five notifications of disruption and prolongation then outstanding, despite the fact that the first such notice had been submitted in August 1993 (Figure 9). This was partly because the services consultant, Building Design Partnership, advised the Council that the services delays were a result of poor performance by the subcontractor, Matthew Hall, and partly because the Council considered that Wimpey had submitted inadequate information in support of their notifications. In October 1994 the Council therefore extended the role of Rose Project Services to include the identification and resolution of all risks to the project's completion, including the notified delays.

Financial measures to address the delayed completion

3.17 Their contract with Wimpey allowed the Council to adjust their monthly payments in line with the project's progress. By March 1994 the delay had increased to four weeks. Therefore the Council negotiated a reduction in the payments for April to June 1994 of £500,000 on a total of £8.4 million. They also agreed with Wimpey that, if the monthly assessment of progress showed delays of over one week behind the programme, then the payment would be correspondingly delayed. Since the delay was never less than two weeks after August 1994 (Figure 9), the Council delayed all subsequent payments.

3.18 The contract also allowed the Council to levy liquidated damages of £12,000 for each day that completion was delayed beyond February 1995. By March 1997 they had deducted damages for the 25 week delay of £2 million from payments to Wimpey. Some or all of the liquidated damages may be returned to Wimpey if they were to submit a further claim for an extension to the contractual completion date and their claim succeeded (paragraph 3.10).

Part 4: Overrun on cost

4.1 In January 1990 the Project Board set a budget of £48 million for the project, which the Council and the University increased in May 1991 to £48.9 million to take account of an increase in the rate of VAT. After making a series of cuts to the requirement, the Council got the estimated cost of the project to within the budget when they let the main contract in November 1992.

4.2 The precise outturn for the project is uncertain because the final account for the main contract has yet to be settled with Wimpey. The outturn may however exceed the budget substantially. In March 1997 the Council's estimated final cost of the project was £51.6 million, an overrun of 5.5 per cent (Figure 10). However Wimpey's assessment of the final building cost was £12.6 million higher than that of the Council. If Wimpey are successful in obtaining all or part of this amount, the cost of the project could rise up to £64.2 million, a potential maximum overrun of over 30 per cent, excluding the costs

Summary of budget and estimated costs

Figure 10

	Estimate[1] (Jan 90) £ million	Budget[2] (Jan 93) £ million	Forecast outturn (Mar 97) £ million	Increases during construction £ million	Increases during construction Per cent[3]
Building cost	49.3 to 57.5	29.0	29.9[4]	0.9	33
Fees	4.3	6.8	8.6	1.8	67
VAT	6.6	6.4	6.5	0.1	4
Land	4.8	5.2	5.2	-	-
Other costs	-	1.5	1.4	(0.1)	(4)
Total	**65.0 to 73.2**	**48.9**	**51.6**	**2.7**	**100**

Notes:
1. The estimated cost of Stage C when the Project Board set a target budget of £48 million
2. The budget when construction started
3. The increase as a percentage of the total increase
4. The forecast overrun for the building cost excludes the liquidated damages of £2 million that the Council have deducted from payments to Wimpey

The estimate in January 1990 exceeded the budget, leading to phasing and cuts. The forecast outturn exceeds the budget of £48.9 million by £2.7 million (5.5 per cent). The overrun is largely the result of an increase in fees. The final outturn may be higher once the dispute with the contractor is settled. The figures quoted do not contain any allowance for the settlement of this dispute.

Source: National Audit Office analysis of Council records

of arbitration or litigation. Figure 11 sets out additional expenditure on the establishment of the Centre which was provided for in other budgets and which increases the total cost of the project still further to £69.3 million.

Other expenditure on the establishment of the Centre

Figure 11

	£000
Replacement of fume cupboards	383
Reinstatement of items cut in 1994[1]	315
Other[2]	305
Additional capital costs	1,003
Staff relocation costs[3]	4,111
Total	**5,114**

Notes:
1. The Centre paid for the library shelving, carpets, and fitting out the kitchen
2. Items where the requirement had changed since the brief was frozen, for example extra data outlets and telephony
3. Includes some redundancy costs, removal of equipment (£447,000), and additional travel and subsistence (£257,000)

Source: National Audit Office analysis of Council records

There has been additional expenditure of £5.1 million on the establishment of the Centre, which has been provided for in other budgets.

4.3 To assess the reasons for the overrun on cost, we examined how the budget was set and the measures the Council took to avoid or contain cost increases.

Was the budget properly compiled?

Summary

4.4 The Council obtained provision in the 1988 Public Expenditure Survey for a new building. At that stage they had not developed their requirements for the building and their bid for funds contained no allowance for risk. The cost of meeting the ideal requirements specified in 1990 would have exceeded the Council's funding and the contribution expected from the University by between £17 million and £25.2 million.

4.5 Since there was no design development contingency in the budget, cost increases during design had to be funded by making cuts. Despite a series of such exercises, further reductions had to be made after the receipt of tenders.

4.6 We expect the budget for a construction project to be set by estimating and costing future requirements, and then assessing the degree of certainty attaching to the figures and including an allowance for risk. Where future requirements are uncertain, it is reasonable to use current accommodation areas as a basis for a first estimate, subject to a realistic provision for risk.

4.7 Guidance from the Treasury's Central Unit on Procurement recommends that project budgets should contain a contingency for risk to give management a realistic target for cost control. As a project proceeds, the accuracy of estimates increases and the risk reduces and the contingency should fall: for example from an initial level of 25 to 35 per cent to 6 per cent once tender uncertainty is eliminated. All contingencies should be set out explicitly in project budgets.

Setting the budget

4.8 The Council drew up their June 1988 bid for funds for the Centre before any work had started on the brief. The bid was for the Council's share of the total cost of the project. The total cost was based on the accommodation then occupied by the intended users, but it did not include any allowance for risk.

4.9 Between 1988 and 1990 the Council and the University defined their requirements for the building in stages (Figure 4 on page 12). The process eventually culminated in Stage C, which was a comprehensive statement of the users' ideal requirements and included projections of new science and services expected to develop during the lifespan of the new Centre and some increase in projected student numbers. The estimated cost for Stage C ranged from £65 million to £73.2 million. The proposed building was twice the size provided for in the original bid. In January 1990 the Project Board considered Stage C, and set a target budget for the project of £48 million.

4.10 In setting the target budget, the Project Board were guided by the money likely to be available as a result of the original bid in 1988. After allowing for fees, inflation and VAT, the bid for the Council's share of the Centre had resulted in a total cash provision of £30 million announced in February 1989. In January 1990 the Board estimated that, in addition to this £30 million, sale of the vacated sites would raise another £6 million and the Council could make an additional contribution of a further £6 million. As for the University's contribution, since the University had not received confirmation of funding from the Universities Funding Council, the Board assumed that this would total £6 million, which was the level estimated in 1988, adjusted for VAT and inflation.

4.11 In November 1989, the University had bid for £17 million from the Universities Funding Council for their portion of the funding. In August 1990 the Funding Council confirmed a grant of £10 million at 1990 prices. Uprated for inflation, the Project Board translated this into a University contribution to the £48 million budget of £12 million in cash terms, thereby making unnecessary the additional Council contribution of £6 million identified in January 1990. In September 1990 the Council's governing body approved their share of the budget at £36 million including the sale of sites.

4.12 The only change to the budget was an addition of £0.9 million in May 1991 to meet an increase in the rate of VAT. Otherwise the Council and the University insisted that the project should keep within the target budget.

Were the project cost estimates within the budget?

4.13 By September 1990 phasing, and work on the design, had reduced the estimated cost of the project to £48.85 million. The Project Board had some doubts that the sale of sites would realise as much as £6 million. The Council, therefore, asked the Project Board to re-examine the costs of the project, to decide what would be included and to reduce the estimated cost to £48 million. This was to include a reserve of £2 million of items set aside but which could be put back into the project if finances allowed. In January 1991, following successive cuts and reductions, the project had an estimated cost of £46.7 million which, for the first time, was within the budget.

4.14 The budget did not contain an explicit contingency for design development. However, in January 1991 EC Harris, the quantity surveyors, warned the Council that budget pressures meant there was no design contingency left. Therefore any allowance must have been contained within the rates used for the cost plans, and this was exhausted by the time detailed design began in January 1991. As the design developed and the estimates of the building cost increased, the lack of a design development contingency forced the Management Committee to make further cuts to meet cost increases (paragraphs 2.26, 2.27 and Figure 5).

4.15 In July 1992 the tenders received for the building contract exceeded pre-tender estimates of £30.6 million by between £1.7 million and £4.9 million, necessitating more savings to bring the estimated cost within budget. The Council entered into post-tender negotiations with Wimpey, the lowest tenderer. Wimpey identified substantial savings on the building fabric and engineering services. The

scope for such savings could have been identified earlier if the Council had carried out value management during the design stage rather than after the start of construction (paragraph 2.34).

4.16 The largest excess of tender price over estimate was for mechanical and electrical services. For example, Wimpey's tender for these exceeded the Council's estimate of £9 million by £1.8 million. Building Design Partnership had estimated for services on a cost per unit area or volume basis, which is less accurate than cost estimates based on measured drawings as used by EC Harris for the building costs. Building Design Partnership recommended in November 1990 that the Council should have costings done on the more accurate basis. However, the Council opted instead for a more limited check on the accuracy of the estimates.

Were responsibilities for cost control allocated properly?

Summary

4.17 Responsibilities for cost estimation and control of mechanical and electrical services were poorly allocated since, in some areas, they were not separated from those for design.

4.18 Responsibility for cost estimation and control should be clearly allocated. For this project, responsibility for cost estimation was split; prior to construction EC Harris, the quantity surveyors, were responsible for the building work and Building Design Partnership, the services' designer, for the mechanical and electrical services. During construction EC Harris became responsible for overall cost control, but Building Design Partnership were given responsibility for assessing and agreeing with Wimpey the value of any variations to the services. Splitting responsibility for variations in this way leads to potential confusion in pricing those which have both building and services elements, and to potential conflicts of interest on the part of the services' designer when agreeing the value of variations (paragraph 5.12).

Was the design complete when construction started?

