IMPROVING BUILDING FUNCTION: AN ANALYSIS OF DESIGN MANAGEMENT PROCESSES AND OPERATIONAL PLANNING IN THE DEVELOPMENT OF HOSPITAL FOOD SERVICE SYSTEMS

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DECLARATION

The candidate has not, whilst registered for this Robert Gordon University PhD submission, been registered for another award of The Robert Gordon University or any other university during the research programme.

None of the material contained in this thesis has been used in any other submission for an academic award. Acknowledgements for assistance received are given under the heading "Acknowledgements" and any excerpt from other work has been acknowledged by its source and author.

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Date:

ABSTRACT

Improving Building Function: An Analysis of Design Management Processes and Operational Planning in the Development of Hospital Food Service Systems

The complexity of future societies will be reflected not only in the buildings that are created but also in the processes that evolve such buildings. Within the construction industry, and specifically in relation to large, complex multi-user buildings, operational planning and design processes will assume greater importance than ever before. Given that increasing complexity is likely to lead to increasing specialism and differentiation amongst the main contributing parties in a construction procurement project, it is also likely that there will be more disruption of the communication and organisation processes central to project procurement. These effects will be transmitted through the procurement process and manifest themselves in various ways in the final product. The most important of these will be the damaging effect which they will have on building function, where function determines the buildings' ability to serve as a facilitator of intended user group activities.

Research has been undertaken to rationalise building design, operational planning and building function in the construction procurement process. Maintaining unity between the different parties responsible for building design and operational planning decisions is hypothesised as the key factor in evolving successful project procurement outcomes in terms of building function. Research into hospital food service building procurement processes has demonstrated that when building design and operational planning processes are not developed in concordance with one another, then deficiencies in the functioning of the food service system resulted.

Seventeen design/operation mis-match outcome deficiencies were identified across three hospital construction projects. On further analysis of these project outcome deficiencies, it was apparent that the majority were due to problems that had arisen because design team members and user specialists had been unable to relate different aspects of system functioning adequately. In particular, there appeared to be an inability to incorporate effectively the catering technological and associated service aspects into the design solution, i.e. the elements that were not purely architectural. Some of these functional relationship problems were relatively simple and did not require significant design or user expertise. The most problematic deficiencies emerged when different components of the food service system (central production unit, distribution system and ward service) were not effectively integrated.

Proposals are made for a planning framework which will maintain greater congruence between building design, operational planning and building function during the procurement process by allowing project contributors to assess the impact of different building design and operational

planning decisions on the human/building interface. The planning framework focuses decision making around a set of critical relationships identified between the components of the building solution, so that any potential divergence caused by environmental pressures can be offset by corrective action using the critical relationships as the parameters upon which successful function must be based. This approach is a pre-requisite for the future construction procurement process in order to improve building function, particularly for complex, multi-user buildings.

FOREWORD

The basic driving force for the research was a concern that many functional problems in the built environment arise because of mis-matches, or failures of interaction, between operational policy formation and building design, during the construction procurement process. The research focused on an investigation of the procurement process of a sub-system of a highly complex whole building structure in order to gain the necessary amount of depth for analysing problems at the user/building interface. The hospital was chosen as an exemplar of a complex multi-user building: the development process of hospital buildings is such that the planning process of individual departments and sub-systems are relatively easily identified within the overall project framework. Hospitals are amongst the most complex building types in terms of their: technical complexity; the range of functions, services and systems which they house; and the complexity of the client/user group involved in the procurement process and building occupation and function. Food service planning was the specific focus of the research: as a sub-system, food service performs a vital supporting function in hospital user welfare against which user satisfaction can be gauged.

This research required a uniquely multi-disciplinary approach, pooling information from a variety of knowledge bases. In particular, knowledge relating to the built environment was constructed from a low base and involved a steep learning curve for the author.

SUPERVISION AND FUNDING

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CHAPTER 1
Research Context and Objective

1.1 Introduction

This research is concerned with investigating the relationship between the construction procurement process and the buildings which are evolved from it. Specifically, the research focuses on examination of the procurement *process* and its role in producing *functionally* successful buildings.

Construction project performance has essentially three dimensions in terms of success, as reported by Walker (1989). These are cost, time and quality. It is the cost and time factors that have been predominantly the most frequently assessed, (Nahapiet and Nahapiet 1985). This is perhaps partly because cost and time deviations are relatively easily understood and measured. In the construction industry there are generally three measures of project performance related to the *quality* of *building* performance: technical; functional and behavioural, (Preiser et al 1988). The definitions offered by Preiser et al (1988) are useful in the context of the research:

(1) Technical: these elements include basic survival issues such as health, safety and security and the performance of building systems which includes such aspects as thermal characteristics, sanitation, durability, lighting, ventilation and air quality;

(2) Behavioural: these elements relate to the psychological and social aspects of user satisfaction and general well being, i.e. the perceptions and psychological needs of the building users and how these interact with the facility. Issues covered are ones such as privacy, security, symbolism, social interaction, territoriality and perceptions of building density;

(3) Functional: these elements deal with the fit between the building and the client organisation's activities, i.e. occupants' ability to operate efficiently and effectively. Issues of operational efficiency, productivity, workflow and organisation are important.

Although these three elements are quite distinct there is a certain degree of overlap between them, for example, notions of "security" can relate to purely technical aspects such as window and door locks, CCTV etc. but can also relate to feelings of safety and vulnerability. Thus, the purely technical aspects of a building's performance may relate to the functional and behavioural elements and so have a significant potential impact on building users. The focus of this research is on the *functional* performance of buildings.

According to Preiser (1989),

> ***"...the performance concept is based on the assumption that a building is designed and built to support, and enhance, the activities and goals of its occupants."*** (Preiser 1989)

This view underlies this research thesis. The most important facet of building function, as a quality indicator, is defined by the ability of the building to provide a setting appropriate for the realisation of building users' needs and goals. The dynamic of the building/user interface is vital, since environments that do not meet user specifications might result in dangerous working conditions and the unpredicatable consequences of users forced to bridge the gap between design intention and reality of building function. This problem is articulated by Preiser and Vischer (1991),

> ***"Designers sometimes miscode the environment, causing building occupants confusion and even injury."*** (Preiser and Vischer 1991)

Work by Wineman (1986) indicated the potential financial implications when "people costs" are not properly addressed as part of building procurement, specifically over a 40 year life-cycle for an office building. Wineman showed that approximately 90% of costs were attributable to personnel salaries and benefits. Thus, even in the early life of a new building, the "people costs" of the occupants or users exceed the construction costs. Therefore, it is crucial that design satisfies the needs of building users. As Hedge (1991) stated quite simply, this meant that,

> ***"The economics of the building life cycle causes close design attention to the health and productivity of the occupant workers."*** (Hedge 1991)

The importance of getting the balance right between capital planning costs and lifecycle costs is also mirrored in other sectors of the construction industry. For example, a study by the Institute of Advanced Architectural Studies at the University of York (1988) on capital planning in health care showed that over a lifetime of 60 years, the operational costs could outweigh the building costs by a factor of nearly 25.

Deficiencies in building function can be identified through post-occupancy evaluation (POE) techniques. Techniques, theories and models related to post-occupancy evaluation have developed over a number of years, since the mid 1960s, and have been applied to a range of environment types: educational; health care; public housing; offices; and government facilities such as prisons and military premises, (Preiser et al 1988).

It is not enough simply to identify post-occupancy problems; of far greater value is analysis of the causes of building function deficiencies, traced back through the procurement processes that evolve buildings. Although the important link between process and product was recognised some time ago, as exemplified by Green's (1972) and Canter's (1972) views below, such concerns are still highly relevant today,

> ***"What is the relative importance of the building as an agent in improving performance and facilitating innovation, compared with the process by which the building was evolved?"*** (Green 1972)

> ***"Criticisms of a building's form has little value without a knowledge of the processes which produced it..."*** (Canter 1972)

Establishing the origins of, or reasons, for any deficiencies or successes in building function is beneficial in two ways: for providing the client with feedback showing whether the procurement process produced a building that met the client's user and organisational needs; and for generating data which can be used to improve the future effectiveness of the construction procurement process. Although the benefits of linking assessment of building function to the process by which the building was evolved are clear, there is considerable doubt that post-occupancy evaluation methods have had any impact on improving building quality through this means. This point was acknowledged by Vischer (1989) in her summing up of possible future advances in building evaluation and, more crucially, she points to the reason why, suggesting that for there to be any real benefit to the construction industry there needs to be a shift in empahsis which focuses on changing *processes* to effect improvement in products,

> ***"And finally, but far from least important, does the knowledge about building performance yielded by POE really improve building quality? Is the information about existing buildings really applied to the creation of new ones? In fact, is it systematically applied to the improvement of existing ones? What many building researchers find is that building errors can often be traced to the building delivery process itself, and this and the industry context in which it occurs do not (yet) change as a result of POE activity."*** (Vischer 1989) [my underlining]

Hughes' (1989) organisational analysis of building projects also raised a similar point to Vischer's. In speaking about buildings, or "artefacts", as they were termed by Hughes, he noted that,

> ***"It is one thing to critically evaluate an artefact, but quite another to propose ways in which a better artefact may be produced."*** (Hughes 1989)

Even the most rigorous post-occupancy evaluations, termed "diagnostic" post-occupancy evaluations, Preiser et al (1988), due to the extent of time, resources, personnel, depth and breadth of evaluation involved in building assessment, do not relate the confirmed project deficiencies to the process through which they were evolved. Although Preiser et al (1988) reported that diagnostic POE research often related to long term actions such as the development of design guides and criteria for future similar facilities, there is no indication as to how these outcomes are linked to the procurement *process*.

The lack of knowledge on the inter-relationship between process and product, with too much emphasis on evaluation of product with limited reference back to process, might partly explain Preiser et al's (1988) perception of *"increasing problems in building performance"*.

The research contends that the potential beneficial impact of feedforward is limited due to difficulties in applying the results of post-occupancy evaluation research to new buildings. Specifically, there is inadequate information about the link between building procurement processes and how data about the relationship between process and product deficiencies can be systematically applied to subsequent building procurement processes. In order to repeat successes and avoid mistakes it is essential to know what *processes* to adopt. The crucial question is, how can the procurement process for new buildings be altered in the light of previous post-occupancy evaluation data so that procurement processes, and eventually the products of these processes, are improved? This is the driving force of the research.

There is an interesting analogy, or parallel, with current work in improving the quality of health care, particularly patient safety. In this field of work there is increasing recognition that errors leading to patient injuries are not failures of a particular person or product but involve complex interactions among individuals, products, technology and organisational systems. Furthermore, inherent latent weaknesses in a system will not become apparent until a unique combination of circumstances arise and combine, (Conference Overview : Enhancing Patient Safety and Reducing Errors in Health Care 1998).

This line of thinking is applicable to the construction industry, as illustrated by Rougvie (1991),

"The diversity and complexity of the activities which are required to generate and realise any building project give ample opportunity for things to go wrong. Most problems are composed of a web of human, technical and extraneous factors." (Rougvie 1991)

Construction project procurement is a complex process, or system, involving many individuals and groups, products and technology which combine to evolve a building. The construction project environment, Rougvie's (1991) "extraneous factors", also has a considerable impact on the outcome of the construction procurement process. It is postulated that when difficulties arise within this process, or system, then the resulting building may display outcome deficiencies in terms of function.

The following statement by Berwick (1998) shows that evolving improvement in the quality of health care will only be gained by changing the underlying process or systems. This is an approach which can also usefully be applied to the construction industry,

"The cutting edge of theory and practice in quality health care, as in other industries, is guided by the deeply held belief that improvements in many qualities of performance are achievable simultaneously in a complex system if one is bold enough, committed enough, and creative enough to continually design and re-design that system, sometimes involving even the first principles - the basic, original design of the system at its core." (Berwick 1998)

Moreover, Berwick makes two important points which emphasise the need to focus on relationships between processes, or systems, and their products in order to make an impact on improving the performance of processes, and ultimately products,

"Prevention of errors - the first level of defence - is most effective when it is informed by knowledge of the causes of errors in the first place." (Berwick 1998)

"If we can figure out how to change to new systems, so as to reduce errors and mitigate their effects, then we are bound to learn generalisable lessons about change itself. Error-reducers and quality-improvers are in exactly the same boat. In fact, they are pulling the same oar." (Berwick 1998)

The research proposes that building function is achieved through marrying the construction procurement activity of design with the associated activity of operational planning; the two must be considered as inseparable parts of a whole and must relate to each other for successful functioning to be achieved. In order to evolve a building's functional attributes, those with expertise in the design/construction professions must come together with the client organisation, particularly user groups, as the client organisation is the expert on its operational activities and requirements. However, differentiation and specialisation of designer and client organisation potentially form a barrier to effective communication between these two project contributors, (Canter 1972 and Wallace 1987).

Confusion regarding the nature of the client, particularly for technologically complex, multi-user buildings, which comprise a multitude of user groups, has a negative impact on this communication process as there is difficulty in determining who the "client" actually is. Increasing differentiation of the client organisation also serves to compound the procurement process. Only a small part of the client organisation controls the financial and resource inputs to a construction project but there are many diverse parties within the client body that will occupy and use the completed building.

In the sphere of health buildings construction, Shumaker and Pequegnat (1989) noted that the number of groups participating in the planning process had increased substantially over the past 30 to 40 years. Bonnie (1990) has noted that as increasingly sophisticated technology spawns ever more specialised disciplines, this trend looks set to continue so that rapid changes in technology will continue to have a major impact on capital planning within the future health care sector.