Summary

4.19 When the Council went out to tender there were still areas of uncertainty in the design, particularly in respect of mechanical and electrical services. The consequent risk of cost increases during construction was exacerbated by the need for design changes to achieve cost savings after tenders were received.

4.20 Incomplete design gives rise to a risk of cost increases during construction. The Council recognised the risk for this project and insisted on the design being as complete as possible: they asked the design team to sign certificates of readiness, delayed the tender issue date and extended the tender period by four weeks to allow for the issue of additional bills of quantities.

4.21 Despite these efforts there were substantial areas of uncertainty in the design when tenders were issued. The services drawings issued for tender in Spring 1992 only included the design development introduced by the Architect up until November 1991. They did not reflect the Architect's design development after that date. The changes needed to make the post-tender savings introduced even more uncertainty into the design. Wimpey and Matthew Hall accepted all the tender drawings and a list of the further changes that would need to be made to these. From March 1992 to March 1993 the Building Design Partnership carried out a catch-up exercise to ensure that the drawings issued to the contractor reflected these later developments. However the quality of these updated drawings, and the extent of and the responsibility for the work needed to develop these in more detail, are now the subject of a dispute between the Council and Wimpey.

Why did the expenditure on fees overrun?

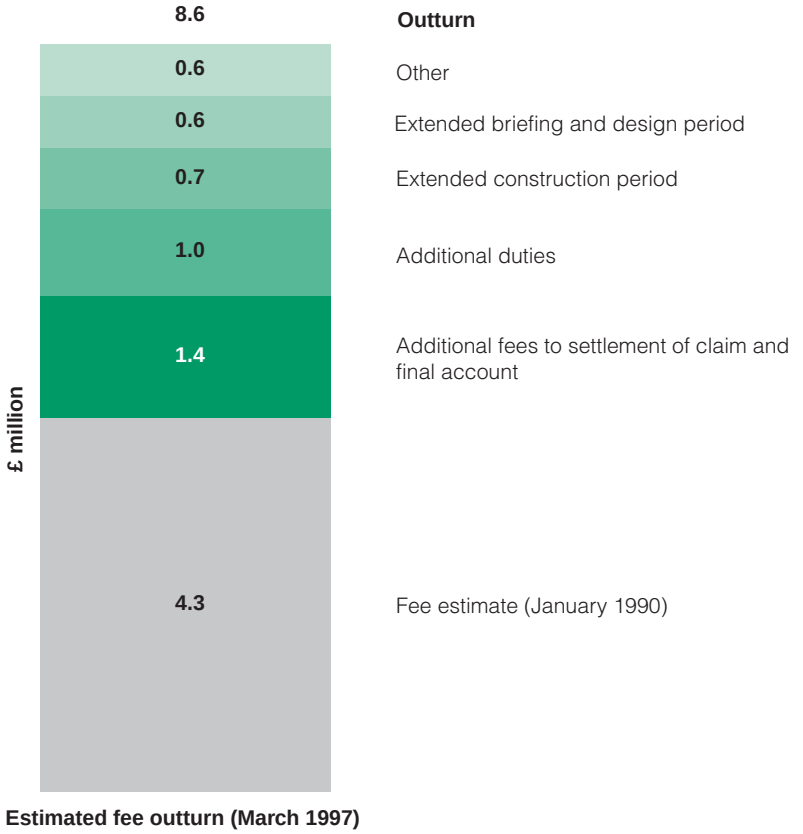
Summary

4.22 Fees doubled during the project, from £4.3 million to £8.6 million. This was due to the extension of the design period to accommodate fundamental changes, the delay in construction, and the consultants' claims for additional duties not covered in their terms and conditions.

4.23 Fees rose by 58 per cent over the briefing and design period, and by a further 26 per cent during construction (Figure 10 on page 28). The outturn ratio of fees to capital cost is 24 per cent, whereas the allowance for fees in the estimates during briefing and design ranged from 10 to 15 per cent. The fees payable were based on percentages of the works cost, as defined at various stages, plus time charges for additional duties.

4.24 It was not until September 1994 that the Council started to monitor regularly fees expenditure against budget. Their management information did not analyse expenditure on fees. Therefore it is possible to make only broad estimates of the increases attributable to various factors. These are set out in Figure 12 overleaf.

Increases in fees **Figure 12**



Source: Natural Environment Research Council

Expenditure on fees doubled during the course of the project.

4.25 The main reasons for the increases in fees were:

a) the extended construction period, and the consequential fees for managing the claim and final account settlement;

b) the number of fundamental changes introduced by the client during briefing and design, and the consequential extension of the design period; and

c) other additional work. The terms and conditions provided for the consultants to be paid for additional duties required by the Council. The Council made an inadequate allowance for these duties in their fee budget.

Why did the cost of construction overrun?

Summary

4.26 Although client changes were strictly limited, variations arising from other factors, principally design development, were poorly controlled. The construction contingency was insufficient and the control over it was unsatisfactory. Because the Council did not act on early warning signs and because of the payment terms in the contract, the extent of the resulting cost overruns was not identified until late in the project when the Council could not take effective remedial action.

4.27 Figure 13 overleaf analyses the cost movements on the main construction contract, up to the forecast outturn in March 1997. These can be considered under two main headings: instructions and contingency.

Instructions to the contractor

4.28 Instructions were issued in writing to the contractor by the architect. They were used for a variety of purposes including: the issue of drawings to the contractor; the rectification of site problems; Clerks of Works' directions; design development; and the release of provisional sums.

4.29 The Architect issued just over 1,900 instructions to the main contractor, which increased costs by a net £1,428,000 based on EC Harris's estimates of March 1997. The instructions were not categorised by type, so it is not possible to quantify precisely the cost increases due to design development, statutory requirements, underestimation or other categories. Figure 13 overleaf shows that a large part of the cost increase was attributable to design development after the contract was awarded. Although some design development during construction is usual, the extent of, and responsibility for, such development on this project is now the subject of a dispute between the Council and Wimpey.

4.30 Within these instructions, routine client changes were strictly controlled and limited in their impact; they increased the works cost by a net £14,000. However in June 1994, when it became apparent that there would be a cost overrun, the Project Progress Group made substantial changes which reduced the scope of the work by £299,000. Such changes run a high risk of increasing management costs when introduced 17 months into a 25 month contract. The incoming management of the Centre had to re-instate and fund most of the omitted work before they occupied the building (Figure 11 on page 29).

Estimated cost movements on the main construction contract

Figure 13

	Increase £000	Decrease £000	Net £000
Instructions[1]:			
Originated by the Design Team[2,3]	2058	206	1852
Statutory requirements	74	21	53
Client variations	44	30	14
Other variations[2]	134	145	(11)
Wimpey savings[4]		31	(31)
Loss of independent validation[5]		150	(150)
Costs from reduction exercise in 1994[6]		299	(299)
Total estimated value			**1,428**
Contingency for construction		550	(550)
Totals	**2,310**	**1,432**	**878**

Notes:
1. The value is in dispute and these figures may change.
2. Includes some design development
3. The Design Team consisted of the Architect, Services Engineer and Structural Engineer. It was not possible to identify for each instruction the reasons for its issue or which member of the Design Team was responsible for it.
4. Under the contract, Wimpey offered ideas and shared the savings with the client.
5. Deleted in February 1995 to save money. Validation was done by Building Design Partnership, for an additional fee of £75,000.
6. Savings made by Project Progress Group when the cost overrun was identified.

Source: National Audit Office analysis of Council records

A substantial proportion of the cost overrun was due to design development, although the amount cannot be precisely quantified. The value of instructions is now the subject of a dispute between the Council and Wimpey.

4.31 Of the 1,900 instructions only 260, worth £285,000, went through a change control procedure. Under these arrangements, the project team and the contractor identified the cost and time implications of proposed changes before the Council's site representative approved them.

4.32 Over 1,600 instructions were issued outside the change control process, increasing the cost of the main contract by a net £1,143,000, based on estimates at March 1997. Control over these instructions was poor:

a) Culpin Partnership, the contract administrator, often exceeded their delegated limit of £200 for authorising instructions without client approval;

b) the cost of these instructions was not usually estimated before their issue. Where there were estimates they were sometimes substantially inaccurate. In particular, the latest forecast outturn for the issue of contract drawings is £462,000, which is 2,200 per cent in excess of the initial estimate in January 1993 of £20,000; and

c) the contract administrator did not highlight changes on the drawings which he issued to the contractor. The contractor proceeded with the work immediately, but was slow to identify the costs implication of the changes.

4.33 The problems were compounded by the payment regime, which provided little incentive early in the contract for the early identification and agreement of the value of instructions. Payments were made in accordance with an agreed schedule which led, early in the contract, to the contractor being paid in advance of the value of the work completed. This over funding was reversed later in the contract when the value of worked planned exceeded the scheduled monthly payments.

4.34 The Council had also revised the standard terms of contract so that monthly stage payments were not adjusted to include any variations completed that month until the Council's quantity surveyor had forecast a cost overrun on the project. Wimpey were the first to forecast such an overrun early in 1994; EC Harris, the Council's quantity surveyor, did not do so until June 1994. There was therefore little pressure on the contractor or the Council before this date to agree the cost of variations. By June 1997 there was still a wide difference between the Council's and Wimpey's estimates of the costs of construction.

Contingencies

4.35 The only contingency which was specified in the project cost estimates was for construction risks such as: unforeseen site conditions; changes in building or fire regulations; and material or labour supply problems. All estimates from June 1989 onwards included a contingency of two per cent of estimated building cost to cover these risks. The Council considered two per cent to be a very tight margin and queried its adequacy on more than one occasion. However EC Harris, the quantity surveyor, assured them that it would be enough.

4.36 By the start of construction, the contingency of two per cent, while tight, should have been sufficient given a complete design with a completed foundations contract. However control over the contingency, which totalled £550,000, was poor. The Council's site representative exercised satisfactory control over the release of £300,000, but no-one had equivalent responsibility for the remainder.

4.37 The Council's monitoring of expenditure of the contingency assumed a constant rate of depletion. Although this method is recommended in guidance issued by the Treasury's Central Unit on Procurement, it does not recognise that work on services, an area of major risk, takes place towards the end of a contract rather than being evenly spread.

Is the overrun on the cost of construction likely to increase?

4.38 The cost of the project may increase considerably if the Council have to pay for claims by the contractor and for items disputed with the contractor. Although Wimpey have yet to submit an itemised claim, the cost of the building could be £12.6 million higher than the Council's estimate. Wimpey and the Council are currently negotiating to reach an agreed figure.

4.39 A key area of dispute relates to the mechanical and electrical services. The dispute is between Building Design Partnership and Matthew Hall, the service sub-contractor, as to who was responsible for the production of the detailed drawings and therefore what could be classified as a variation.

4.40 Wimpey began to submit notifications of disruption and prolongation from August 1993. EC Harris reported the notifications to the Project Progress Group, but did not estimate their likely cost since, contrary to the contract's requirements, Wimpey did not provide the necessary cost details and the Project Progress Group did not pursue Wimpey for this information. It was not until May 1994, after Wimpey had produced their first draft final account, which forecast a cost overrun of £1 million to £1.5 million, that this Group asked for a full estimate of the potential final cost. From August 1994, EC Harris started to report estimates of associated risk and an allowance for claims. Since August 1994 the Council's estimate for associated risk has been refined following discussions between EC Harris and Wimpey.

Part 5: Managing the project

5.1 To identify the underlying causes of the time and cost overruns we examined how the Council managed the project. Drawing on our experience of other construction projects, we focused on four critical areas:

a) setting up the management of the project;

b) procurement of the project;

c) management of the risks associated with the project; and

d) use of project reviews and audits.

Did the Council follow good practice in setting up the management of the project?

Summary

5.2 The Council did not make adequate arrangements for the management of the project. They did not fully define and document the roles and responsibilities of those involved, particularly those of their own staff. No single person was made responsible for ensuring the delivery of the project to time and within budget. In practice, responsibility for project management fell on the Council and their staff. The staff lacked the necessary training and expertise. As a result there was a lack of active management of the project.

5.3 The Treasury's Central Unit on Procurement have issued guidance on the management of projects since 1988. Their recommendations are summarised in Figure 14 overleaf. The model management structure for a traditionally procured construction project is set out in Figure 16 on page 42. The Council's management of the project on those points is summarised below.

Appointment of a Project Sponsor

5.4 During the project, the Council appointed three different members of their staff to take charge of it - the Director of Marine Sciences and then the two successive Establishments Officers. None of these staff had expertise or experience in construction projects. Neither were they full-time on the project. Although in charge of it, they did not fulfil the normal sponsorship role since they

Good project management practice

Figure 14

Departments should appoint a **Project Sponsor** for the duration of a project who will take full personal responsibility for its successful completion.

Departments should make one person responsible for the project's management, including delivery to time and within budget. On large or complex projects they should appoint a dedicated professional **Project Manager** rather than one who combines this responsibility with others such as design.

Departments should clearly define and allocate **roles and responsibilities**.

Departments should compile a **Project Execution Plan** at the start and review this as the project progresses.

Source: National Audit Office analysis of Treasury's Central Unit on Procurement Guidance

were not fully responsible for the project's successful completion or for its management. For example, during the briefing and design stages, responsibility for the project's budget lay with the Head of Building Services while separate Project Co-ordinators for the Council and the University supervised the users' input to the project.

Project management structure

5.5 The Council's normal practice was to take a collective approach to project management so as to represent the interests of all stakeholders at every stage. Accordingly, they did not make one person the project manager, with responsibility for the delivery of the project to time and cost. Instead the Council and their consultants managed the project jointly through a network of committees and groups.

5.6 During the project the Council commissioned eight reviews which included the management arrangements (Figure 15). These reviews advised against the Council's collective approach and recommended the appointment of a single independent project manager. However, the Council considered that the use of such a consultant would duplicate expertise already available and would be an unnecessary expense. Thus, for example, they rejected Culpin Partnership's offer in March 1992 to perform the full Project Manager role for the remainder of the project for a fee of £324,000.

Figure 15

Advice to the Council on the management of the project

Date	Source	Advice and action
1990 September	The Council's Governing Body	Responsibility for management of this project should be assigned to an individual who was not a member of the Design Team. The Council rejected this proposal. They considered that such an appointment would lead to extra cost and duplicate expertise which was already available in the project.
1991 February	Touche Ross	The Council should appoint a project manager at the start of a project and consider the need for formal training in project management.
June	Internal Council review of options for managing the project's construction stage	The Council rejected the use of an independent project manager, since they considered that the construction stage was relatively routine. Instead they nominated the Head of Building Services to co-ordinate and supervise the project.
August	Clarke Bond Partnership	The Council should seek the views of the Design Team on the appointment of a professional project manager for this project.
1992 March	Rose Project Services's Project Audit	There should be a full-time, professional project manager.
April	Second Governing Body Review of the project	The Project Manager should be independent of the Design Team. Although that person could be a member of the Council's staff, it was doubtful that the Council could provide someone with sufficient authority or experience to do the job. The Council should therefore appoint an independent consultant. In subsequent discussions the person who conducted this review agreed that in-house management would be sufficient if supported by part-time external expertise. As a result the Council appointed an Employer's Agent for the project in January 1993.
1993 October	Building Services's review of all current Council projects	There was no single, clear project management responsibility for the Centre. As a result, this responsibility had fallen on the Council. Their in-house resources for managing this project were stretched and lacked training in the management of construction projects.
December	Rose Project Services's report on the project management arrangements for the Centre	The project management arrangements were inadequate. Since it was too late to appoint an independent project manager, the current management structure should be strengthened. The University's representative should take a more strategic role. The Council should appoint a consultant as their new site representative at a cost of about £80,000. This person's remit should include the duty to be more proactive in the project's day-to-day management. The Council rejected this since the project at that point was only in slight delay and was still forecast to finish within budget.

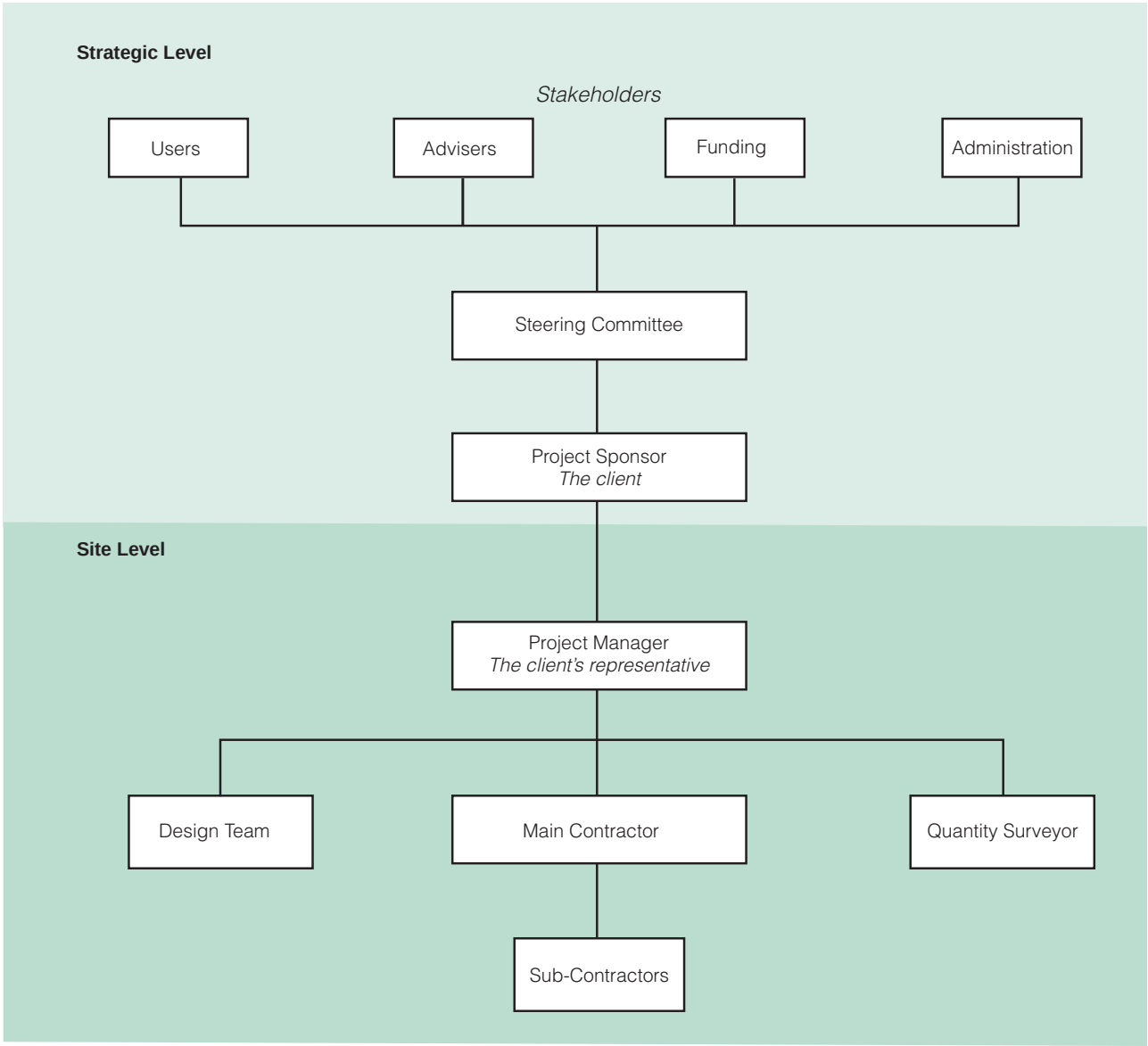
Source: National Audit Office examination of Council documents

The Council received advice on a number of occasions that they should appoint an independent project manager. However, at no point during the project did the Council do so.

5.7 Figure 16 shows the recommended organisation structure for a project procured using a traditional contract strategy as used in this case. Figures 17 and 18 show the project management arrangements that the Council put in place for the briefing and design and the construction stages respectively. The arrangements for the management of the project during construction were especially complex. The Council appointed their Head of Building Services to liaise between their committees and the consultants and contractors. Her role was to co-ordinate and supervise the project. She was not given the project manager role because of the Council's collective approach to managing the project.

Figure 16

Model organisation structure for the traditional approach



Note: —— denotes lines of reporting and/or instruction

Source: National Audit Office

This figure shows the usual structure for a traditional contracting strategy. All requests from stakeholders are transmitted through the steering committee and the project sponsor. The project manager has the responsibility for representing the client and the contractual authority to instruct those beneath him.