In technologically and organisationally complex buildings, the relationship and communication between designer, other construction professionals, and client organisation become more crucial: complex inter-related user activities that influence the form of the building have to be carefully considered to establish the functional priorities that will drive the design and construction of the new facilities. It is the users who are the experts on the environment in which they work and on the technologically specific aspects of the buildings they occupy. Effective communication among project contributors is, therefore, difficult because of this confusion, and increasing specialisation of project contributors and their associated differing conceptualisations.

Recent work by Cairns (1996), aimed at identifying key issues relating to the perceived effectiveness of the design process is pertinent to the research. One of Cairns' (1996) key findings confirmed that although paymaster clients and designers might communicate freely with each other, both believing that they were working towards the fulfilment of user needs, this was often done without involving the user in the communication process. This, along with two other findings: that users' needs are judged to be met regardless of the level of user involvement in the briefing process; and that project success is frequently judged without reference to users at feedback stage, point to the potential negative impact that this could have on construction project outcomes, as defined by building function.

These factors raise questions about the nature of the client body in complex buildings. These are explored in Chapter 4 of the thesis. Since the focus of the research is in identifying functional outcome deficiencies which affect building occupants, the thesis emphasises the users' perspective.

1.2 Context

A longer term projection of this potentially wide-reaching problem is an important issue which requires addressing if future construction industry procurement processes are to evolve functionally successful buildings, by learning from past mistakes and successes. The increasing future complexity of building design and procurement processes provide an important context to the research. In terms of the future, Kivistö and Huovila (1992) identified the powerfully inter-related "global mega-trends" shaping the built environment,

> ***"Today's society faces fundamental changes such as the transition from the industrial society to the information society, increasing complexity of the global systems, accelerating technological progresses, decreasing population in developed countries, strong population growth and urbanization in developing countries, increasing environmental problems, demands for sustainable development, regional integration and internationalization. All these phenomena create enormous challenges and opportunities for housing, building and planning."*** (Kivistö and Huovila 1992)

As future building products are shaped by these mega-trends, it follows that the processes that evolve these products must also be modified. Bakens (1992) supports this notion,

> ***"Technological innovation in the Construction Industry can have a profound influence on the organization of the building process, especially in those building projects in which technology is a dominant characteristic."*** (Bakens 1992)

and Kivistö (1992),

> ***"People, firms, institutions and systems will become more complicated when the amount of people and human interactions increase and new technologies will develop. The increasing complexity and individuality of the globe will in many ways influence the construction process and the construction industry."*** (Kivistö 1992)

Other trends, impacting on the project procurement process in developed countries are having a considerable impact. Two of these, in particular, form an important context to the research and are illustrated by Bakens (1992),

> ***"The client is becoming more professional and better informed about his rights, he is setting more specific specifications and often he wants to be involved more in***

professional decision-making processes. In this context "client oriented building" and "customer oriented building" are becoming popular terms in the research and development programs in some Western countries. Decisions about quality related items are becoming more complex. In this context the emphasis more and more is changing towards decisions about integrated performances of a building project, in which the life-cycle thinking is slowly replacing the simple thinking in terms of minimal costs." (Bakens 1992)

Recent key reports on the UK construction industry also embody the issues raised by Bakens (1992). For example, the Office of Science and Technology's Technology Foresight Construction Panel (1995) identified a number of "Engines of Change", including the need for,

> ***"Setting up mechanisms to ensure that all players in the construction process are kept well informed and their activities are fully co-ordinated"*** (Office of Science and Technology 1995)

More recently, the Egan Report, "Rethinking Construction" (1998) identified five key "Drivers for Change", the first of which included,

> ***"A focus on the customer, integrated processes and teams, a quality driven agenda and commitment to people"*** (Egan 1998)

Thus, there is a need for research that focuses investigation on the relationship between construction procurement processes and the buildings that they evolve, from the building function perspective, because of the growth of increasingly complex and technologically driven built environments. Since the Industrial Revolution, increasingly complex technology has had a major impact on the differentiation and specialisation of construction professionals. Modern buildings are no longer constructed from a few simple materials which, in the past, would have served a range of structural, environmental and functional needs. There are many more building components and they have become technologically more complex. The interactions between these different components have multiplied, (Turner 1986). Thus, the existence of specialist activities within the construction industry, at least in developed countries, could be viewed as a development of the requirement for clearly different skills arising from an increasingly technologically complex industry.

The value of, and need for, research investigating the relationship between construction procurement process and product, in terms of building function, is highlighted by a comment made by Preiser and Vischer (1991), *"The complex and lengthy building delivery process that exists in most countries often means that buildings planned for specific uses are dysfunctional by the time they are completed."* (Preiser and Vischer 1991)

Interestingly, Vischer (1991) emphasised the impact of planning *process* rather than creative building form on design innovation.

1.3 Aim, Objective and Hypothesis

The aim of the research was to contribute to enabling the construction procurement process to develop built environments which perform better in functional terms.

The specific objective of the research was to identify the cause of building function deficiencies, determining whether there are common factors or attributes associated with these deficiencies. This primary objective directed the development of a research hypothesis, central to the investigation. This hypothesis postulated a causal relationship between management of building design and operational planning integration and building functionality, and the impact of the project environment thereon.

Hypothesis

A functionally successful building is dependent on the project procurement process maintaining integration between building design and operational planning, particularly at periods of increased environmental complexity.

The hypothesis was formulated from eight research tenets, drawn from the postulations in the earlier part of this chapter and expanded in later chapters, as follows:

(1) Over time, the product process relationship will become increasingly important because the complexity of future societies will be reflected not only in the buildings that are created but also in the processes that evolve such buildings. Pressure from the environment, such as that exerted by increasing complexity, forces organisations to be able to adapt quickly and effectively so that outside demands can be matched with a corresponding level of supply. The realisation of new facilities will result when the client envisages construction as the most suitable way to adapt to environmental pressures.

(2) Environmental complexity is increasing, partly because of rapid developments in technology. The more technologically complex the building is, the greater the impact on the building procurement process.

(3) Increasing environmental complexity, such as diversity in technology, will increase specialism and differentiation among the main contributing parties involved in construction project procurement. These effects will be compounded in complex, multi-user buildings.

(4) Differentiation and specialisation of the main contributing parties potentially form a barrier to effective communication, particularly between construction professionals and client organisation.

(5) The disruptive effects of increasing specialism and differentiation are transmitted through the project procurement process and ultimately they manifest themselves in the final product. The most important of these is the damaging effect on building function, where function determines a building's ability to serve as a facilitator of intended user group activities. As a direct consequence of this, the *real* needs of the users may not be expressed in the final building form and the resultant building solution does not fulfil the performance requirements demanded by the users.

(6) Building function is achieved through integration of design and operational planning activities and the project procurement process is an important variable effecting the necessary union between building design and operational planning. Building design and operational policy formulation should concur throughout project procurement in order to relate building structure (fixed elements - such as the building envelope, that is, those elements that could be considered to be the domain of the architect) and unfixed elements (those elements for which the users could be considered to be expert, for example, items of equipment) to users' planned organisational/work activities, thus producing a building which is a facilitator and not an inhibitor of function.

(7) Procurement processes must change to counter the potentially disruptive effects of increasing differentiation and specialisation in order to maintain unity between the disparate contributing individuals and groups; this is essential to effect a successful project outcome in terms of function. The extent to which project procurement processes fail to integrate building design and operational planning, by maintaining effective communication, would be reflected to differing degrees in the final building solution. In the worst case scenario, the construction of archaic, vast structures, which are unable to meet the important functional requirements of their users, would result.

(8) As environmental pressure results in major organisational decisions such as the decision to build, and impacts throughout the project procurement process, it is crucial that the influences of the environment on both building design and operational planning are related to one another so that the two develop in parallel. Environmental pressure forces decisions and affects potential choices and, therefore, adds increasing definition to the design solution. It is an important variable affecting the ability of the procurement process to develop a functional building solution.

1.4 Evolution of Research Method

A case study approach was employed to generate evidence against which to test the hypothesis. The case studies, a range of building outcome deficiencies, identified from three different construction projects, were investigated by using a systems based analytical method. The technique permitted close examination of the relationship between the project procurement process, associated deficiencies in building function and the impact of project environmental pressures. Data collection, relating to project procurement and environmental analysis, was undertaken wholly on a retrospectice basis for case studies associated with two of the projects as the projects were complete at the time the research commenced. However, for case studies derived from a third project, this data was collected on a retrospective and longitudinal basis as the project was still in progress at the time the research was undertaken. Since retrospective case study analysis relied considerably upon the collection of data relating to past events, decisions and circumstances, the longitudinal case studies provided the opportunity to test the validity of this aspect of the research methodology. Specifically, the longitudinal approach indicated how accurately historic information reflected what actually happened during the project procurement process.

The research method was based on three fundamentally linked investigative tasks, as summarised below:

(1) Recently completed buildings were evaluated, from the user perspective, in order to identify functional deficiencies. Different user groups were surveyed to obtain data on these functional deficiencies;

(2) The procurement processes which evolved the buildings were analysed. The project procurement processes were mapped in order to determine: the relationship and

timing of project activities; and the roles, responsibilities and relationships of project contributors (individuals and groups) participating in these activities;

(3) An environmental analysis was undertaken in order to identify the timing, nature and effect of the most influential environmental factors impacting on the development of the projects, focusing particular attention to their involvement in the development of functional deficiencies (the case studies).

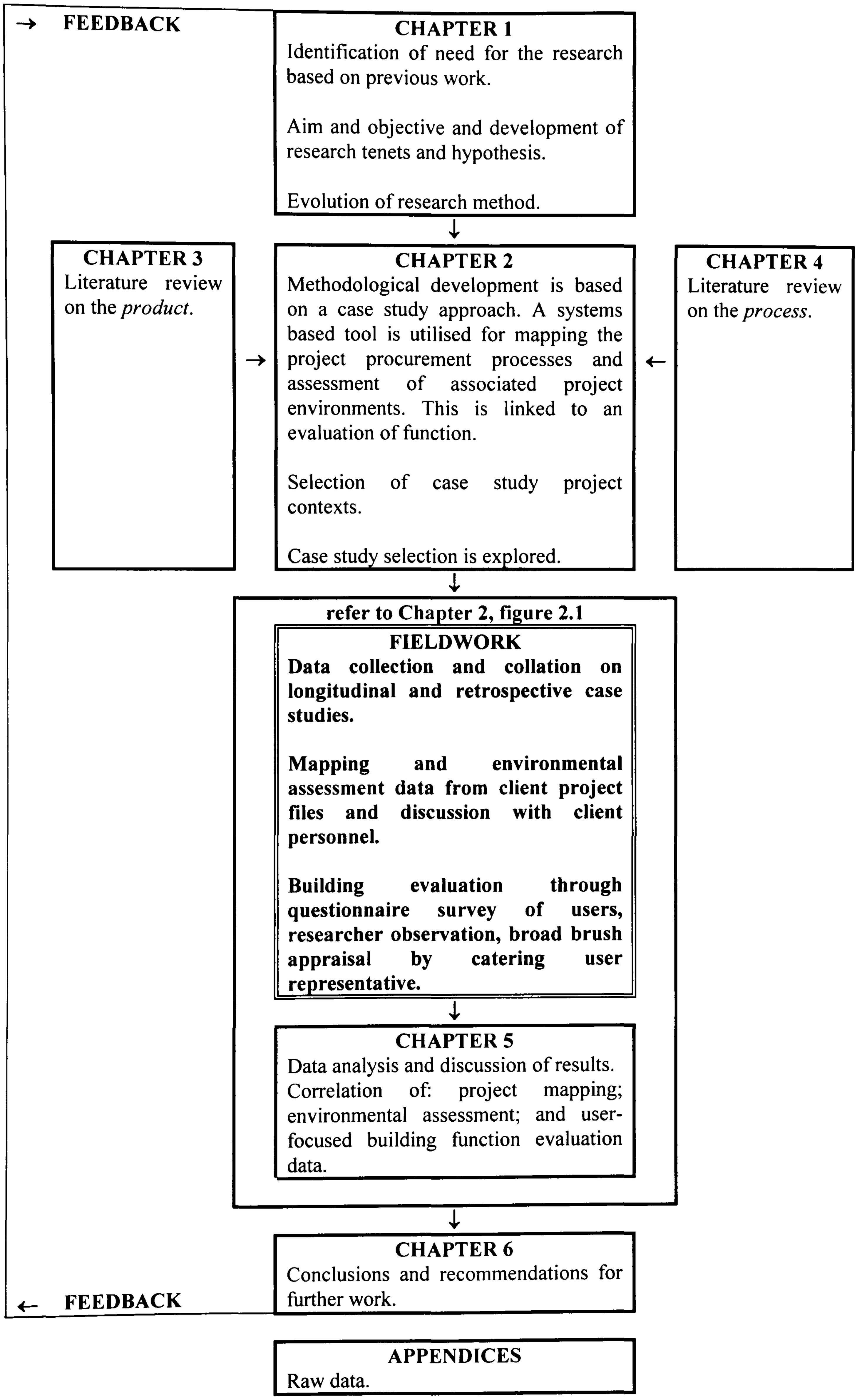
The functional deficiencies, identified by user group survey, were analysed as individual case studies, within the contexts of the construction projects from which they were derived. Analysis and comparison of the case study data provided the evidence for testing the research hypothesis and identifying any common factors, or attributes, of these functional deficiencies. This process is explained in Chapter 2.

The need to focus a microscope on cause and effect necessitated investigation of a building sub-system. To facilitate comparison between the results from the case studies, one type of building was chosen for investigation. The hospital procurement process for the food services sub-system, provided the scenario for the research against which the effectiveness of project procurement processes, in relation to building function, could be investigated. The hospital was identified as one of the most profitable areas of investigation because it represents one of the most complex building types in terms of: its technical complexity; the range of functions, services and systems it houses; and the complexity of the user groups involved in the procurement process and building occupation and function. Moreover, the development process of hospital buildings is such that the planning process of individual departments and sub-systems are relatively easily identified within the overall project framework. The food service system was chosen as it is: (1) all pervasive within the hospital organisation; (2) more readily understandable by the various parties involved; (3) more open to intelligent criticism by non-specialists than, say, the specialist environment of the operating theatre; (4) though complex, potentially open to sensible analysis by designers; (5) present in all hospitals.

1.5 Thesis Structure and Content

The thesis describes the research in terms of the process/product relationship within the context of large, complex, multi-user buildings, specifically hospitals and their food service sub-systems. Figure 1.1 shows the structure of the research/thesis and the relationship between component chapters.

Figure 1.1 Structure of the Research/Thesis



Chapter 2 details the development of the methodological approach of the research. This chapter details:

(1) The selection of the three construction projects from which the case studies were derived; case study selection;

(2) The three main areas of data collection (assessment of building function, assessment of environmental pressures, mapping of project procurement process);

(3) Data sources;

(4) The testing of the validity of the retrospective approach to data collection;

(5) The format of data presentation and links to relevant appendices.

Chapter 3 is concerned with the product, particularly in identifying project performance indicators. The importance of function as an indicator of success in hospital project performance is discussed. The importance of successful functioning, in relation to the hospital food service sub-system, is also considered with respect to the staff groups concerned in food service provision and to the patients, the ultimate consumers of hospital food service. The results of these discussions highlight the need for a functional definition of quality which should be applied to the construction industry. This theoretical study was crucial to the practical methodology developed in Chapter 2, pointing to measures of quality which could be adopted by the research and identifying a particular building sub-system to be used in identifying functional deficiencies.

Chapter 4 is concerned with the building procurement process and identifies the problems inherent in communication of information between different project contributors. Specifically, this chapter explains the difficulties which surround the procurement process when the client organisation is complex, i.e. is comprised of a heterogeneous mix of specialist users which is further compounded by a distinction between that part of the client organisation which actually uses/occupies the building and that part of the client organisation that funds the construction project. The main sources of information input into the briefing process are discussed: user input; post-occupancy evaluation and design guidance. The effect of these on the functional outcome of the building solution is discussed. Within this context, the problems surrounding the procurement of the hospital food service sub-system are considered in more detail. The results of these discussions were crucial in exploring the potential causes of sub-optimal building function, highlighting in particular, the key role of the procurement process in evolving a functionally successful solution. This chapter also develops theoretical constructs to assist in explaining the complexities of the user/building interface, particularly in terms of functional problems in complex, multi-user facilities. These are applied to the case studies in order to help to determine the cause of the functional outcome deficiencies.

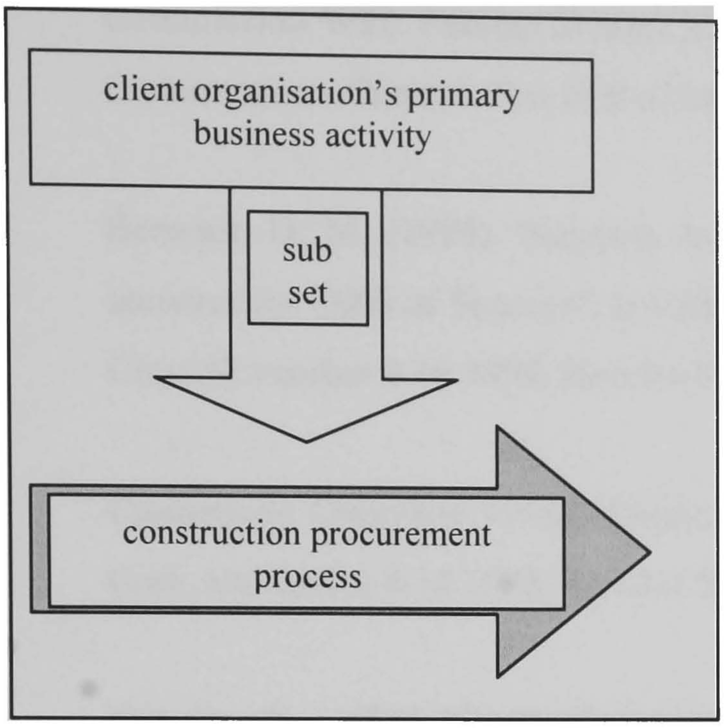
Chapter 5 presents, and provides a critical analysis of, the results, detailing the findings of the longitudinal and retrospective case studies. This chapter draws together the findings of the project procurement mapping, environmental analyses and post-occupancy evaluations, seeking to identify and explain the functional problems according to the theoretical constructs developed in Chapter 4.

Chapter 6 details the main conclusions arising from the research and makes recommendations for further work.

Figure 1.2(a) to (d) shows, in diagrammatic form, the relationship between key research concepts discussed in the above chapters.

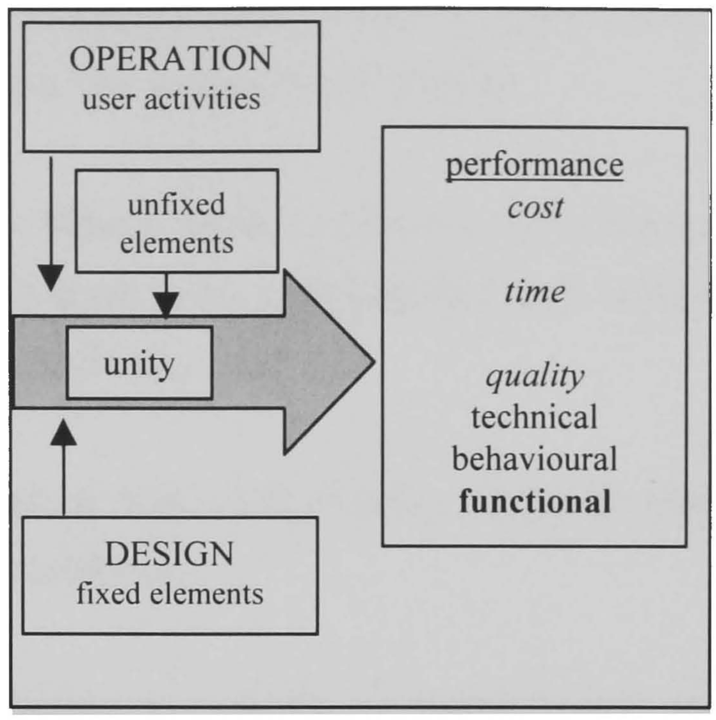
Figure 1.2 Relationship Between Key Research Concepts

Figure 1.2(a)



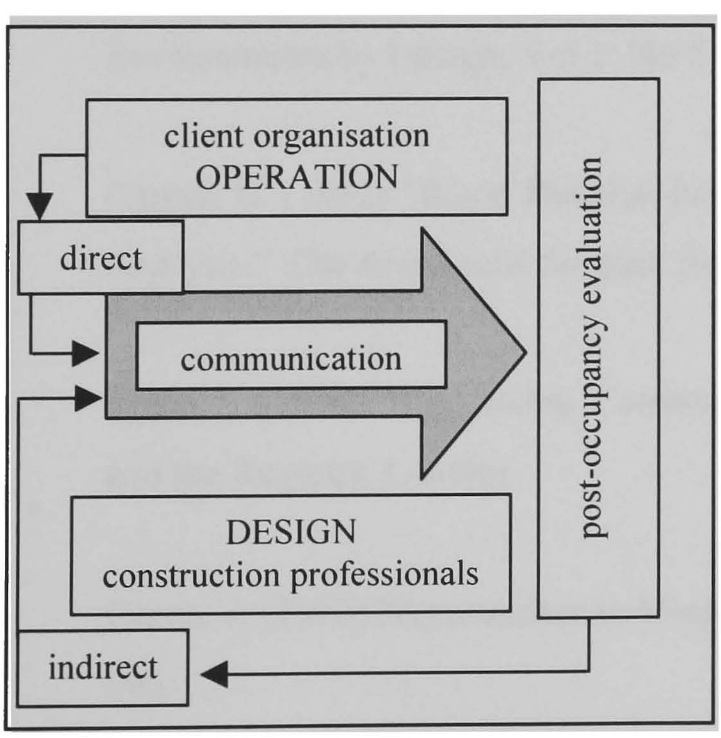
The construction procurement process is a sub-set of the client organisation's primary business activities.

Figure 1.2(b)



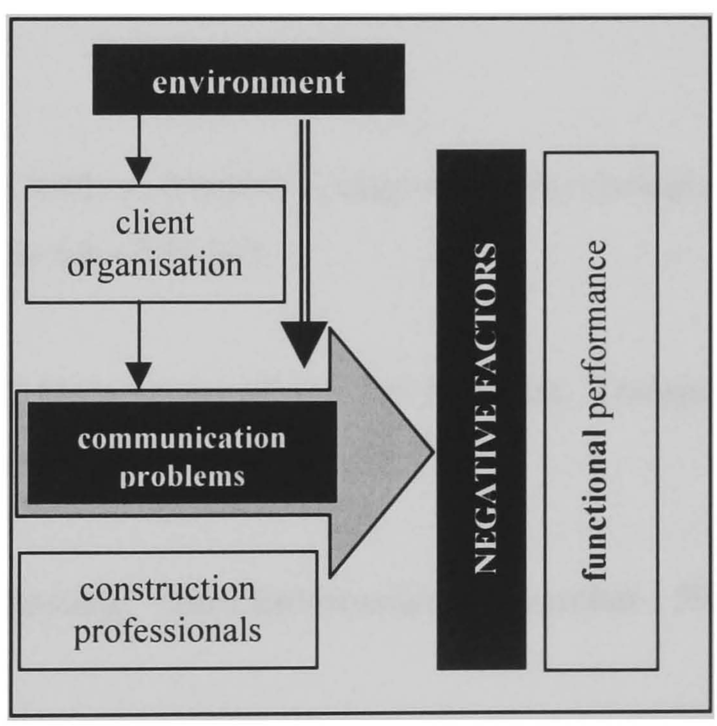
To fulfil the client organisation's functional performance requirements of the new building, design and operational planning activities must be developed in unison.

Figure 1.2(c)



The functional aspect of building performance will be informed by: the client organisation's direct input into the briefing process; and indirectly through functional performance data obtained by post-occupancy evaluation of existing similar buildings. Effective communication between construction professionals and the client organisation is essential in maintaining unity between design and operational planning activities.

Figure 1.2(d)



Achievement of the client organisation's functional requirements may be affected by: communication problems – caused by different language/vocabulary, differences in specialism, conceptual, perceptual and value differences; and by the impact of the environment, directly on the construction procurement process, or indirectly through the client organisation's primary business activities.

1.6 References

Bakens, W. (1992) "Future Organisation of the Building Process: Interim Results of a W82 Study." in Pre-Proceedings of First International Symposium of C.I.B. Working Commission W82: Futures Studies in Construction. Construction Beyond 2000: Future of Construction - Construction of the Future. June 15th to 18th, Espoo, Finland.

Berwick, D. M. (1998) "Keynote Address - Taking Action to Improve Safety: How to Increase the Odds of Success", in Enhancing Patient Safety and Reducing Errors in Health Care, November 8-10 1998, Rancho Mirage, California.

Conference Overview (1998) Enhancing Patient Safety and Reducing Errors in Health Care, November 8-10 1998, Rancho Mirage, California.

Bonnie, B. (1990) "Technology - The Catalyst for Change in Health Care." Joint Conference of the Public Health Group, Committee on Architecture for Health and Architecture for Health Care Committee. The Role of Architecture in Health Care : Year 2000 and Beyond, Ottawa, May 25th.

Cairns, G. M. (1996) "User Input to Design: Confirming the User-Needs Gap Model." Environments by Design, Vol 1, No 2.

Canter, D. (1972) "Royal Hospital for Sick Children, Yorkhill Glasgow : A Psychological Analysis." The Architects' Journal, September 6th : 525-563.

Egan, J. (1998) "Rethinking Construction." Department of the Environment, Transport and the Regions; London.

Green, J. (1972) "Approaches to Hospital Planning." Built Environment, December : 593-596.

Hedge, A. (1991) "Design Innovations in Office Environments", in Presier, W. F. E., Vischer, J. C. and White, E. T. (eds) Design Intervention: Toward a More Human Architecture. Van Nostrand Reinhold; New York.

Hughes, W. P. (1989) "Organisational Analysis of Building Projects." PhD Thesis, Department of Surveying, Liverpool Polytechnic.

Institute of Advanced Architectural Studies, University of York (1988) Points System for Evaluating Development Options to Reduce Operating Costs.

Kivistö, T. (1992) "The Global Megatrends - Conclusions for the Future of Construction." in Pre-Proceedings of First International Symposium of C.I.B. Working Commission W82: Futures Studies in Construction. Construction Beyond 2000: Future of Construction - Construction of the Future. June 15th to 18th, Espoo, Finland.

Kivistö, T. and Huovila, P. (1992) "Preface" in Pre-Proceedings of First International Symposium of C.I.B. Working Commission W82: Futures Studies in Construction. Construction Beyond 2000: Future of Construction - Construction of the Future. June 15th to 18th, Espoo, Finland.

Nahapiet, J. and Nahapiet, H. (1985) "The Management of Construction Projects : Case Studies from the USA and UK." CIOB.

Office of Science and Technology (1995) Technology Foresight: Progress Through Partnership: Construction. HMSO.

Preiser, W. F. E. (1989) "Towards a Performance-Based Conceptual Framework for Systematic POEs," in Preiser, W. F. E. (ed) Building Function. Plenum Press; New York.