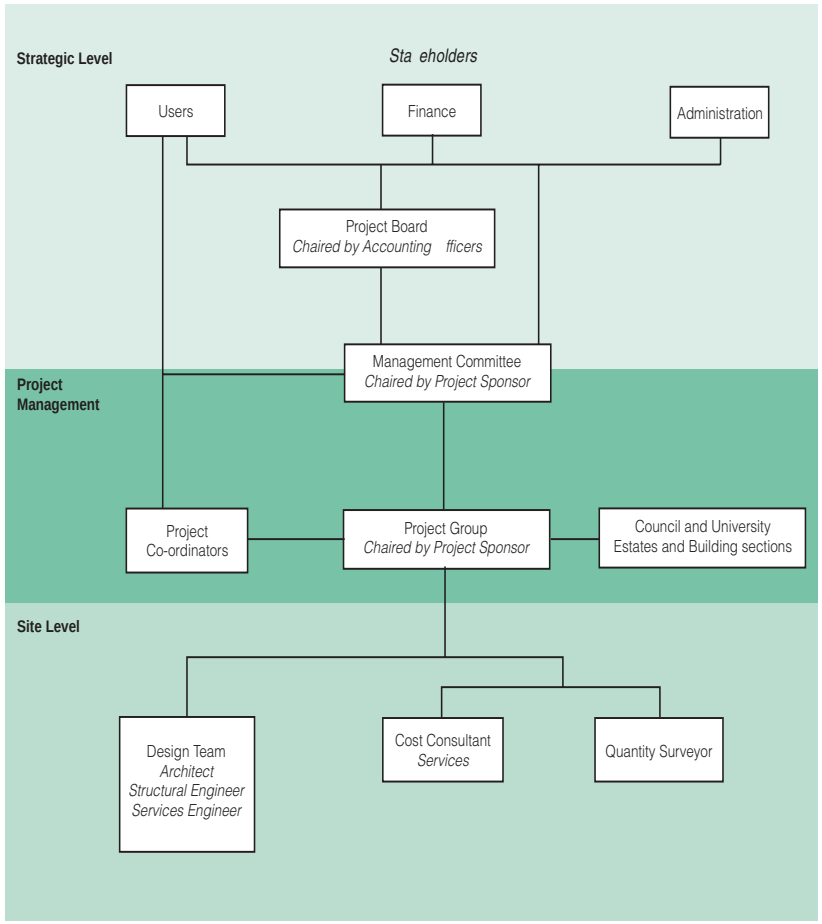
Fig 17 & 18 foldout

Figure 17, Project managment structure for the Centre prior to construction
Figure 18, Project management structure for the Centre during construction.

Figure 17 and Figure 18 overleaf

Figure 17

Project management structure for the Centre prior to construction



Note: ——— denotes lines of reporting and/or instruction

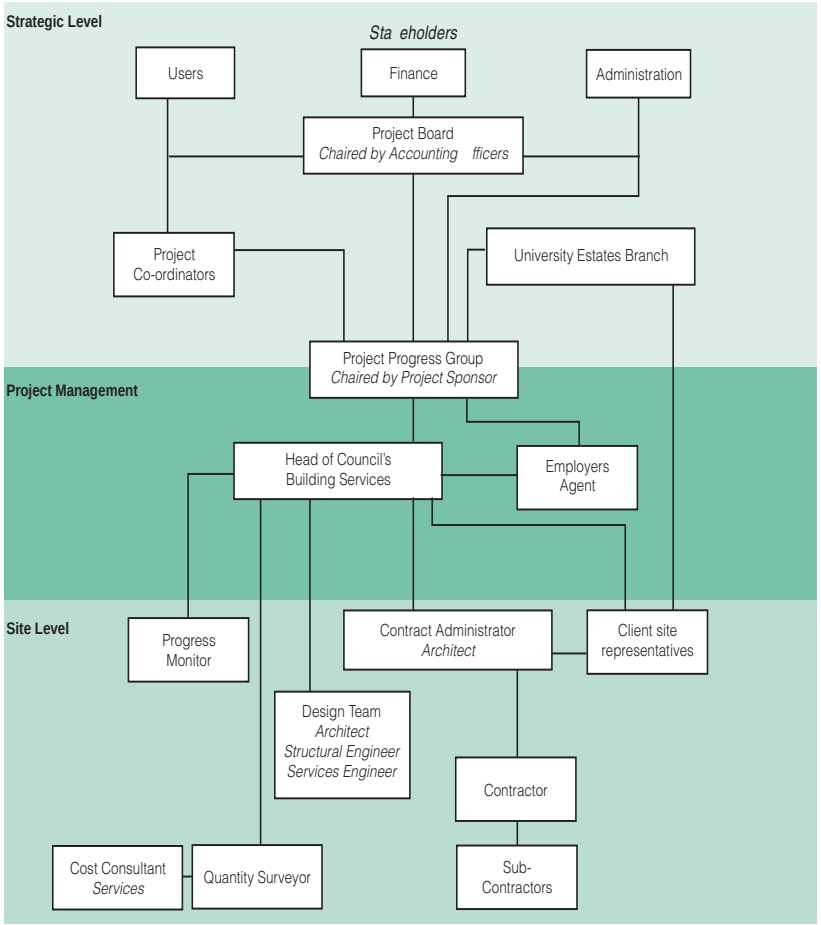
Source: Natural Environment Research Council

There was no single project manager. The Council took a collective approach and managed the project using a hierarchy of committees.

The services engineers, Building Design Partnership, had more responsibility for services' costs than usual.

Figure 18

Project management structure for the Centre during construction



Note: ——— denotes line of reporting and/or instruction

Source: Natural Environment Research Council

The project manager was effectively the Head of the Council's Building Services, although some of the duties of the post were allocated to others. The Project Progress Group met only monthly.

The services engineers, Building Design Partnership, had more responsibility for services' costs than usual. As the Contract Administrator, Culpin Partnership, the architect, administered the contract with Wimpey the contractor. Culpin Partnership were not responsible for managing the other members of the Design Team or settling disputes and claims. EC Harris Project Management, the progress monitor, performed one of the duties of the administrator - the assessment of the project's progress. The two site representatives were staff from the Council and University. Their role was to monitor the project's progress and to take any low-level decisions required.

5.8 In January 1993, to help the Head of Building Services, the Council appointed Rose Project Services as an Employer's Agent (Figure 18). Their role was advisory and part-time and they had no contractual authority to direct the contractor or consultant team. As the Council did not employ an independent professional project manager, they would have benefited from the earlier appointment of an Agent.

5.9 The Council's contracts with their consultants made none of them responsible for ensuring the delivery of the project to time and within budget. Therefore the task of managing the project fell to the Council by default; particularly, during construction, to their Head of Building Services. But she had limited construction experience, no formal training in project management and was part-time on the project.

5.10 In September 1994, after EC Harris had forecast serious time and cost overruns, the Project Board met for the first time since July 1992 to consider a report on the reasons behind the problems from Rose Project Services, the Employer's Agent. The Board continued to meet every two to three months thereafter to review the situation.

Roles and responsibilities

5.11 Every construction project should have from the start a Project Execution Plan, which should be regularly updated. It should define the roles and responsibilities of everyone working on the project so as to prevent gaps, overlaps and contradictions. For the Oceanography Centre, responsibilities were defined in a number of documents: the terms and conditions of the professional appointments; the contract with Wimpey; the specifications for sub-contractor work; and in a Project Handbook drawn up by the project team.

5.12 There was no clear and comprehensive allocation of responsibilities, causing problems with the management of the project. In particular, the allocation of responsibility for cost estimation and control of the mechanical and electrical services was inadequate. For example responsibility for agreeing with Wimpey the value of variations to the services during construction was given to the Building Design Partnership, the designers, rather than to EC Harris, the quantity surveyors. Hence there was a potential conflict of interest when Building Design Partnership, in this costing role, adjudicated between Matthew Hall, the sub-contractor, and themselves as the designers.

5.13 We found no evidence that the Council had defined the role and responsibilities of the three Council staff who were in charge of the project. Similarly, although the Council defined the role of the Head of Building Services as one of co-ordination and supervision, the details were never spelt out. Nor did they define her delegated authority to take decisions.

5.14 The Council envisaged a collective approach to the project's management, but they did not determine all the tasks involved in project management and how these were to be allocated to the various parties. As a result some of these duties were not allocated and therefore not performed. Figure 19 overleaf sets out the resulting problems and indicates how the presence of a professional project manager would have helped prevent their occurrence or resulted in their faster resolution. The appointment of such a project manger may have helped to avoid many of the project's problems for a cost of about £225,000 over the life of the project.

The Project Handbook

5.15 The project team did not produce a draft Project Handbook (paragraph 5.11) until August 1992. It therefore covered only the construction stage. The Handbook omitted several significant matters, for example: the roles and responsibilities of the contractor and services sub-contractor; and the day-to-day responsibilities of Culpin Partnership as the administrator of the contract with Wimpey. The Council did not complete the Handbook, although they issued the draft to all parties except the contractor. The Handbook was not updated to reflect the practice on the site.

Figure 19

The benefits of employing a professional project manager

Problems	Benefits
The Council did not set any objectives at the start but part way through. Nor was there any prioritisation of objectives.	The Project Manager's duties include a review of the project's objectives in terms of quality, time, and cost, and their relative priorities.
There were weaknesses in the appointment of the professional team and the basis of their fees.	The Project Manager advises on the appointment of other consultants, their terms and conditions, and fee structures.
The Council did not consider at the start of the project the contract strategy and form of contract to use. Instead they adopted what they had used in the past.	The Project Manager evaluates the forms of contract and contract strategy to be used.
Briefing for the project took 15 months instead of the planned 9 months.	The Project Manager is responsible for managing the briefing process.
The time allowed for design was extended to ensure that the design was complete when the Council went out to tender. But the design remained incomplete and work continued after tenders were issued.	The Project Manager is responsible for managing progress during the design stages.
The Council had no independent advice on the design solutions proposed by the Design Team.	The Project Manager is able to offer independent advice on the design solutions proposed by the Design Team.
The Council did not have any independent advice on the implications of the 1991 market test of cost estimates for the appointment of the main contractor.	The Project Manager is involved in the appointment of the main contractor.
Difficulties with the detailed design information for the mechanical and electrical services contributed to delays. The cost of this information was not estimated before its release.	The Project Manager co-ordinates consultant activity to ensure the timely provision of design information to the contractor and the estimation of its cost before issue.
There was an incomplete division of responsibility for the monitoring of progress. No one was responsible for reviewing the contractor's plans for recovering delay.	The Project Manager is responsible for monitoring progress and reviewing the contractor's work programmes.
The Council did not make any consultant responsible for the early identification and resolution of problems. As a result there was a lack of action on this aspect.	The Project Manager is responsible for identifying existing and potential problems and resolving them in the client's interest.