Preiser, W. F. E., Rabinowitz, H. Z. and White, E. T. (1988) "Post-Occupancy Evaluation." Van Nostrand Reinhold; New York.

Preiser, W. F. E. and Vischer, J. C. (1991) "An Introduction to Design Intervention: A Manifesto for the Future of Environmental Design", in Preiser, W. F. E., Vischer, J. C. and White, E. T. (eds) Design Intervention: Toward a More Humane Architecture. Van Nostrand Reinhold; New York.

Rougvie, A. (1991) Project Evaluation and Development. Mitchell; London.

Shumaker, S. A. and Pequegnat, W. (1989) "Hospital Design, Health Providers and the Delivery of Effective Health Care", in Zube, E. H. and Moore, G. T. (eds) Advances in Environment, Behaviour and Design. Plenum Press; New York.

Turner, R. G. (1986) Construction Economics and Building Design. Van Nostrand Reinhold; New York.

Vischer, J. C. (1989) "Issues and Future Directions" in, Preiser, W. F. E. (ed) Building Evaluations. Plenum Press; New York.

Vischer, J. C. (1991) "Summing Up Opinions on Architectural and Social Change," in Preiser, W. F. E., Vischer, J. C. and White, E. T. (eds) Design Intervention: Toward a More Humane Architecture. Van Nostrand Reinhold; New York.

Walker, A. (1989) Construction Project Management. Second edition, BSP Professional Books; London.

Wallace, W. A. (1987) "The Influence of Design Team Communication Content Upon the Architectural Decision Making Process in the Pre-Contract Design Stages." PhD Thesis; Heriot-Watt University.

Wineman, J. D. (1986) "Behavioural Issues in Office Design." Van Nostrand Reinhold; New York.

CHAPTER 2
Research Methodology Development

2.1 Introduction and Overview

As outlined in Chapter 1, the research involved an investigation of the relationship between *process* and *product* and this chapter focuses on the development of the research methodology. This chapter develops and explains the fundamental concepts within the methodological approach used in this research and details the methodology.

Central to the methodology were three distinct, but linked, investigative tasks:

(1) Recently completed buildings were evaluated in order to determine the effectiveness of their function, from the perspective of building users. Different user groups were surveyed to obtain data on perceived deficiencies within the completed buildings. All those deficiencies, categorised as functional deficiencies, formed individual case studies, each being investigated further through the collection of data on the case studies' project procurement processes and environment, as detailed in (2) and (3) below;

(2) The project procurement processes which evolved the buildings, from which the individual case studies were drawn, were analysed. Specifically, this involved mapping the projects' procurement processes in order to determine: the relationship and timing of project activities; and the roles, responsibilities and relationships of project contributors, (individuals and groups) participating in these component project activities;

(3) Environmental analyses were undertaken for each of the construction projects from which the case studies were drawn. This involved identification of the timing, nature and effect of the most influential environmental pressures impacting on the development of the projects, focusing particular attention on their involvement in the development of the functional deficiencies (case studies).

This investigative technique provided a strategy for determining cause and effect relationships in the development of functional building deficiencies. Comparison of data across the case studies facilitated identification of common factors, or attributes, associated with these deficiencies.

Focusing on project outcomes, in terms of deficiencies, avoided the need to make value judgements around how to distinguish building successes and identifying one building, or an aspect of a building, as being "better" than another. It was considered to be more objective to determine incidence of functional deficiencies.

Part of the methodology involved a theoretical, literature-based review of themes central to the research. Therefore, Chapter 3 is concerned with the *product*, particularly in identifying project performance indicators. The importance of function, as an indicator of success in hospital project performance, is discussed. The importance of successful functioning in relation to the hospital food service sub-system is also considered with respect to the staff groups involved in food service provision and to the patients, the ultimate consumers of hospital food service.

Chapter 4 is concerned with the building procurement *process* and identifies the problems inherent in communication of information between the client organisation and construction procurement professionals. Specifically, this chapter explains the difficulties which surround the procurement process when the client is complex, i.e. is comprised of a heterogeneous mix of specialist users which is further compounded by a distinction between that part of the client group which actually uses/occupies the building, and that part of the client group that funds the construction project. The main sources of information input into the briefing process are discussed: user input; post-occupancy evaluation and design guidance. The effect of these on the functional outcome of the building solution is considered. Within this context, the problems surrounding the procurement of the hospital food service sub-system are explored in more detail.

2.1.1 A Case Study Approach

As outlined in Chapter 1 (section 1.4 Evolution of Research Method), the research employed a case study approach. Case studies, a range of building outcome deficiencies identified from three different construction projects, were investigated by using a systems based analytical tool. Analysis and comparison of the case study data provided the evidence for testing the research hypothesis. Within this thesis, the term "construction project context" refers to the three construction projects from which the case studies were selected.

There were several reasons for selection of a case study strategy as the over-arching methodological approach of the research. The rationale was based on the following, drawn from Yin's (1994) work on design and methods in case study research:

(1) The appropriateness of a case study approach in understanding complex social and organisational phenomena - the case study approach has been used extensively in the traditional disciplines, and more practice oriented fields, of social science research (e.g. in organisational and management studies);

(2) The distinct advantage of the case study strategy in describing and testing propositions and for causal explanations, i.e. case studies are the preferred strategy when "how" or "why" questions are being posed, when the investigator has little or no control over events and when the focus is on a recent phenomenon within some real-life context. This is because such questions deal with operational links needing to be traced over time, rather than simple frequencies or incidence. As the focus of the research was in tracing and *explaining* the *causes* of building function deficiencies, and one of the most important uses of the case study is in explaining causal links, the case study approach was the preferred option;

(3) The case study approach is the preferred option for examining contemporary events but when relevant behaviours cannot be manipulated. The approach relies on many of the same techniques as historical research strategies but adds two sources of evidence not available to the historian - direct observation and systematic interviewing. One of the unique strengths of the case study as a research strategy is its ability to deal with a full variety of evidence – documents, artefacts, interviews and observations;

(4) The case study strategy is not mutually exclusive to other research strategies so that different research strategies can also be used in any given investigation (for example, a survey being used within a case study);

(5) Case studies provide for the rigorous and fair presentation of empirical data.

Single or multiple case studies can be undertaken as the basis of a case study research investigation. This research was conducted using multiple cases. In case study research, statistical generalisation is not the method of generalising the results of the case(s). Analytic generalisation is used – this is when a previously developed theory is used as a template with which to compare the empirical results of the case study (the theoretical constructs of the research, against which the case studies are analysed, are developed in Chapter 4, section 4.6 Theoretical Constructs and the Complexities of the User/Building Interface). If two or more cases are shown to support the same theory, replication may be claimed. The technique of analytic generalisation can be used whether the case study investigation involves one or several cases (i.e. single-case or multiple-case studies). As the case study does not represent a sample, the primary aim of the case study approach is to expand and generalise theories. Therefore, case studies should be generalisable to theoretical propositions and a complete research design requires the development of a theoretical framework for the case study that is to be conducted. This use of theory becomes the main vehicle for generalising the results of the case study.

An advantage of using multiple cases in case study research, is that the evidence from multiple cases is often considered more compelling and the overall study is therefore regarded as being more robust, (Yin 1994). To make proper use of the findings from multiple case studies, replication logic is crucial. In simple terms, this requires the findings and conclusions from a single case, relative to the investigation's theoretical framework, to be replicated by another case. To explain this aspect of case study research, Yin (1994) draws an analogy with experimentation in which an individual case is considered akin to a single experiment and the analysis must follow *cross*-experiment rather than *within*-experiment design and logic. Across a multiple-case study approach, the research findings should indicate the extent of replication logic and why certain cases were predicted to have the same results (literal replication), whereas other cases, if any, were predicted to have contrasting results (theoretical replication).

As a sampling logic is irrelevant in case study research, and generalisations are not statistically based, any statistically derived criteria regarding sample size are also irrelevant. What is important is consideration of how many literal and theoretical case replications are desired in a particular study. The selection of the number of replications depends upon the certainty which is required about multiple-case results (i.e. the greater certainty lies with a larger number of cases so that a large number of replications provides more convincing support for a particular theory or proposition). At the outset of a case study based investigation it should be predicted, according to the proposed theory, which cases will display similar results (literal replication) and which will exhibit contrasting results (theoretical replication).

Yin's (1994) description of the technically critical features of a case study approach provides an excellent summary of this particular research strategy,

> ***"A case study is an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The case study enquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points and, as one result, relies on multiple sources of evidence, with data needing to***

converge in a triangulation fashion, and, as another result, benefits from the prior development of theoretical propositions to guide data collection and analysis." (Yin 1994)

2.1.2 Structure of Chapter

The content and structure of this chapter parallels the progressive, incremental development of the research methodology. The origins of key theory and concepts underpinning the methodological approach are discussed in detail, thus this chapter includes that part of the literature review dealing with the development of methods. As the research focused on the investigation of a system, i.e. building procurement, a methodological approach based on systems theory was considered highly relevant.

Figure 2.1 and table 2.1 provide a summary of the methodological process, serving as a guide through the various related research tasks. In particular, figure 2.1 provides an overview of the research methodology and cross-refers to table 2.1 which provides a broad, aggregated summary of the main objectives and associated research tasks of the methodological approach. Figure 2.1 also cross-refers to: relevant sections of this chapter which explain the different methodological elements in detail; and to other relevant parts of the thesis which present the results and discuss the findings.

Section 2.2 (Applicability of a Systems Based Approach to the Current Research) provides the rationale for the adoption of a systems based approach, followed by a brief review of the most significant systems based studies and approaches, as applied to the construction industry.

The next part of the chapter focuses on explaining the key concepts and proposals central to the application of systems theory in analysing construction procurement/organisational processes. The review draws substantially from the work of Walker (1980) and Hughes (1989) (refer sections 2.3 The Basis of the Current Methodological Approach and 2.4 A Systems Based Approach to Analysing the Organisation of the Construction Project Procurement Process).

The final part of the chapter focuses on the development of the current methodological approach and covers the undernoted elements:

(1) Selection of case study project contexts (refer section 2.5.1 Selection of Case Study Project Contexts);

(2) Analysis of building function (refer section 2.5.4 Analysis of Building Function);

Figure 2.1 Overview of the Research Methodology

Develop Theoretical Framework and Hypothesis

↓

Selection of Case Study Construction Project Contexts

1. One longitudinal project selected to validate retrospective approach. (refer section 2.5.2)
2. Two retrospective projects selected.
3. Three linked lines of investigation for each project : Building Function Investigation; Mapping of Project Procurement Process; Environmental Analysis.

Refer table 2.1 A, B5, C4

↓

Fieldwork
Building Function Investigation
(Refer section 2.5.4)

1. Questionnaire survey of the user groups involved in food service system operation.
2. Researcher observation.
3. Broad brush appraisal of food services sub-system functioning by catering user representative involved in planning (if still available).

Refer table 2.1, B1

↓

Analysis
(Refer section 2.5.4, 2.5.5)

1. Identification of functional problems and selection of case studies.

Refer Chapter 5, table 5.7
Refer table 2.1, C1

Fieldwork
Mapping of Project Procurement Process
(Refer section 2.5.6)

1. Information from client project files sought (items of communication between project contributors; outcomes of meetings; content and influence of reports on decision-making.
2. Corroborate by discussion with project personnel.
3. Construction of a project diary detailing timing of activities, decisions and people involved.

Refer table 2.1, B2, B3

↓

Analysis

1. Development of 3R charts for each case study project context.

Refer Appendix 5
Refer table 2.1, C2

Fieldwork
Environmental Analysis
(Refer section 2.5.7)

1. Information from client project files and discussion with project personnel.
2. Qualitative data sought to determine the nature and timing of the key environmental pressures constraining the projects.

Refer table 2.1, B4

↓

Analysis

1. Qualitative description of environmental pressures impacting on the project contexts.
2. Development of environmental influence diagrams showing the timing and interaction of environmental pressures.

Refer Appendix 4
Refer table 2.1, C3

↓

Analysis
(Refer section 2.5.8)

1. Analysis of cause and effect relationships for the case studies.
2. Development of diagrams showing the interplay between building design, operational planning and project environment, leading to problems in building function.

Refer Chapter 5 and table 2.1, C5

Table 2.1 Research Method : Main Objectives and Associated Research Tasks

A. Selection of Project Contexts	
Objectives	**Research Tasks**
1. Identify appropriate construction projects for longitudinal and retrospective analysis.	1. Access the CONCISE (Computerised National Capital Intelligence Service And Exchange) database to identify potential projects located in England. 2. Contact Welsh Health Authorities and Scottish Health Boards to identify potential projects in Wales and Scotland. 3. Gain approval from the projects' authorities to conduct the research.
B. Fieldwork	
Objectives	**Research Tasks**
Building function investigation 1. For each construction project, evaluate food services system operation to identify deficiencies in food service system.	1. Identification of key user groups involved in food service system operation. 2. Determination of most appropriate method for gauging user-group assessment of food services sub-system operation: - questionnaire survey of user groups - broad brush appraisal by catering user representative involved in planning (if possible).
Mapping of project procurement process 2. For each construction project define project outline, specifically that relating to the food services sub-system. 3. For each construction project, construct a project diary in order map the project procurement process.	3. Scrutiny of client project files for: items of communication between project contributors, indicating their roles and responsibilities during the project and the extent and duration of their involvement; relevant reports; relevant minutes of meetings. 4. Corroborate the information by discussion with key project personnel.
Environmental investigation 4. For each construction project, identify the timing and the nature of the key environmental influences constraining the project as a whole and, in particular, the food services system.	5. Sourcing relevant information from client project files. 6. Corroborate the information by discussion with key project personnel.

Table 2.1 Research Method : Main Objectives and Associated Research Tasks (continued)

B. Fieldwork	
Objectives	**Research Tasks**
Determine validity of technique 5. Determine validity of retrospective data collection technique through longitudinal, "live" construction project.	7. For longitudinal case study only, attend key meetings. Record and transcribe discussions and formulate draft notes.
C. Analysis	
Objectives	**Research Tasks**
Selection of case studies from building function investigation 1. Identify outcome deficiencies in food service system functioning.	1. Compare data from the different user groups' evaluations (and corroborate with researcher observation and broad brush appraisal by catering user representative involved in planning) to determine cases of inadequacies in system operation. Categorise the identified deficiencies in food service system operation and select functional deficiencies (those proposed to arise from deviation in building design and operational planning) for detailed analysis.
Mapping of project procurement process 2. For each construction project, map the project procurement process related to food service system development.	2. Construct 3R charts, incorporating precedence diagrams, using project diary data.
Environmental investigation 3. For each construction project, determine the impact of the project environment.	3. Provide a qualitative description of environmental pressures impacting on the project. 4. Develop a set of environmental influence diagrams showing the timing, nature and interaction of key environmental pressures.
Validation of technique 4. Determine validity of retrospective data collection technique.	5. Check transcribed meeting minutes against officially recorded minutes and related items of communication/reports to ascertain any discrepancy between live discussions and records of these. From this, determine the validity of the retrospective data collection technique as this is dependent upon interpretation of historical data recorded in client project files.

Table 2.1 Research Method : Main Objectives and Associated Research Tasks (continued)

C. Analysis	
Objectives	**Research Tasks**
Determining cause and effect relationships 5. Determine cause and effect relationships of the case studies (functional problems).	6. Determine the cause and effect relationships of functional problems arising from inadequate building design and operational planning integration. 7. The above is achieved through correlation between data from the user-focused building function studies to data obtained from mapping the project procurement process and data obtained from the associated environmental analyses. 8. Synthesis of diagrams showing the interplay between design decisions, operational decisions and the project environment, leading to observed functional problems, as identified by user groups.

(3) Selection of case studies (refer section 2.5.5 Selection of Case Studies);

(4) Mapping the project procurement process (refer section 2.5.6 Mapping the Project Procurement Process);

(5) Analysis of the project environment (refer section 2.5.7 Analysis of the Project Environment);

(6) Determination of cause and effect relationships (refer section 2.5.8 Investigation of Causes of Building Function Deficiencies).

For (2), (4) and (5) above, a review and critique of previous approaches/methods is presented and the methodology for the current research developed from that.

2.2 Applicability of a Systems Based Approach to the Current Research

According to Walker (1989),

> ***"Recent developments in the application of project management organisational concepts and techniques to the construction industry (e.g. management contracting, alternative methods of management, design and construct contracts and negotiated contracts) have proved to be useful for learning from the experience of others but these developments have not provided a generalised conceptual framework which allows identification of the features of significance in the construction process as a basis for designing organisation structures that take account of them."*** (Walker 1989)

Various researchers have been prompted to look for an appropriate framework, or analytical model, for investigating the organisational structure of building projects. The most significant of the earlier analytical models were developed by Von Seifers (1972) and Stoelwinder and Charns (1981). Von Seifers (1972) developed a model for the analysis of building project responsibilities which he termed TREND (Transformed Relationships Evolved from Network Diagrams). The model was based on drawing a network diagram of a building project and analysing the links between each task to determine the pattern and potency of relationships between the contributors. Stoelwinder and Charns (1981) "Task-Field" model approach was dependent upon the classification of contributors to a particular operation or task within a project. Classification (either primary, secondary or tertiary) was based on considerations of differentiation of contributors.

Other attempts at finding an appropriate framework for modelling the organisational structure of building projects have led researchers towards systems theory and concepts. Although General Systems Theory originated in the biological sciences, Von Bertalanffy, its originator, acknowledged its general applicability, and indeed systems theory,

> ***"...permeates a very great deal of social science work - sociology, history, economics etc. It is also a pervasive influence in medicine and biology, in technology generally (group technology, electrical engineering and computing), in the pure sciences (especially physics) and in many of the arts, particularly music."*** (Von Bertalanffy 1969)

The systems approach is essentially a way of thinking about complex processes so that the inter-relationships of their parts and their influence upon the effectiveness of the total process can be better understood, analysed and improved. The systems approach stresses the contribution of the inter-relationships of the parts of the system and the system's adaptation to its environment in achieving its objective. These two key tenets of systems theory are widely accepted. For example, in acknowledging the many definitions of the word "system" in systems literature, Checkland and Scholes (1990) noted that,

"… all take as given the notion of a set of elements mutually related such that the set constitutes a whole having properties as an entity. Secondly comes the crucial idea that the whole may be able to survive in a changing environment by taking control action in response to shocks in the environment." (Checkland and Scholes 1990)

This first, fundamental characteristic of systems thinking was described by Rougvie (1991) as,

"Any entity conceptual or physical, which consists of interdependent parts. Each of a system's elements is connected to every other element, directly or indirectly, and no sub-set of elements is unconnected to any other sub-set." (Rougvie 1991)

In terms of the second fundamental characteristic, Rougvie (1991) also drew the distinction between closed and open systems, emphasising the importance of an open systems approach in relation to construction project systems,

"The environment in which the system operates are those elements, not part of the system itself, that produce an effect on the system. An open system contrasts with a closed system by its ability to be influenced by changes in the environment. This concept of an open system is important in relation to construction project systems. Any development which involves design and construction must of necessity be influenced by a huge range of factors outside the project boundary. Closed systems are those in which there is no contact or exchange between the system and its environment." (Rougvie 1991)

The construction project procurement process is temporary and dynamic in nature, evolving as a response to a unique and unstable environment. Cherns and Bryant (1984) described the organisational structure of construction project procurement as a "temporary multi-organisation". Clearly, a system is either closed or open but within open systems there will be different levels of interaction within the environment, thus open systems exist within a spectrum of varying environmental influence. It is this relationship, between the project procurement process and its environment, which makes systems theory particularly applicable to investigation of construction project procurement processes. It is highly relevant to the current research as systems theory provides a theoretical framework, which allows the impact of the environment on project outcomes, through its effect on the construction procurement process, to be assessed.

Since the origins of systems thinking, two distinct, but complementary styles of systems thinking have developed. These are commonly known as "hard" and "soft" systems thinking. In attempting to distinguish between the two, Checkland and Scholes (1990) provide a particularly useful distinction, *"The adoption of the word "holon" would also make clearer the two complementary schools of thought within systems thinking, usually labelled "hard" and "soft". Probably most people aware of the distinction imagine that it marks the difference between the kinds of problems tackled. Hard systems engineers tackle rather well-defined problems, while soft systems methodologists address messy, ill-structured problem situations. This is true, but it is not the fundamental difference between the complementary schools...hard systems thinking assumes that the perceived world contains holons; soft systems thinking takes the stance that the methodology, M, the process of enquiry, can itself be created as a holon. In the case of SSM we have a cyclic methodology which is itself a systemic (we would better say, holonic) process, one which within its procedures happens to make use of models or holons. In summary, then: we engage with the world by making use of concepts whose source is our experience of the world; this process of engagement, usually unconscious as we live our everyday life, can be made explicit; one way of doing so is embodied in so-called "systems thinking", based on the idea of making use of the concept as "whole". In systems thinking, accounts of wholes are formulated as holons, and these can be set against the perceived world, in order to learn about it. Within the systems movement two schools are complementary: that which takes the world to be holonic ("hard systems thinking") and that which creates the process of enquiry as a holon. SSM is such a holon, a cyclic process of enquiry which happens also within its processes to make use of holons. In everyday language, we say that SSM is systemic in two senses. It is a systemic process of enquiry, one which happens to make use of "systems models"."* (Checkland and Scholes 1990)

[The term "holon" used by Koestler (1978) is suggested as an alternative to "system".]

Application of systems theory to the construction industry has been undertaken by various researchers including: Handler (1970); Napier (1970); Morris (1974); Walker (1980); and Hughes (1989).

Handler's (1970) work was principally concerned with the building as a system, as opposed to the procurement process. This concept was developed from General Systems Theory by drawing an analogy between living organisms and a building. The work was essentially an abstraction of the way in which architects should work and think rather than how the *building process* should be organised. However, Handler did recognise the need for a structure to integrate the work of the specialists and the value of systems concepts in its achievement.

Another application of the systems concept to the construction industry was made in Sweden by Napier (1970). The main objective of Napier's work was to gain an understanding of the problems of the Swedish building industry through the application of systems theory concepts and development of a theoretical model. Napier concluded that his theoretical model appeared to work well as an instrument for interpretation and that by considering the building industry as a system with a number of sub-systems, and by studying these systems in their environment, it was possible for him to obtain a realistic picture of the industry and the causes of its major problems.

Other systems researchers have focused their work on the application of systems concepts to the organisational design of the building process. For example, Morris' (1974) research examined the various types of design/production interface which exist in the building process by using analytical techniques belonging to organisation and systems theory. Specifically, Morris chose to examine information flow between the design and construction activities' boundary. Morris discovered that organisational theory, particularly when employed in the context of a systems framework, could be used to describe and explain the nature of the management process for building projects. However, as the organisational pattern within a construction project changes as the project progresses from one stage to another, this makes it difficult to draw general conclusions from Morris' analysis. Since Morris concentrated solely on one interface, other areas of potential interest were excluded from analysis. Therefore, this technique would not provide a comprehensive approach to modelling the organisational structure of building projects.

Further systems research, although not specifically related to the construction industry, prompted development of systems concepts and models in this area. For example, Cleland and King (1975) focused on the development of a model for analysing temporary organisational structures. Their systems based approach modelled organisations as dynamic, open systems and provided a useful conceptual model for defining the structural relationships within an organisation, whether they were temporary or permanent.

In summary, these three major studies, by Handler, Napier and Morris highlighted the potential for the application of systems theory to the building process. Each study took a different perspective but used the same basic systems concepts.

Building on their predecessors' work, more recent systems based research by Walker (1980) and Hughes (1989) took the perspective taken of the relationship of management on behalf of clients to the process of providing a building. Their research work took a broader view than did Morris but a more specific one than Napier.

2.3 The Basis of the Current Methodological Approach

The research work of Walker (1980) and Hughes (1989), in applying systems theory to the construction industry, was central in informing the development of the methodology and this chapter includes a critical analysis and development of the methods used by them.

Walker's (1980) work developed a model for the analysis and design of project management structures for construction clients. The basis of the model lay in the systems approach to management. In developing his model, Walker drew on and brought together the work of a number of different organisation theorists. More recent research by Hughes (1989) modified and developed the systems theory as applied to construction project management, originated by Walker, using the revised theory and model to analyse projects for public sector clients.

The major development of Walker and Hughes' approaches was that their theory and modelling concepts provided a holistic view of the problems of organisational design affecting the construction industry. In particular, their research work evolved a systematic analysis of the relationships between project contributors, producing a quantitative assessment of the effectiveness of the organisation structures used, accounting for the environmental pressures to which the project was subjected. Walker and Hughes also attempted to link specific project outcome deficiencies (including functional deficiencies) to quantitative analysis of the project in order to determine the cause and effect relationships of these deficiencies. One of the greatest attributes of the analytical tool developed by Walker and Hughes, which makes it particularly applicable to the current research, is that it can be used to map the general organisational framework of the whole of a large project, down to the design of the way in which a small section of the work is to be organised.

Whilst Hughes' work provided a technique for mapping the roles, responsibilities and relationships of project contributors, in relation to component project activities, conversion of this qualitative data to numerical scores, by the application of organisational hypotheses, was not undertaken in this current study. Although a preliminary numerical analysis of the data, using Hughes' method, was undertaken it was ultimately rejected as an analytical technique. This was primarily due to the fact that the approach adopted for the current research, that of identifying cause and effect for individual functional problems in building design, did not require the numerical conversion and reduction of qualitative data. The dominance of this approach in Hughes' work was driven by the need to develop a framework, or model, upon which quantitative comparative analyses of different case study projects could be based.

Hughes' reliance on the numerical manipulation of data raised concerns regarding quantification of unlike variables, particularly with regard to environmental assessment (refer to section 2.5.7 Analysis of the Project Environment).

The current research focused on examining the role of the construction procurement process in the development of the functional aspect of building performance. This was undertaken through a case study approach, employing a systems based analytical tool developed from the work of Walker (1980) and Hughes (1989). The case studies (functional outcome deficiencies) were elicited through user-focused building function studies. This data was correlated with two other complementary data sets: data obtained from mapping the project procurement processes (that generated the case studies); and data obtained from environmental analyses of the case studies' project contexts.

In order to gain the necessary amount of depth for investigating problems at the user/building interface, it was essential to concentrate on the procurement process of a building *sub-system* rather than the procurement process of a whole building. For the purposes of this research, the hospital was chosen as an exemplar of a complex multi-user building. The reasons for utilising hospital food services sub-systems as the project contexts from which the case studies were selected, have already been explained in Chapter 1 (refer section 1.4 Evolution of Research Method).

The distinctiveness and originality of the current research is in its focus on identifying and analysing cause and effect relationships, specifically the relation of functional problems to the ability of the project procurement process to maintain building design and operational planning integration, particularly at periods of increased environmental pressure.