Source: National Audit Office analysis of Treasury guidance and standard terms and conditions for the appointment of a Project Manager

Did the Council procure the project satisfactorily?

Summary

5.16 The Council used a traditional contract strategy that they had adopted on previous projects. We consider that their choice was appropriate for a highly serviced building.

5.17 The Council used standard government forms of contract with some amendments. The contract documents for professional appointments were not entirely consistent with the construction contract. The latter assumed that there would be a single project manager whereas the professional appointments lacked a clear and comprehensive allocation of responsibilities. Two of the Council's amendments to standard contract clauses caused some management problems.

5.18 In appointing some of the consultants, the Council limited their choice to firms who had worked previously for them, though on much smaller projects. Given the size and complexity of the Centre, in our view they should have considered a wider range of firms.

5.19 In 1991 the Council asked six firms to submit estimates for the construction of the Centre, in order to check the accuracy of their own estimates. We consider that such a practice should be avoided. The responsibility for establishing reliable cost estimates should lie with the Council's consultants.

5.20 The procurement of a project requires a department to take high level decisions as to the contract strategy and forms of contract. Having made these decisions, the department proceed to appoint a team of consultants and a contractor to undertake the work.

Contract strategy

5.21 The Council's past experience of projects was to use a traditional contract strategy, whereby the building is fully designed before a contract for the construction is placed. They decided to follow this approach for the Oceanography Centre. An alternative method would have been a Design and Build strategy, where a single contract is placed for both the design and construction of the building and the design is developed as construction proceeds. The Treasury's Central Unit on Procurement state that a Design and Build strategy is inappropriate for technically advanced or complex buildings. As the Centre was to be a highly serviced building, the Council's choice of strategy was appropriate.

Forms of contract

5.22 The Council used the former Property Services Agency's standard terms and conditions for the professional appointments and the standard government contract for the works (GC Works 1), with some amendments.

5.23 The contract documents were written by the Property Services Agency for their own use and reflect the Agency's practice at that time. The contracts assumed that there would be a Project Manager with responsibility for ensuring the delivery of the project to time and within budget, rather than the collective approach to project management adopted by the Council. The terms and conditions of the professional appointments, as amended by the Council, were drafted inappropriately to meet the risks of a large project procured traditionally. For example, there was a lack of clear and comprehensive allocation of responsibilities (paragraphs 5.11 and 5.12), and inadequate provision for cost control of mechanical and electrical services (paragraph 4.18). These factors directly contributed to the project's problems.

5.24 The Council modified the standard responsibilities of Building Design Partnership, the services engineers, for the co-ordination of the services drawings as this was an area of major risk. In our opinion, there was some uncertainty as to the exact allocation of responsibilities for this work between Building Design Partnership and Matthew Hall, the services sub-contractor.

5.25 The Council decided to use the latest version of the Government works contract, GC Works 1 Edition 3. However they amended the clause covering the stage payments to the contractor which resulted in the late valuation of variations and instructions early in the contract (paragraph 4.34).

Procurement of professional services

5.26 The Council appointed all but one of their consultants after fee competitions. The exception was EC Harris with whom the Council negotiated a fee. Where the Council used competitive tendering, they undertook a pre-qualification exercise to identify suitable firms. Although the Council had pre-set quality criteria against which to review firms, they made no formal assessment of each firm against these criteria. Once the firms were invited to submit fee bids, the Council's evaluation was limited to consideration of fee levels alone rather than assessing them on both price and quality. When the final account with Wimpey is settled, the Council intend to review their use of consultants on this project.

5.27 Figure 20 summarises our findings on the consultant appointments. The Council might have been better served had they asked professional organisations to suggest architects and services engineers with past experience of highly serviced laboratory projects of a comparable size. In that way the Council could have identified potential services engineers more quickly and ensured that they had a wider choice of architects with the relevant experience.

Figure 20

The Council's procurement of professional services

Position	Consultant	Selection Method	Appointment Date	Comments
Architect	Culpin Partnership	Fee Competition	July 1989	The Council limited their choice to firms who had worked previously for them. The three firms invited to bid had only limited experience of projects of a similar type to the Centre and these were smaller. The Council did not approach the Royal Institute of British Architects for the names of suitable firms. The National Audit Office approached the Institute who supplied a list of eight firms, which the Council had not considered. There is little evidence that the Council's chosen architects had experience in highly serviced laboratories other than on the previous Council projects.
Structural Engineer	Gifford & Partners	Fee Competition	November 1989	Appointed after competition.
Services Engineer	Building Design Partnership	Fee Competition	March 1990	The Council were slow to identify suitable consultants and only invited fee bids from two firms. Of these the Council chose the more expensive, but there is no record of the evaluation to support this decision.
Quantity Surveyor	E C Harris & Partners	Fee Negotiation	April 1990	E C Harris had worked for the Council previously on other projects. They had also been involved in this project since 1989, costing the requirements identified during briefing on a time charge basis. The Council therefore chose to negotiate a fee with them in order to provide continuity. However the Architect had been in place since July 1989 and therefore already provided continuity.
Employers Agent	Rose Project Services	Fee Competition	January 1993	Appointed after competition.

Source: National Audit Office examination of Council records

Selection of the main contractor

5.28 In 1991 the Council invited six firms to submit estimates for the cost of the Centre's construction. The Council intended to use these to check the accuracy of their own estimates at a time when the market was volatile. The responses supported their estimates at that date. The Council told us that such an exercise was not unusual in their experience. However, the Central Unit on Procurement considered that the exercise was uncommon and did not represent good practice since it wasted private sector resources. The responsibility for establishing reliable cost estimates should lie with the Council's consultants.

5.29 After a pre-qualification exercise in 1992 the Council included in their tender list Wimpey and Mowlem, two of the firms who had participated in the 1991 costing exercise. These two firms submitted the lowest bids. Thus, although none of the unsuccessful 1992 tenderers complained, the 1991 exercise left the Council open to claims that Wimpey and Mowlem had unfairly benefited from the information they had received then. As a matter of good practice, Government organisations should avoid any actions which would allow unsuccessful tenderers to allege unfairness. Wimpey told us, however, that the 1991 information had been of no use to them when preparing their 1992 tender. The Central Unit on Procurement told us that it was unlikely that data over one year old would have been useful to Wimpey.

5.30 In the event the Council's estimates proved to be inaccurate. The tender evaluation report showed that the tenders returned in 1992 exceeded the pre-tender estimate (paragraph 4.15). The Council therefore had to negotiate with Wimpey, the lowest tenderer, to identify further savings. These negotiations took three months.

Did the Council manage the risks associated with the project?

Summary

5.31 The Council made attempts to reduce the risks inherent in the project. However, there was little or no guidance or industry awareness of risk management available to them. Consequently, the Council did not manage the risks in a concerted manner and their efforts were not always successful. For example, despite delays, there were still areas of uncertainty in the design before tenders were invited.

5.32 The management of the risks associated with construction projects is difficult and is of increasing concern to the industry. When the Council started the Oceanography Centre project there was very little guidance or consensus on the

appropriate methodology within the construction industry. In 1993 the Central Unit on Procurement issued a guidance note on the management of risk and contingency for works projects. The main features of the guidance are that:

a) effective risk management is an integral part of the project management process;

b) all the important risks should be identified and assessed from the earliest phase of a project; and

c) continuous risk management throughout the project is essential.

5.33 The Council were aware that construction projects risk encountering time, cost and quality problems. At different times during the project they took action to reduce risks. However they did not carry out a formal risk assessment, nor did they manage risk actively throughout the project. Nevertheless they:

a) tried to reduce the risks associated with the mechanical and electrical services by placing additional responsibilities for design on Building Design Partnership, the services consultant;

b) prevented users' changes to the project during construction by removing all the future users from the management of the project in July 1991;

c) delayed going out to tender in an attempt to ensure that the design was complete by then. However, despite these delays, there were still areas of uncertainty in the design, particularly in respect of the mechanical and electrical services, when the tenders were invited;

d) appointed a separate contractor for the foundations work to prevent claims for delays in this area during the construction phase. This work was completed in February 1992, before the main construction contract was let; and

e) commissioned EC Harris, in August 1994, to quantify the risks and estimate the likely claims. But Wimpey had first notified delays in August 1993.

Did the Council make proper use of project audits and reviews?

Summary

5.34 There were a number of reviews of the project; these highlighted management deficiencies which the Council did not fully address. The Council have however learned lessons for use on future projects.

5.35 Departments should ensure that lessons from previous projects are used to improve performance. Project evaluations should be carried out at predetermined stages during a project. Project sponsors should commission independent reviews of specific areas of concern. A post project evaluation should be done soon after completion to measure success, record lessons and improve subsequent performance.

5.36 There were 11 reviews of the project during its course, which examined many aspects including the management arrangements, the contract strategy and design. None of these reviews were planned by the Council at the start of the project. Instead the need for review was identified as the project progressed. For example, the need for a project audit was identified in August 1991 by Clarke Bond Partnership, who were advising the Council on the contract strategy. But the audit was delayed as the Council did not obtain the design team's agreement to co-operate with the examination until January 1992, after the team had provided the design information needed to go out to tender. However this late agreement left the auditors, Rose Project Services, with little time in which to perform the audit before the main construction work was put out to tender in March 1992. As a result the scope of their examination and their methodology were limited. Nevertheless, the Council implemented many of their findings.

5.37 In 1993 we reported on the management of capital projects by the British Antarctic Survey, another division of the Council. The report was critical of a number of aspects of project management and procurement. The subsequent report from the Public Accounts Committee, in December 1993, made recommendations for improvements. Following this, the Council issued guidance on the management and control of major capital projects. Some of the weaknesses addressed by the guidance were repeated on the Oceanography Centre project which was already in construction by the time the reports and guidance were published. Figure 25 in Appendix 5 sets out the relevant Public Accounts Committee recommendations and the action the Council have taken on them.

5.38 In July 1995 the Council commissioned from Rose Project Services a post project evaluation, to assess whether the project had met its objectives, highlight any lessons for subsequent projects and prepare a plan for future action. In January 1996 Rose Project Services concluded that the project had not met its objectives in terms of time and cost. They gave the main reasons as:

a) the person who controlled the budget did not control the brief;

b) split responsibilities for project management;

c) incompleteness of design; and

d) poor performance by Wimpey and Matthew Hall.

5.39 Rose Project Services believed that the project had met the briefing requirement to develop a centre in which to undertake 21st century science within an integrated environment. They did not conclude on any other, more specific performance objectives such as flexibility or energy usage. Their evaluation was structured around ten detailed heads of evaluation which they had agreed with the Council. They drew out a wide range of recommendations for improved control on future projects. Figure 26 in Appendix 5 sets out Rose Project Services' recommendations and the action the Council have taken on them.

Appendix 1

Chronology of the project

1985	December	House of Lords Select Committee report on Marine Science and Technology
1988	June	Council submitted a bid to the Advisory Board for the Research Councils for the construction of a Centre for Oceanography at Southampton.
1989	January	Council and University Study Groups began to define their requirements.
	February	Secretary of State announced funding for the Council's share of the project.
	May	Study Groups produced Stage A requirements which were to be developed into Stage B.
	July	Culpin Partnership appointed as Architect. The Management Committee considered Stage B.
	November	University bid submitted to Universities Funding Council. Gifford and Partners appointed as structural engineers.
1990	January	Integrated building requirement produced - Stage C (cost of £65.0 million to £73.2 million). Project Board agreed target budget of £48 million.
	February	Stage C split into two phases, the first of which formed Stage D. Users asked to certify that Stage D would meet their operational requirements.
	March	Management Committee considered further reductions to Stage D (cost £49.45 million). Building Design Partnership appointed as services engineers and EC Harris and Partners confirmed as quantity surveyors.
	May	Project Board agreed the outline design (cost £48.9 million).
	August	Universities Funding Council agreed a grant of £10 million (at 1990 prices).
	September	Project Board agreed the scheme design (cost £48.85 million), subject to the approval of the Council's Governing Body which gave formal approval for the Council's contribution of £36 million to the budget of £48 million.

	October	Project Board identified the items to be covered by the £48 million budget.
	December	Timetable slipped because of design changes to establish a £2 million reserve. The Council approved the start of detailed design.
1991	January	Cost estimated at £46.7 million.
	February	First formal review by the Council's Governing Body.
	March	Timetable slipped because of design changes arising from detailed interviews with users about room specifications.
	May	Council and University approved an extra £0.9 million to meet an increase in VAT. Test of market conditions confirmed the cost estimate of £46.7 million.
	August	Clarke Bond Partnership report on contract strategy.
1992	January	The Council approved tender action for the main contract.
	March	Rose Project Services' Project Audit.
	April	Second formal review by the Council's Governing Body.
	June	Tenders received at over £32 million against a pre-tender estimate of £30.6 million.
	November	Contract awarded to Wimpey for £29 million. Total estimated cost of project was £48.9 million.
1993	January	Start on site. 110 week contract with planned completion on 13 February 1995. Rose Project Services appointed as Employer's Agent.
	March	Value management report from Value Management Limited.
	August	Wimpey gave notification of prolongation/disruption on builders' work in connection with mechanical and electrical services.
	November	Wimpey gave notification of prolongation/disruption on brickwork. Rose Project Services expressed doubts about Wimpey's ability to recover the delay on construction.

1994	March	Wimpey issue a revised programme.
	May	Wimpey indicated possible £1 million to £1.5 million overspend on contract sum of £29 million and gave further notifications of prolongation and disruption.
	June	EC Harris cost report indicated that there would be an overrun on the construction cost. Cost reduction exercise identified savings of £299,000.
	July	Staged payments re-negotiated.
	August	Wimpey aimed to recover delay and still finish by February 1995. EC Harris estimated cost of claims and associated risks, resulting in an overrun on the contract sum of £29 million of £1.7 million. The Council delayed monthly payments to Wimpey.
	September	Project Board met for first time since July 1992, to consider predicted cost overrun. Delay on construction increasing due to problems with commissioning.
	October	Wimpey claimed an extension of time of 8 weeks. Rose Project Services role increased to identify and resolve risks to the project's completion.
1995	January	Wimpey wrote to increase their claim to 11 weeks.
	February	Contractual completion date missed. The Council began to levy liquidated damages.
	June	The Council rejected Wimpey's offer of early access to parts of the building.
	July	The Council commissioned a Post-Project Evaluation from Rose Project Services and appointed McKenna & Co as legal advisers.
	August	Issue of practical completion certificate on 4 August (24 week and 4 day delay). The building was handed over to the Centre who began fit-out works.
	September	Centre staff began to occupy the building.
1996	April	Commissioning of the building completed, although some snags and defects were still outstanding.

Appendix 2

The Natural Environment Research Council and the University of Southampton

1 The Southampton Oceanography Centre was constructed against a background of change in the administrative structure in which the Research Councils work and also within the Natural Environment Research Council itself. Similar changes took place within the education sector. Figure 21 shows the Council's mission.

Figure 21

The Council's mission

The mission of the Natural Environment Research Council is to:

- promote and support, by any means, high quality basic, strategic and applied research, survey and long-term environmental monitoring and related post-graduate training in terrestrial, marine and freshwater biology, and Earth, atmospheric, hydrological, oceanographic and polar sciences and earth observation;
- advance knowledge and technology and to provide services and trained scientists and engineers which meet the needs of users and beneficiaries, thereby contributing to the economic competitiveness of the UK, the effectiveness of public services and policy, and the quality of life;
- provide advice, disseminate knowledge, and promote public understanding of the field aforesaid.

Source: Natural Environment Research Council, Corporate Plan Update, 1995

Sponsoring departments

2 Between 1985 and 1996, the Natural Environment Research Council was sponsored by three different government departments. At the start of the Southampton project, the Council reported to the Department of Education and Science via the Advisory Board for Research Councils. In 1992 the Office of Science and Technology was created within the Cabinet Office and took over responsibility for funding and oversight of the Research Councils. Finally, as the project neared completion in July 1995, the Office of Science and Technology was transferred to the Department for Trade and Industry.

3 The University of Southampton have experienced several changes in their arrangements for obtaining public funds (other than from the Research Councils). Initially, the University obtained funding from the University Grants Committee

which changed in April 1989 to the Universities Funding Council. In April 1993, a further change produced the Higher Education Funding Council. These bodies all reported to the Department of Education and Science, which became the Department for Education in 1992, and then the Department for Education and Employment from its creation in April 1995.

Funding

4 The funding for the project came from two separate streams: the Council and the University. Both streams were approved ultimately by the Department of Education and Science from the start by two separate funding routes. The funding from the Council came from a bid to the Advisory Board for the Research Councils who approved the expenditure in 1988. The money was then included within the Natural Environment Research Council's public expenditure survey allocation each year. The funding from the University was bid separately from the Universities Funding Council who made a grant in August 1990. The grant was subsequently confirmed by the incoming Higher Education Funding Council for England in August 1992.

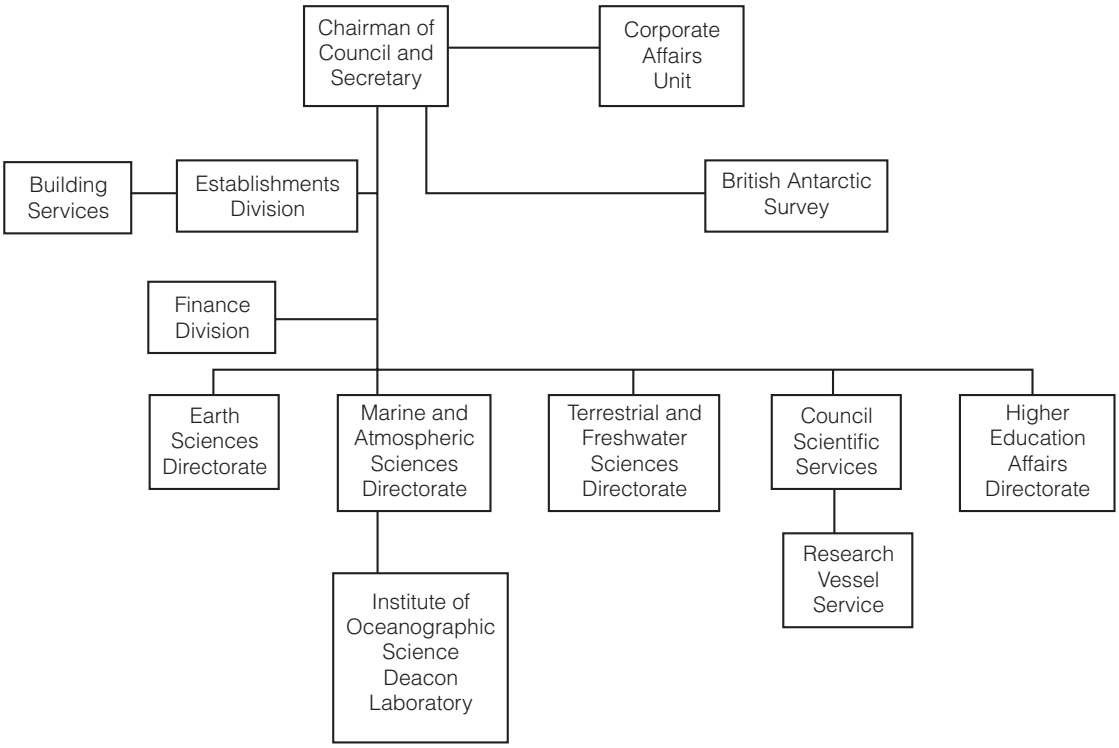
Structure of the Council

5 During the period there were also changes to the Research Councils and their responsibilities as a result of the 1993 White Paper 'Realising our potential'. The changes included the abolition of the Science and Engineering Research Council and the creation of two new research councils. The Natural Environment Research Council gained extra science programmes for Earth Observation, Atmospheric Chemistry and Science-based Archaeology.