2.4 A Systems Based Approach to Analysing the Organisation of the Construction Project Procurement Process

2.4.1 Overview of the Systems Based Analytical Tool

By applying the ideas central to the systems approach to management to the construction procurement process, Walker (1980) developed a technique for the analysis of construction project management processes. This work was further refined by Hughes (1989). Walker and Hughes' approach was based upon the comparative analysis of selected construction project case studies. Analysis of each case study consisted of:

(1) The development of a mapping technique showing the relationship between decisions and tasks on a construction project and showing the roles, responsibilities and relationships of project contributors in relation to component project decisions and tasks. The mapping technique was based upon Linear Responsibility Charting, a technique which first appeared in the 1950s;

(2) Analysis of the mapping data using a series of organisational hypotheses, developed from systems theory concepts and proposals;

(3) Describing the environment within which the construction project took place. A framework was developed which was used to describe construction projects; this was based on earlier work on environmental influences on construction projects;

(4) Assessment of the level of success of the project;

(5) Comparing the level of success of the project with deviations and matches between the mapping data and the ideal state, as described by the organisational hypotheses. As an example, one of the seven organisational hypotheses developed by Hughes stated that the level of skill diversity associated with the project had to match the level of environmental complexity.

For the current research, items (1), (3) and (4), above, were essential components of the methodological approach. For the purposes of this research, success focused on the ability of the building to support the activities that the occupying users were to carry out: this was defined as building function. Analysis of building function focused on those aspects of the food service system, which user groups identified as being problematic. Further investigation of all these functional deficiencies (case studies) permitted the depth of analysis required for determining the cause and effect of the observed functional deficiencies.

The three main components of the investigative technique are explored in the following sections and are considered in the context of previous research in developing a specific methodology for the project. The most significant methodological developments in the current research are in the environmental analyses and assessment of outcome deficiencies. Furthermore, the relationship between the two is explained more fully, particularly in attempting to determine cause and effect.

In order to understand more fully the methodological approach of the research, it is necessary to explain the general concepts and proposals of the systems theory approach as applied to the construction industry. In particular, the work of Walker (1980) and Hughes (1989) provided the basis for explaining key systems theory concepts, proposals and terminology, and this is examined in section 2.4.2 Key Concepts and Proposals, below.

2.4.2 Key Concepts and Proposals

There are several key concepts central to the development of a systems approach to construction project management. Examination of the work of the main systems theorists in construction project management, including Walker (1980) and Hughes (1989) identified the following as the key concepts: activity; decision points; interdependence; differentiation; integration; and feedback. Previous research in this field involved formulating a set of proposals relating to these concepts in order to describe construction procurement processes. For example, Walker's (1980) proposals suggested that:

(1) The building process is divided into the systems of "Conception", "Inception" and "Realisation" at "Primary Decision" points and into sub-systems at the "Key Decision" and "Operational Decision" points, all of which identify clear feedback loops;

(2) The differentiation of the system should be matched by a corresponding level of integrative effort. (The very nature of the construction procurement process requires the input of many individuals with different skills, knowledge and expertise, i.e. project contributors are very different from each other but all are essential in terms of the whole. This "differentness" between contributors has to be overcome by some integrating mechanism which will bring contributors together to work on the activities that constitute the procurement process);

(3) The managing system and the operating system should be differentiated. (This means that there should be a clear distinction between project contributors who are actually undertaking the work and those contributors that manage the activities being undertaken);

(4) The managing system itself should be undifferentiated;

(5) The client/project generator and the process of building provision should be integrated.

Walker's model suggested that if a construction project's organisational structure subscribed to the above propositions then it would have the potential to mitigate and harness environmental influences to the advantage of the client and achieve client satisfaction with the outcome of the project.

Later work by Hughes (1989) adopted a slightly different approach. Basically, Hughes recognised the need for a common base of reference so that systematic descriptions and quantitative comparisons between different project organisational structures could be meaningful. In order to make his model applicable to a wide range of construction projects, Hughes adopted a general approach which provided a frame of reference within which comparisons of different construction projects could be made. Hughes achieved this by using a regular pattern based on the plans of work recognised by the construction industry. The following sections explore the common concepts of the systems approach as applied to construction project management.

2.4.2.1 *Decision Points and Sub-Systems*

As a starting point, systems approaches to construction project organisation identify the major components and decision points inherent in this particular type of organisational structure. For example, Walker identified only four factors that different building projects must have in common. These were the four Primary Decision points, which split the process of construction into three major systems of activity: the Process of Conception; the Process of Inception; and the Process of Realisation. As far as Walker (1980) was concerned, an activity,

> ***"...refers to the systems of work which have to be done in order to transform input into output and to incrementally produce a building."*** (Walker 1980)

"Activity" describes the work packages, which take place between decision points. The term applied by Walker (1980), to the sequence of activities which progressed a construction project from beginning to completion, was the "Operating System" i.e. the system of activity through which the project is actually achieved. Walker's application of systems theory to construction project organisation also recognised that alongside the Operating System there is also a "Managing System". This system provides the regulating and maintenance activities which keeps the Operating System functioning. Figure 2.2 shows the relationship between the four Primary Decisions and the three major systems of activity.

Figure 2.2 Relationship Between the Four Primary Decisions and the Three Major Systems of Activity

from Walker (1989)

Primary Decisions	Systems of Activity
Adaptation to external influences	
↓	CONCEPTION
Provision of a performance through the acquisition of real property	
↓	INCEPTION
Identification and construction of a new building	
↓	REALISATION
Final completion	

Decision points form the major boundaries to activities and were ranked by Walker according to the degree to which they commit the client to given courses of action or commitment of finance. These are the Primary, Key and Operational decisions. In the context of building provision, Walker recognised four Primary Decisions, which are common to all building projects, and are the highest ranked decisions. Key Decisions are the next highest ranked and Operational Decisions are the lowest ranking decisions. An example is given in figure 2.3 to illustrate the relationship between the three major systems of activity and the four Primary Decisions, as may be seen in the hypothetical provision of a specialised health care building.

The conventional design and construction stages of building procurement lie within the Project Realisation System: this system, therefore, contains the majority of design decisions and decisions relating to operational function. The four Primary Decisions will be taken in response to environmental forces. Each of these three major systems of activity will be divided into sub-systems at the next level of decision-making, the Key Decision level.

Key Decisions are determined by the client as a result of the client's internal procedures for expenditure and similar approvals, and will be strongly affected by environmental influence upon the client's activities. Key Decision points imply a degree of irrevocability, since to revoke such decisions would entail the client in loss of resources either already expended or to be expended in the future. Each Primary Decision is reached through a succession of sub-systems of activity bounded by these Key Decision points. At this level, Walker (1981) did not think it possible to identify universal sub-systems: he envisaged that it would only be possible to identify their determinants, which would enable sub-systems to be identified for each particular project.

These Key Decisions are taken by the client and range from, for example, approval of design, budget and tender proposals, to decisions to delay the project, to decisions to abort work or change the nature of the project. The clients organisation should be responsive to environmental forces, otherwise, Walker suggested, Key Decision points may be inappropriately identified to the detriment of the project outcome.

The sub-systems created by Key Decision points are further sub-divided by Operational Decision points. Operational Decisions contribute to, and constrain, Key Decisions and may be taken by the client's advisors as a result of, or in making progress towards, a Key Decision. Such Operational Decisions are mainly concerned with implementation of procedural aspects of building project organisation. The process of building provision is thus characterised by discontinuity due to decision points and the resulting incremental nature of the task. Each level of this hierarchy of decision making provides important feedback opportunities within the client's organisation and also for the process of building provision. To sum up, the systems created by Primary Decisions consist of a number of sub-systems of activity created by Key Decisions, which in turn consist of a number of task sub-systems created by Operational Decisions.

One of the main conceptual differences between Hughes' and Walker's work lies in the fact that Walker's model is based on the premise that Key and Operational Decision points cannot be universally prescribed for all projects and need to be uniquely identified for each project analysed. This minimised the potential for easy comparison between analysis of different projects since each was presented in a unique way. Additionally, this approach led to an unwieldy form of data presentation. One of the benefits of Hughes' approach was that, in examining and comparing a variety of plans of work typical of the construction industry, including RIBA's work stages, he identified eight major decision points which were common to all construction projects. Thus, for all construction projects there would be a common point of reference at the start of analysis. These decision points formed the boundaries to the seven Stages of Work identified by Hughes as being common to all construction projects.

Figure 2.3 Illustrative Example of the Four Primary Decisions and Three Sub-systems of the Process of Building Provision

PRIMARY DECISION 1 The disease AIDS has emerged. The client adapts to this external influence.

SYSTEM : CONCEPTION
A Regional Health Authority is concerned over the number of AIDS/HIV cases reported in recent years. The Regional Planning Team anticipates a future demand for specialised services to care for these people.

PRIMARY DECISION 2 Client decides that real property must be acquired to achieve these objectives.

SYSTEM : INCEPTION
The Regional Planning Team has decided that a special centre is required that will : provide care for terminally ill AIDS patients; incorporate counselling and HIV screening facilities and serve as a community education base for AIDS/HIV infection.

PRIMARY DECISION 3 Deciding the form that the real property should take.

SYSTEM : REALISATION
The Regional Planning Team has a number of options available for acquiring property but decides that a purpose built centre would best achieve the objectives.
At this stage the Regional Planning Team is involved in the building procurement process.

PRIMARY DECISION 4 The decision that the project is complete.

The Regional Planning Team may envisage the end of the project as being the end of the defects liabilities period.

Thus, in comparison with Walker, Hughes' approach recognised far more similarities between construction projects. The main advantage of this aspect of Hughes' approach was that the identification of sub-systems of activity was not entirely dependent upon each particular project. The Stages of Work and decision points identified by Hughes would fall within the Project Realisation System identified by Walker. These common Stages of Work, identified by Hughes (1989), are listed and described briefly below.

Inception: Define need and determine financial implications and sources.

Feasibility: Preliminary designs, costings and investigation of alternatives.

Scheme Design:
(or Sketch Scheme) Programming, budgeting, briefing and outline design.

Detail Design: Development of all sub-systems within the design, detailed cost control, technical details.

Contract: Contract specification, pricing mechanism, sufficient documentation for selection of contractor etc.

Construction: Execution and control of all site work and associated activities, further contract documentation.

Commissioning: Snagging, operating instructions, maintenance, manuals, opening ceremonies, occupation, evaluation, managing the facility, staff training etc.

After commissioning, many more decisions will be taken regarding the use of the building. As environmental pressures exert their effects on the occupying organisation there are likely to be several changes to operational policy and these may require physical modification of the building. Finally, although not altogether inevitable, at the end of the building's life-cycle is demolition. Either this, or abandonment and ultimate human neglect will result in an unoccupied monumental shell. As soon as an organisation has made the decision to decommission and evacuate a building then it is likely that it will have already become involved in a new building scheme to replace old and outdated facilities. Within the lifetime of an organisation there is, therefore, a cycle of construction procurement projects, one leading onto the next, albeit with significant gaps between.

The stages may occur in a variety of sequences and some stages may overlap. Although the sequence may vary, the Stages of Work remain sequential. The traditional method of procurement would exhibit the pattern of decisions shown in figure 2.4.

Figure 2.4 Pattern of Decisions Exhibited by the Traditional Method of Procurement

modified from Hughes (1989)

Eight Major Decision Points	Seven Common Stages of Work
DECISION	
	Inception
DECISION	↓
	Feasibility
DECISION	↓
	Sketch Scheme
DECISION	↓
	Detail Design
DECISION	↓
	Tender
DECISION	↓
	Construction
DECISION	↓
	Commissioning
DECISION	

The first decision is the one in which the client will make a decision to adapt to external influences. At the inception stage, the need for the project will be identified and the resources required may be approximately quantified.

This leads to the second decision point in which the client decides that, to meet the organisation's needs, a new building must be constructed. At the feasibility stage, the client will be investigating possible and alternative solutions, preliminary designs and costings.

From this, the third decision can be made, that the preferred solution is feasible and the project can advance. During scheme or sketch design, client and designer interaction becomes more intensive. Tasks such as drawing up a brief, identifying user needs and approving sketch designs will be carried out.

At the end of this, is the decision that the design is acceptable within financial limits and is an adequate interpretation of the client's requirements. The next stage is the detail design stage where specialist consultants will develop the design and integrate services, circulation and structural systems. The technical problems will be fully worked out and statutory consents checked.

The fifth decision point is that the contractor can be selected, the tendering process thus commences using information produced on specifications, bills of quantities and tender drawings.

The sixth decision point is that the contractor has been selected and work on site can commence. The construction stage contains all site related activities, including further documentation and design work brought about as a result of the emergence of further information.

The seventh decision point is that the building is ready for commissioning. During commissioning, the staff will be trained and occupy the new building.

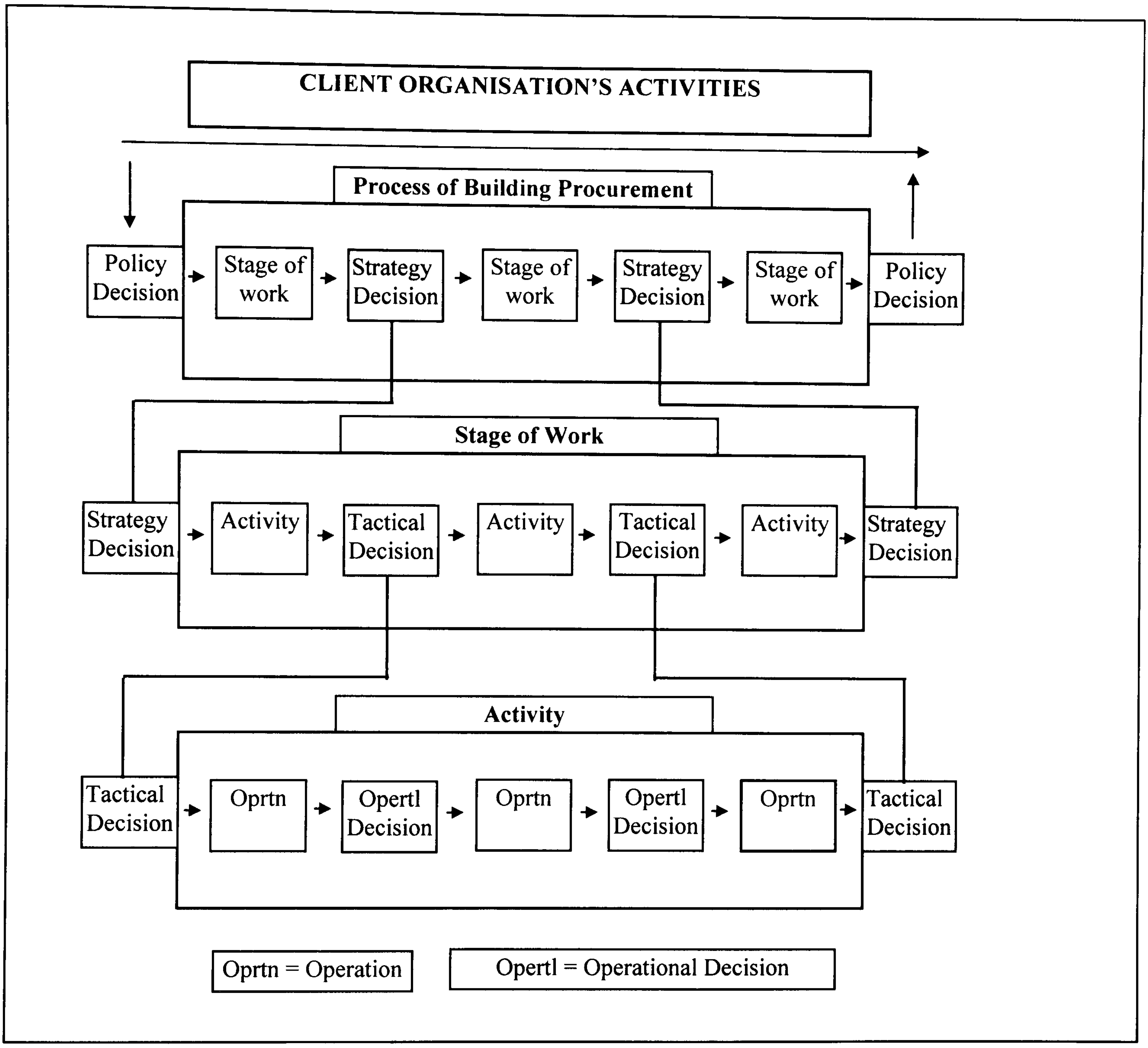
The final decision taken is that the project is complete. Usually, contractual completion is taken as the finish point to the building project but the definition of finish point will be dependent upon the particular client and project. As indicated previously, these decision points and Stages of Work account for only a very small proportion of the life of the building.

Like Walker, Hughes recognised a hierarchical decision-making structure for construction project organisational structures. His model proposed that Policy Decisions form the trigger and finish points in the process of building procurement. This process is sub-divided into Stages of Work, each terminated by a Strategic Decision. Each Stage of Work is further sub-divided into a series of Activities, each of which is terminated by a Tactical Decision. These Activities are again further sub-divided into Operations, punctuated by Operational Decisions. The relationship and structure of these decision points and different systems of activity, to the client organisation's activities, is shown diagrammatically in figure 2.5.

An Activity relates to one of the seven Stages of Work, identified by Hughes as being common to the construction of all buildings. Each Activity can be broken down into a group of Operations, which have to be undertaken with a realistic relationship to each other. These Operations may be linked reciprocally or sequentially. Operations, which are linked reciprocally, occur within the same time frame and are dependent on each other for completion. An example of this is illustrated by Operations 7 to 10 in Appendix 5 (Table 5.3).

Figure 2.5 Hierarchy of Decisions

from Hughes (1989)



Sequential Operations occur one after the other and are dependent on the output of the previous Operation and feed into the subsequent Operation. An example of this is illustrated by Operations 11 to 12 in Appendix 5 (Table 5.3).

The work to be done in any one Operation may consist of combining a variety of information inputs, some from previous or concurrent Operations, some from consulting contributors. The information inputs are transformed into information outputs by exercising technical skill.

Policy, Strategic, Tactical and Operational Decisions form the major boundaries to activities. These decisions have been defined by Hughes (1989) thus:

Policy Decisions : These are the highest ranking decisions and define the beginning and end of the building procurement process. Policy Decisions are the major constraint on any project and determine the framework within which the project takes place. The trigger Policy Decision sets the objectives for the project, and the terminal Policy Decision terminates the project. These decisions lie at the interface between the Macro-environment and the project. It is the Managing System, which regulates, maintains and adjusts the process of building procurement in terms of the project's environment.

Strategic Decisions : These decisions define the beginning and end points of the Stages of Work and, as such, they deal with matters of the environment impinging on the project boundary. The sub-systems created by Strategic Decisions determine the Micro-environment of the project.

Tactical Decisions : These are concerned with the deployment of resources and the management of the project on a day to day basis.

Operational Decisions : These are made in the absence of a higher rank of decision.
The Operating System is the term used to signify groups of Operations, which interact to progress the project incrementally towards the objectives of the Stage of Work. The term used to describe groups of Operations between Tactical Decisions is Activity. Thus Operations are sub-systems of Activity; Activities are the sub-systems of the Stages of Work and Stages of Work are sub-systems of the process of building procurement.

Since Hughes' model is based on an "open-systems" view there is a requirement for some kind of mechanism to regulate transactions occurring between the system and its environment. This is provided for by the Control System. This involves comparing progress to pre-determined targets or plans, and taking some sort of corrective action. The Control System is concerned with regulating and adjusting the work taking place in terms of the objectives set by the Strategic Decisions. In other words, performances will be matched to objectives. The Managing System sets the policies and objectives for the project and the Operating System undertakes work in order to achieve these objectives. The Control System acts as an interface between the two and matches activity to objectives in order to ensure that output is oriented towards objectives.

Hughes (1989) defined a contributor's role as the relationship between a contributor and an Operation. Walker and Hughes identified a variety of these roles, which could be combined for a particular contributor. This variety and combination, could be determined by the contributor's skill, and ability and the purpose of the contribution being made. The roles and responsibilities, which Hughes identified in the Operating, Controlling and Managing Systems, are summarized in figure 2.6. A more detailed discussion of these can be found in Hughes (1989).

In developing his model, Hughes encompassed the same elements of construction project management as Walker, delineating projects in terms of "Activities" and "Decisions". For the purposes of this research, the convention developed by Hughes was considered to be most appropriate for use in the current methodological approach. The main benefit of adopting this general conceptual framework was that it allowed project mapping data to be presented in a consistent format because it recognised seven Stages of Work common to all construction projects.

The concepts of inter-dependency, differentiation and integration and feedback are also central to a systems based approach and these are considered in some detail in the two following sections.

2.4.2.2 *Differentiation, Project Environment, Inter-Dependency and Integration*

This section explores four related factors, central to the systems approach to construction project organisation and management: differentiation; the project environment; inter-dependency; and integration. The relationships between these are illustrated in figure 2.7.

The construction industry is a project based industry; each project creating a "temporary multi-organisation", Cherns and Bryant (1984), through which a heterogeneous mix of professionals from the construction industry, and those from the client body, are brought together. Those involved with the temporary organisation are derived from different professional practices, each working for their own particular company, and brought together purely for the purpose of creating a new building. Thus, within such an organisational structure, individuals will be working: on different aspects of the project with skills of varying types; at different times; in geographically separate locations. Thompson (1967) termed this phenomenon as *differentiation* and it is typical of the organisational issues intrinsic to the construction industry.

Figure 2.6 Roles and Responsibilities Within the Operating, Managing and Controlling Systems

from Hughes (1989)

OPERATING SYSTEM ROLES:

The Operating System is the system of activity through which the project is actually achieved.

Operating	The activity of actually carrying out work (i.e. performing an Operation) on some aspect of the project.
Co-operating	Membership of a team or committee in which all of the contributors are present at the same time, thus achieving integration.
Consulting	The provision of technical or other information when asked for it. Typically undertaken in the construction industry by professional consultants.
Receiving	A person who is in receipt of information about the project for purposes outside the management of the project; for example the accounts department of a client organisation.

CONTROL SYSTEM ROLES:

The Control system acts as an interface between the operating and managing systems, acting as an interface between the two and matching activity to objectives in order to ensure that output is oriented towards objectives.

Monitoring	The function of recording and filtering information about an Operation and communicating it to the right people who may take action.
Supervising	The responsibility for comparing progress with a predetermined plan and for bringing about some sort of response to the situation.
Resourcing	The function which ensures that the people who carry out Operations have sufficient resources (both in terms of skill and economic resources).

MANAGING SYSTEM ROLES:

The Managing System sets the policies and objectives for the project; it regulates, maintains and adjusts the process of building procurement in terms of the project's environment.

Co-ordinating	The function which ensures that information flows successfully between Operational links.
Directing	The executive responsibility for ensuring that the output of Operations is oriented towards the objectives.
Recommending	The function of passing information or the results of an Operation to someone who must take a decision on it.
Approving	The executive function of taking decisions about the output of Operations. This decision will usually form the input of a subsequent Operation, Sub-system or System.

Three types of differentiation are related directly to these characteristics of construction projects, as described above: technology; time; and territory, Thompson (1967). These types of differentiation can be reinforced by *sentience*, Miller and Rice (1967). The concept of sentience is most easily understood through Walker's (1989) definition of a sentient group,

> ***"A sentient group is one to which individuals are prepared to commit themselves and on which they depend for emotional support."*** (Walker 1989)

In the construction industry context, with substantial autonomy of contributing consultants, firms and professions, sentience can arise as allegiance to a firm, and/or allegiance to a profession.

From discussions about differentiation, above, it is clear that a variety of skills, exhibited by different professionals, are combined in unique ways to produce buildings. When various groups combine on a temporary basis to form a construction project team, the nature of the differentiation can be complex. However, this variety is necessary in terms of providing the range of skills demanded by the *project environment*. The dependency of organisational structure on the environmental demands upon the organisation was demonstrated by Lawrence and Lorsch (1967) and is commonly known as the "contingency approach". Key to this approach is the recognition that organisational structure must be appropriate to (or contingent on) the environment in which it operates. Thus, the more complex the environment, the greater the variety of skills that are required, and hence the greater the organisational differentiation. Logically then, projects with the highest technical and environmental complexity should exhibit the greatest differentiation since more expertise is required to determine the impact of the environment on the project. Hughes (1989) indicated that it was technical complexity coupled with the dynamic nature of the project environment that led to uncertainty in construction projects. Uncertainty might also be related to the effects of the lead in/lag time of projects.

Crichton et al (1967) indicated that this uncertainty produced a demand for *inter-dependence* in the organisational structure. Von Seifers' (1972) TREND model also demonstrated the link between inter-dependence and uncertainty. Thompson (1967) defined three types of inter-dependence: sequential; reciprocal; and pooled. Walker (1980) showed that only the first two types existed in construction projects.

The sub-systems identified in Walker's (1980) model can be considered to be either *sequentially* or *reciprocally* inter-dependent. Similarly, in Hughes' (1989) work, Operations were envisaged as being either sequentially or reciprocally inter-dependent but Activities were deemed to be sequentially inter-dependent. Sequential inter-dependency means that each sub-system (or Operation) relies upon output from preceding sub-systems; i.e. this type of inter-dependency requires that one sub-system (or Operation) must act properly before the next sub-system (or Operation) can act. Reciprocal inter-dependency occurs when two task sub-systems (or Operations) are mutually dependent on each other i.e., the outputs of each sub-system (or Operation) become the inputs for the others and the process moves forwards through a series of steps, in which each step requires interaction between sub-systems (or Operations). An example of reciprocal inter-dependency might be the fact that architectural proposals for the external envelope for the building rely heavily upon the structural solution adopted and vice versa. This information flow, and link between Operating System contributors was described in Hughes (1989),

> ***"Additionally, within an operation, different contributors may be providing input, or receiving input. Thus the work to be done in an operation consists of combining a variety of information inputs, some from previous or concurrent operations, and some from consulting contributors. These inputs are transformed into information outputs by exercising technical skill. The outputs will be made to other contributors, in other operations, thus forming the inputs of subsequent operations."*** (Hughes 1989)

In terms of Hughes' (1989) Operating System, a distinction can be drawn between inter-Operational and intra-Operational differentiation. Intra-Operational differentiation is concerned with the differences between contributors within an Operation. Inter-Operational differentiation is concerned with the differences between contributors between Operations. Consequently, when a construction project is demarcated by high environmental and technological complexity, there should be a corresponding effect on the level of differentiation and inter-dependence required in the project organisational structure.

Hughes (1989) indicated that identification and control of differentiation was one of the key elements of construction project management. Differentiation requires a mechanism to ensure that the accumulative effort of individuals remains oriented towards the client's objectives. The vehicle through which this is achieved is described as *integration*. Hierarchy is one of the simplest and commonest integrating mechanisms, i.e. the placing of inter-dependent units under one manager. Other integrating mechanisms, identified by Khandwalla (1977), include rules, procedures and policies, and participation in group decision making. Lawrence and Lorsch (1967) indicated that hierarchy was the most important aspect from the point of view of organisational structure and envisaged it as an individual approving the output of each contributor. Hughes (1989) deemed co-ordination to be the integrating mechanism for intra-Operational differentiation. According to Miller and Rice (1967), inter-Operational differentiation, displayed in the Management System, was due to changes in the Management System leading to discontinuity and hence differentiation. Hughes (1989) identified the continuous provision of the directing role (refer to figure 2.6) as the organisational structure's mechanism for overcoming the adverse effects of discontinuity, i.e. differentiation in the Managing System.