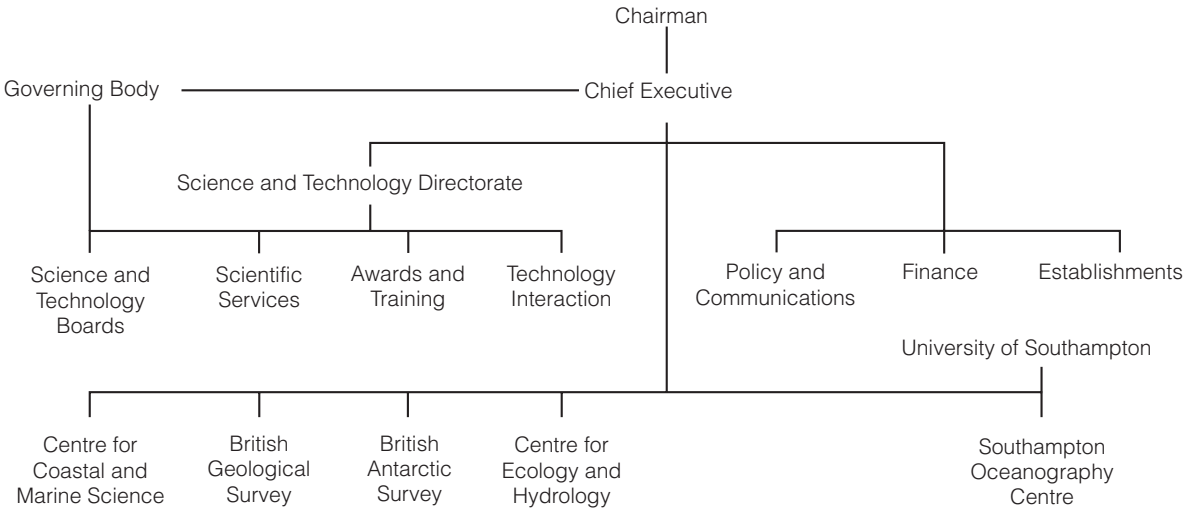
6 Also in response to the white paper the responsibilities of the senior staff within the Council changed. Prior to 1994, the Chairman of the Council had been a full-time executive post. In April 1994, the post of Chairman became part-time and non-executive. The administration of the Council became the responsibility of the Chief Executive - a new post. Following his appointment, the new Chief Executive brought about changes in the structure of the Council to reflect the increasing interdisciplinary research teams and projects. Figure 22 shows the structure of the Council in 1990, when the building was being designed, and the structure in 1994 following the reorganisation.

Figure 22 **Organisation charts for the Natural Environment Research Council**

Organisation chart for the Council in 1990



Organisation chart for the Council in 1994



Source: The Natural Environment Research Council Report and Accounts 1990-91 and 1994-95

Appendix 3

Composition and roles of the project committees

Committee	Purpose	Composition
Project Board	■ To receive reports on progress ■ To advise the two Accounting Officers on any decisions to be made	■ Two Accounting Officers and their deputies ■ Council's Director of Marine Sciences ■ Council's Heads of Finance, Establishments and Building Services ■ University's Finance Officer ■ Heads of Departments ■ Representatives from the local Council (during the project's development stage) ■ Culpin Partnership, the Architect
Management Committee	■ To oversee the preparation of the brief, design, timetable and budget for the project	■ Council's Director of Marine Sciences ■ Council's Heads of Finance and Establishments ■ Member of the Council's Building Services ■ University's Finance and Building Officers ■ Heads of the User Departments ■ Project Co-ordinators[1] ■ Culpin Partnership, the Architect
Project Group	■ To manage the project on a day-to-day basis ■ To liaise with the Architect and Design Team ■ To provide user feedback on technical matters	■ Council's Director of Marine Sciences and Head of Establishments ■ Heads of the Council's Building Services and University's Estates Sections ■ Project Co-ordinators[1] ■ Culpin Partnership, the Architect
Project Progress Group	■ To ensure the project's completion to time, within budget, and to an acceptable standard ■ To keep the Accounting Officers informed	■ Council's Heads of Establishments and Building Services ■ Head of University's Estates Section ■ Representatives from the Council's and University's Finance Sections ■ Project Co-ordinators[1] ■ Rose Project Services, the Employer's Agent ■ Culpin Partnership, the Architect ■ Heads of the User Departments (if necessary)

Note: 1. The Council and the University each appointed a Project Co-ordinator to supervise user input into briefing and design. The Council's Project Co-ordinator acted as secretary to the project committees and drew up the brief

Appendix 4

Interview with the Heads of Department at the Oceanography Centre

1 We interviewed the Heads of the seven operational Departments at the Oceanography Centre in spring 1996, about six months after the users moved into the Centre. Their views reflected their early impressions of the building since they had not then experienced occupation over a whole year.

2 The Heads of Department said that the users were broadly happy with the building although they did see some disadvantages. The main issues they raised are presented below.

The advantages of the Centre

3 The users considered that the Centre was already acting as a national focus for oceanography. They noted particularly improved communications, within the Centre and with outside interests. Interaction between the Council and University staff was growing with joint research projects and studentships. The proximity of the Research Vessel Services allowed greater involvement of University staff in the Council's scientific cruises. However, the Research Vessel Service provides a national service, with the Centre forming only a third of their customer base. Since the Centre opened there had been considerable private sector interest and four firms already had a base within the Division for Ocean Technology Development.

4 The Centre provided greater opportunities for stimulating ideas and for changing working practices. New recruits had brought a new culture, and their interaction with the more experienced staff was expected to aid scientific output.

The disadvantages of the Centre

5 The Centre had funded their start-up costs from existing science budgets, and the users doubted that there would be enough money for running costs.

6 The users felt that the building was isolated. Links with other University departments had been lost and teaching staff spent a lot of time travelling to and from the main University campus.

7 It was too early to demonstrate whether the MEDA floors gave the necessary flexibility. In the short term the users were finding that minor changes to the accommodation were expensive, probably because the change procedures were more complex than before.

8 The difficulties with the fume cupboards had been disruptive, affecting four departments (paragraph 2.39).

The impacts of the time slippage on the users

9 Some Council staff moved home in the expectation that the building would be completed in February 1995. As a result they had to travel back to their original place of work for about six months, at a total cost of £257,000.

10 The late completion meant that the users occupied the building before all the defects had been cleared or commissioning completed. The fume cupboard problem had been the major fault, but there were also problems with the level of lighting, and wrongly specified window blinds.

11 The delay caused uncertainty to staff and disruption to teaching and research programmes. Because the users began teaching almost immediately after moving in, there was not time to iron out small problems. The short time allowed for the move made synchronising moves of major equipment difficult.

The cuts and reductions made to the project

12 The group discussed the cuts and reductions to the project and classified them as essential, desirable and unimportant. Figures 23 and 24 summarise their conclusions on the cuts and the reductions.

The users' classification of facilities cut from the project

Figure 23

Essential	
Conference Centre	For any major conference, the Centre have to hire an outside venue. The conference for the opening of the Centre was held at the main University campus.
Discovery collection	A national working facility, which needs to be on-site. The Council has funded its move to temporary storage at Petersfield, Hampshire.
Deep testing tanks	The Centre have now bought one of these.
Hydrophonic Tank	Research Vessel Services plan to buy one of these from their existing budget.
Library shelving, carpets and Kitchen fitout	These items were re-instated by the Centre as part of the post contract works.
New Equipment	The users have had to transfer existing equipment, some of which is quite old.
Desirable for operational reasons	
Department of ship science and interdisciplinary research centre for ocean instrumentation	To benefit the Division for Ocean Technology Development, the Centre needs to develop more links with the University's Faculty of Engineering. This would be easier if the Department of Ship Science was at the Centre.
Creche	The University has a creche at the main campus which is over-subscribed.
Footbridge to Ocean Village	There is little interaction with the general public.
Pontoon for University launch	The University cannot send out their launch from the Centre.
Desirable for value for money reasons	
Rock store	A reference collection for the geologists, currently held off-site. It is operationally inefficient that academics and their students need to travel off-site whenever they need to consult it.
Unimportant	Squash courts, a garage, towing tank and new furniture for Council staff were considered to be unimportant.

The users' classification of reductions

Figure 24

Essential	
Main storage	The Centre have had to hire off-site storage at a cost of £120,000 a year. There are also increased staff and transport costs. The Centre are considering a bid for funding an extra 200 square metres of on-site accommodation.
Number of computing connections	The Centre installed extra computing connections as part of the post-occupation work. They consider that this would have been cheaper if it had been done as part of the main contract.
Desirable for operational reasons	
Lifts	Inconvenient for staff in getting round building.
Desirable for value for money reasons	
Finishes and mechanical and electrical services specifications, including:	All these reductions will probably result in higher running costs than if these features had been included. Lighting is proving a problem - current levels are inadequate, both in offices and in laboratories.
An energy-efficient combined heat and power system	
Energy-efficient lighting systems	
Automation of the Building Management System	
Unimportant	Across the board space reductions, reprographics and photographic services, CCTV, and the reduced size of the building's plant were considered to be unimportant.

Appendix 5

Action to address weaknesses in the management of the project

1 In 1993 the National Audit Office and the Public Accounts Committee produced reports on the Management of Major Capital Projects and Scientific Programmes by the British Antarctic Survey, another division of the Council (HC 572 and HC 640 1992-93 respectively). The reports made a number of recommendations to the Council. Work on the Oceanography Centre had begun in 1989, and the project exhibited many of the failings identified on the Survey's projects. In December 1993 the Council issued a guidance note on the Management and Control of Major Capital Projects to address the Public Accounts Committee's recommendations. Figure 25 sets out the recommendations of the Committee which relate to weaknesses also found on the Southampton project, and how the Council's guidance addressed them.

2 In July 1995 the Council commissioned a post project evaluation from Rose Project Services. Their report of January 1996 highlighted weaknesses in the management of the Oceanography Centre project and made recommendations accordingly. Figure 26 sets out the recommendations of the post project evaluation and the Council's action on them.

3 Figures 25 and 26 therefore summarise all the actions the Council have already taken to address weaknesses in the management of the project. However, in this report we have identified further lessons which are drawn together in the Summary and Conclusions.

Figure 25

Recommendations of the Public Accounts Committee on Management of Capital Works by the British Antarctic Survey

Committee Recommendation*	National Audit Office finding on Southampton Oceanography Centre	Council Action
Feasibility		
We are concerned that … both feasibility and need are adequately established before a decision is taken to proceed with detailed design.	The Council did not commission any feasibility studies for the Centre.	The Council's guidance note of December 1993 on management and control of major capital projects emphasised that the Council should allow adequate time for the performance of feasibility studies and the implementation of their recommendations.
Project Management		
We recommend that projects should not in future be allowed to proceed unless their management is properly resourced.	Although the Council planned a collective approach to the management of the project, in practice this responsibility fell on their staff. In-house resources were inadequate and lacked training in project management (paragraphs 5.5, 5.6 and 5.9).	The guidance note stated that the pre-approval evaluation should cover the arrangements for managing the project. If the Council decide to undertake this in-house, the resources available should be adequate and staff should have up-to-date training in project management.
	The Council took a collective approach to project management. They did not make a single person responsible for ensuring the delivery of the project to time and within budget (paragraphs 5.4 and 5.5).	The guidance note mentioned the use of an outside project manager as an option to be considered during the pre-approval evaluation.
	The Council did not adequately define the roles and responsibilities of all those involved (paragraphs 5.11 to 5.15).	The guidance note recommended that the roles of consultants, and the delegation and division of authority internally and between the Council and consultants, should be clearly defined in writing.
The Council should undertake a formal risk analysis for each project.	The Council did not undertake such analysis for this project (paragraph 5.33).	The guidance note recommended that such an analysis be performed early for every project.

* The recommendations of the Committee of Public Accounts were published in December 1993, a year after construction of the Oceanography Centre had started; but before it was completed.

continued…

Figure 25
continued

Committee Recommendation*	National Audit Office finding on Southampton Oceanography Centre	Council Action
Cost Estimation		
We stress the need for estimates of cost prepared at the project approval stage to be based on realistic assessments of the work that will be necessary.	The preliminary estimates on this project were prepared before any work had started on the brief, but did not include any allowance for risk (paragraph 4.8).	The guidance note highlighted risks to the accuracy of early estimates.
Design		
We recommend that in the future the Council should ensure that, wherever possible, through-life costing routinely forms part of pre-project evaluation.	The Management Committee did not identify and evaluate the life-cycle costs of the whole design. They examined only the life-cycle costs of certain elements (paragraphs 2.27 to 2.30).	The guidance note recommended that there should be an early assessment of the life-cycle costs of a project.
Procurement		
We stress the need for caution in adopting contract strategies under which the Council seek to maintain as much control as possible over design and construction.	The Council used a traditional contract strategy to procure this building (paragraph 5.21).	The guidance note recommended the inclusion of Design and Build as an option when considering contract strategies at the start of a project.
We stress that … the Council … take every possible opportunity to tender contracts competitively.	The Council competitively tendered for all appointments except for that of E C Harris as Quantity Surveyor (paragraph 5.26).	The guidance note re-iterated that the Council should tender competitively for consultants and contractors wherever possible.
	The Council limited their choice of architect to firms who had worked for them previously. However the Council projects they had worked on were smaller than this one (Figure 20).	The guidance note stated that, when selecting contractors for design and construction, the Council should not apply criteria which narrow the field too rapidly.
We stress the importance … of adequately evaluating the capabilities of contractors before letting contracts …. We stress that selection criteria for contractors should always be formulated before tenders are opened and their evaluation started.	The Council appointed the main contractor after a pre-qualification exercise and a formal tender evaluation report (paragraphs 5.29 and 5.30).	The guidance note stressed that contractors should only be appointed after a review of their experience and capability.

* The recommendations of the Committee of Public Accounts were published in December 1993, a year after construction of the Oceanography Centre had started; but before it was completed.

Figure 26

Results of the Post Project Evaluation

Recommendations of the Post Project Evaluation	Council Action	National Audit Office finding on Southampton Oceanography Centre
Project Management		
The Council should appoint an independent project manager.	The Council plan to issue new guidance.	The Council took a collective approach to project management. They did not make a single person responsible for ensuring the delivery of the project to time and within budget (paragraphs 5.4 and 5.5).
The Council should streamline the senior client interface.		The Council managed the project through a hierarchy of different committees with much senior user involvement (paragraphs 1.7 and Appendix 3).
The Council should prepare a project handbook confirming the roles and delegations of consultants, client and project manager, and issue it to all parties.		The Council did not adequately define the roles and responsibilities of all those involved (paragraphs 5.11 to 5.15). They did not prepare a Project Handbook until shortly before the start of construction (paragraph 5.15). The National Audit Office note that such a document should be updated as the project progresses.
Cost Estimation		
The Council should ensure that the correct level of authority is placed in the budget holder.	The Council plan to issue new guidance.	The budget holder during the briefing and design stages was not in charge of the project (paragraph 5.4).
Design		
The Council should consider a value management review for all major projects before the start of work on the detailed design.	The Council plan to issue new guidance.	The Council did not undertake a value management review of the design until after the start of construction. The savings it identified were therefore limited (paragraph 2.33). The National Audit Office recommend that such reviews are also undertaken at other stages (for example to challenge the users' requirements).

continued …

Figure 26
Continued

Recommendations of the Post Project Evaluation	Council Action	National Audit Office finding on Southampton Oceanography Centre
Procurement		
The Council should perform an evaluation of alternative contract strategies at the start of a project.	The Council plan to issue new guidance.	The Council used a traditional contract strategy to procure this building as this was the strategy they had used previously (paragraphs 5.21).
The Council should ensure that all team members have experience in projects of a similar size and scope.		The Council limited their choice of architect to firms who had worked for them previously. However the Council projects they had worked on were smaller than this one (Figure 20).
Professional Fees		
The Council should introduce comprehensive lump sum fees.	The Council plan to issue new guidance.	The Council chose a basis for professional fees which did not provide an incentive for the completion of the project to time and within budget (paragraph 4.23).
The Council should monitor the cost plan and expenditure against the elemental analysis of the budget.		The Council did not monitor regularly expenditure on professional fees against the budget (paragraph 4.24).
Change Control		
The Council should ensure that the time and cost implications of all instructions (including those for drawings issue) are estimated prior to their issue.	The Council plan to issue new guidance.	The cost of the majority of instructions to the contractor was not estimated before their issue (paragraph 4.32).

Glossary of terms

bills of quantities	a set of descriptions of the materials and labour needed for construction work, with their quantity and unit price listed as numbered items.
brief	a document which defines precisely the client's requirements.
building control	laws and inspection procedures, administered by the local authority, to ensure that buildings are built correctly.
Central Unit on Procurement (CUP)	a Treasury unit which provides advice to departments on procurement, including the procurement of construction services.
certificate of readiness	a document signed by the design team to certify that they have provided all the design information necessary for the invitation of reliable tenders.
claim	a contractor's application for an extension of time or additional payment.
combined heat and power system	equipment which provides a building with both its heat and power.
commissioning	starting a completed building system and checking that it works correctly. Relates mainly to mechanical and electrical services.
contract administrator	consultant responsible for administering the terms of the contract with the contractor.
contract strategy	determines the allocation of risks and responsibilities for design and construction between the client, their consultants and the contractor(s).
design team	the client's team of consultants (architect, services and structural engineers) whose main responsibility is to design the building.
design:	
- outline	design developed from the brief to provide an outline of proposals.
- scheme	a development from the outline design which covers the complete scope of the planned building works.
- detailed	detailed design includes the working information needed for site works to begin.
employer's agent	an independent adviser to the Council, appointed to supplement and enhance the in-house expertise available to manage the project.
extension of time	extra time added to the contract completion date because of reasons beyond the control of the contractor.
instructions to contractors	the formal contractual method for directing the contractor to undertake work. Instructions should only increase costs if they involve changes in the scope of the work or increase the contractor's expenses.
life-cycle costs	the construction, maintenance, operating and disposal costs of a building over its life.
liquidated damages	a sum of money specified in the contract as a fair and reasonable amount to compensate the client for a building's late completion.

MEDA	a Mechanical and Electrical Distribution Area; a level between the normal floors which accommodates the distribution of the building's services. They provide flexibility in facilitating maintenance and changes to services with minimum disruption to users.
notification of prolongation and disruption	the contract requires the contractor to inform the contract administrator of matters which have or are likely to prolong or disrupt the progress of the building's construction.
post project evaluation	a review carried out soon after completion of a project to learn lessons for application to future projects.
practical completion	the stage when the building is reasonably fit for occupation. Minor faults may still need to be put right provided they do not inconvenience the occupier.
project co-ordinators	the persons appointed by the Council and the University to supervise user input into briefing and design.
project evaluation	a technique to review the current status of a project against plan and make recommendations for corrective action where necessary.
project execution plan	a document which details a project's objectives, the contract strategy, and the responsibilities of those involved, and lays down a detailed timetable with milestones to be achieved.
project manager	a person appointed by the client to plan and control the project and co-ordinate the project team for the project's duration.
project sponsor	the individual within the client organisation appointed to take personal responsibility for the success or failure of the project.
project team	the Council's representatives from their Building Services section and the consultants appointed by the Council.
provisional sum	an allowance in the contract price to provide for work for which an exact price cannot be obtained.
quantity surveyor	a person trained in accounting for building materials who estimates the cost of the design, prepares the bills of quantities, and advises the client on financial control during the work.
services engineer	a consultant appointed to design the building's mechanical and electrical services (heating, power, lighting, air-conditioning, communications etc).
structural engineer	a consultant appointed to design the load-bearing frame of the building, its walls, floors and roof.
validation	the witnessing, reviewing and acceptance of the results of commissioning.
value management	a process including pre-planned, formal reviews of the philosophy and development of the design at one or more stages of the design process, with the aim of eliminating unnecessary cost without loss of function.
variation	a change in the quantity or quality of the work agreed in the contract.