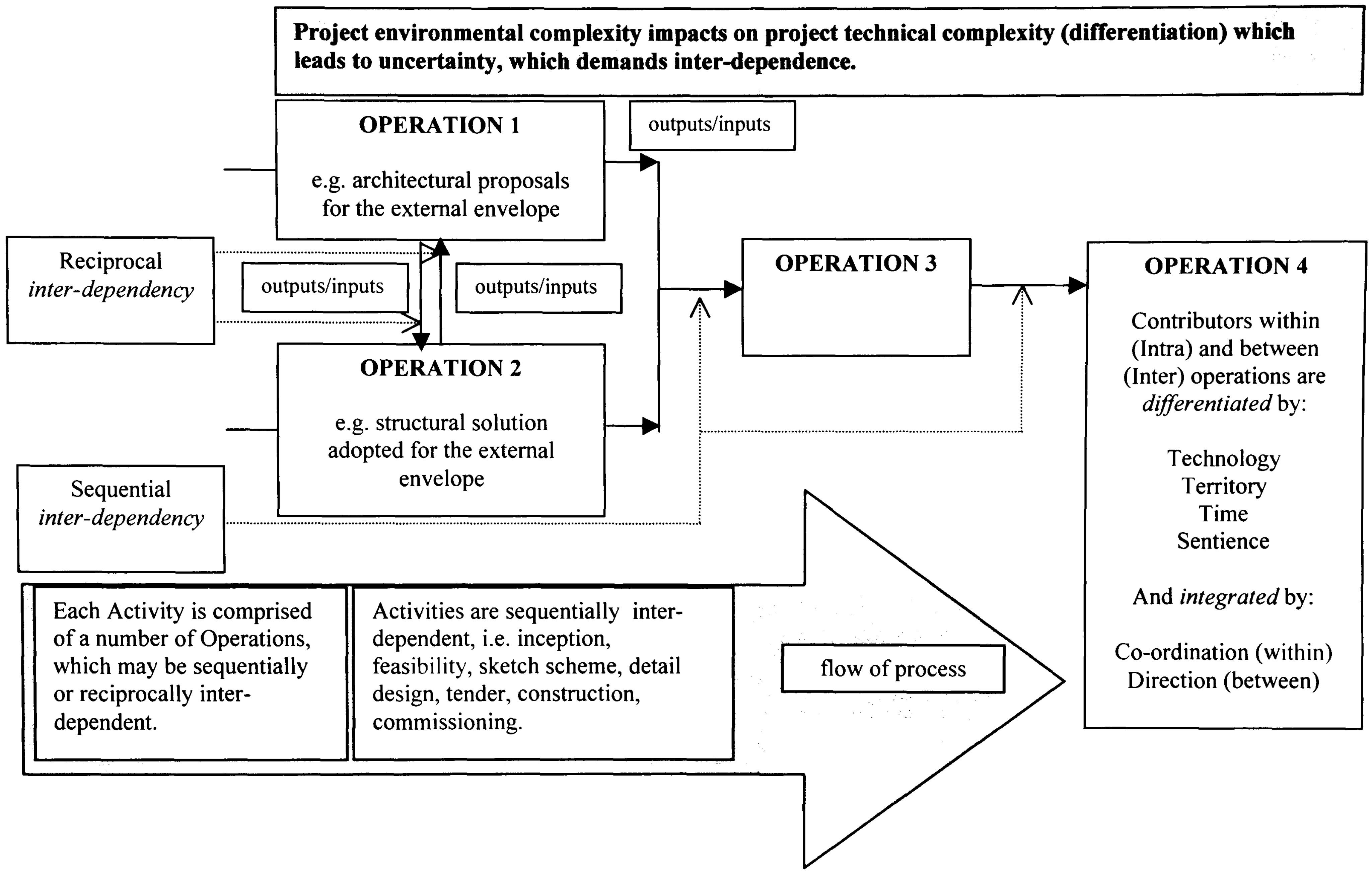
In previous studies of organisational structure, such as Lawrence and Lorsch (1967) and Walker (1980), considerable data was provided with regard to the range and intensity of different combinations of differentiation. However, as highlighted by Hughes (1989), these studies did not relate the varieties of differentiation to integration: they only accounted for the presence or absence of integration, implying that it was unnecessary to examine all types of differentiation.

In the context of the current research, the incidence of sentience was not accounted for in the case study analyses. Whilst it is accepted that sentience is an important variable, and derivative of culture, the hypothesis of this study related to being able to improve functionality by integrating design and operation in a communication process, irrespective of sentience.

Although Walker (1980) did take account of sentience in his research work, by identifying either the presence or the absence of it between the transactions of different operating contributors, this measure did not account for differences in the *degree* of sentience present between different transactions of different contributors. If contributors were sentient to more than one group there was no distinction between the level of sentience the contributor attributed to each different group: this could have been an important effect.

As the contingency approach demands technological differentiation, according to the complexity of the environment, and other types of differentiation that contributors bring with them can re-inforce/highlight the differentiation due to differing skills (technological) but cannot mitigate it, Hughes considered it sufficient to examine only the presence/absence of differentiation relating to technology. Therefore, Hughes (1989) deemed technological differentiation to be primary (arising as a consequence of environmental complexity) and all other differentiation to be secondary.

Figure 2.7 Diagram Showing the Relationship Between Differentiation; the Project Environment; Inter-Dependency; and Integration



2.4.2.3 *Feedback*

Comparing progress with pre-determined targets, or objectives, so that corrective action can be taken to change the performance of an activity to bring it closer to that which is planned is an essential activity within the project management process. Hughes (1989) termed this concept "feedback", distinguishing it from forward control in which the plan is changed so that it more closely reflects the changed situation brought about by the departure from the plan. Hughes envisaged that a Control System (regulating the transactions between the system and its environment) was necessary to compare progress to pre-determined goals and to take corrective action. In such a model, the Control System acts as an interface between the Operating System and the Managing System. The Managing System sets the policies and objectives for the project, and the Operating System undertakes work in order to achieve them, Hughes (1989). The Control System matches activity to objectives in order to ensure that output is oriented towards objectives.

Walker's model recognised the need for a Control System, adopting the concept of feedback. Walker identified the major feedback loops common to all new developments and his model also allowed the development of further control feedback loops to be identified as the project progressed, Walker (1980). Hughes (1989) suggested that control activities took up much of the detail in the plans of work and accounted for many of the differences between them. Objectives regarding time, quality and cost commonly form the basis of the control of construction projects. As well as these three types of control, Hughes (1989) also considered legal and functional control to be present to differing degrees at all stages of the project. His argument for including these two factors was that since much of the work involved in contract administration and the technical work of professional consultants is taken up with legal control, and the client's briefing is the technique for controlling the functional content of the schemes, then these two types of control must be accounted for too.

2.5 Research Methodology

2.5.1 Selection of Case Study Project Contexts

The case studies were selected from three construction project contexts. The projects were schemes, representative of UK project management procedures/organisational structures, chosen from among the NHS building stock. The NHS Estates Directorate's CONCISE (Computerised National Capital Intelligence Service And Exchange) database was accessed and a list of hospitals from the NHS building stock, which formed potential retrospective projects, was generated. Project selection criteria imposed on the database were:

(1) Hospitals, or hospital phases, completed and brought into operation between January 1985 and September 1990;

(2) Of the above schemes, those which had in-patient food services incorporated as part of the solution to the planning problem.

This database only accessed information relating to hospital building stock in England. With these criteria, the database generated a possible 190 projects. In order to narrow the field of selection to a more workable population number, a further time criterion was applied; to select hospitals, or hospital phases, which had been completed and brought into operation between January 1989 and September 1990. Further reduction of the time scale was thought to be beneficial in three ways. Firstly, the selection of newly completed schemes/phases would reduce the possibility of selecting a project that had introduced major changes in in-patient food service operation or design since commissioning. Secondly, it was anticipated that selection of recently built hospital schemes would decrease the likelihood of selecting projects where background data kept in client project files had been lost or destroyed. The information supplied by the CONCISE database indicated only contract start and completion dates. There was no information relating to the actual inception dates of schemes. This meant that although contract dates could be relatively recent, the actual inception of schemes could be much earlier. This was the situation with all of the projects and meant that only part of the early planning data was available for consultation. Thirdly, by choosing more recently completed hospitals, it was envisaged that planning details would still be relatively fresh and clear in the memories' of planning contributors. This added time criterion narrowed the potential number of projects to18, in England.

A similar database did not exist for Scotland and Wales. Therefore, the nine Health Authorities in Wales and 12 of the Scottish Health Boards (the more inaccessible Boards of Orkney, Shetland and the Western Isles were omitted) were contacted to pursue the possibility of finding potential projects which met the selection criteria. This search produced another two potential projects. The complexities of the research methodology and time constraints of the research meant that these 20 potential projects had to be narrowed down further.

Three projects were finally chosen for analysis. In addition to the two selection criteria previously stated, the undernoted were also important factors affecting selection:

(1) Accessibility of project history information from client project files;

(2) Geographical accessibility;

(3) Co-operation of the client body, since significant input was required from it.

The projects comprised one development from Scotland and two from England.

2.5.2 <u>Mode of Data Collection : Retrospective Versus Longitudinal</u>

Data collection, relating to project procurement and environmental analysis, was undertaken wholly on a retrospective basis for case studies associated with two of the projects, since the projects were complete at the time the research commenced (these are referred to as retrospective projects A and B within the thesis). However, for case studies derived from a third project, this data was collected on a retrospective and longitudinal basis. This particular project was still in progress at the time the research was undertaken (this project is referred to throughout the thesis as longitudinal project C). However, due to the long lead in time of the project, and the impact of early planning decisions and activity on later progress, the data collected with regard to this project (and associated case studies), of necessity, also included retrospective data, i.e. that recorded in client project files etc. It was essential to gather this early planning data to construct a data set that was as complete as possible. Since retrospective case study analysis relied upon the collection of data relating to past events, decisions and circumstances, and its subjective interpretation, the longitudinal project (and associated case studies) provided the opportunity to test the validity of this aspect of the research methodology. Specifically, the longitudinal approach indicated how accurately historic information recorded what actually happened during the project procurement process. For project C, all information surrounding food services planning, up until the time when suggestions had been made to build an entirely new department, was obtained in a retrospective manner. Thereafter, data was obtained in an ongoing manner, as and when the project progressed. Testing the validity of retrospective data collection focused specifically on attendance at key meetings in which the design of the new phase 1A catering department was worked up in detail. Notes were taken during the meetings, and the meetings were recorded on audio tape. The tapes were later transcribed and the transcriptions, along with the notes, were checked against the official meeting minutes. This provided a check to validate the method of data collection by:

(1) Ensuring that officially recorded minutes: were an accurate reflection of events and decisions; could provide valid evidence for determining the timing of project activities; and be a reliable source of information for assisting in determination of the roles, responsibilities and relationships of project contributors. This information provided the basis for building up the project diary, from which the mapping of the project procurement processes was derived;

(2) Checking the researcher's interpretation of events - this was important since a degree of interpretation would need to be applied to retrospective data, particularly in the absence of parties able to refute/corroborate documented evidence.

This check indicated that the information in client project files was sufficient to provide the basis for mapping accurately the project procurement process. However, it also identified loss of some of the detailed reasoning behind decisions. This emphasised the need to obtain close co-operation from personnel involved in projects being analysed retrospectively so that any issues that were unclear could be resolved through discussion. However, this would only be useful if those individuals that were in post at the time of planning were still in post at the time of data collection.

2.5.3 Use of Multiple Sources of Evidence

In recognising the benefits of evidence gained from multiple sources, data for the case studies was drawn from the following: documentation, archival records; interviews, direct observations; and physical artefact. The most compelling reason for this, is emphasised by Yin (1994),

"...the most important advantage presented by using multiple sources of evidence is the development of converging lines of enquiry, a process of triangulation...Thus any finding or conclusion in a case study is likely to be much more convincing and accurate if it is based on several different sources of information following a corraboratory mode." (Yin 1994)

For each of the three main investigative tasks, reiterated below, the sources of evidence, or data, are identified, as undernoted:

(1) Recently completed buildings were evaluated, from the user perspective, in order to identify functional deficiencies. Different user groups were surveyed to obtain data on these functional deficiencies;

Questionnaires were devised in order to elicit information from user groups on food service system functioning. The responses to the questionnaire essentially represented users' direct observations of a physical artefact (the functioning food service system). The main user groups involved in food service system functioning were targetted, in order to obtain the broadest possible coverage of system functioning, and to corroborate information provided by different users on aspects of poor system functioning. This information was used to identify deficiencies within the system, and from this, the case studies were selected. This data, sourced from the users, was also corroborated by: direct observations of the researcher (by observing the food service systems in operation); discussions with key management personnel; documentary evidence.

(2) The procurement processes which evolved the buildings were analysed. The project procurement processes were mapped in order to determine: the relationship and timing of project activities; and the roles, responsibilities and relationships of project contributors (individuals and groups) participating in these activities;

The largest data source was that contained within client project files. A variety of documentation was scrutinised and included items such as (a) letters, memoranda and other items of correspondence; (b) administrative documents such as proposals, progress reports, formal evaluations, minutes of meetings (c) newspaper articles. The main archival records that were sourced were site plans and design drawings. As in (1) above, this data was corroborated by interviewing key project personnel.

(3) An environmental analysis was undertaken in order to identify the timing, nature and effect of the most influential environmental pressures impacting on the development of

the projects, focusing particular attention to their involvement in the development of functional deficiencies (the case studies). As in (2) above, the most significant data source was documentation contained within client project files. As detailed in section 2.5.7.2 (Environmental Assessment : Methodology for the Current Research), key personnel were questioned about the project environment, using six qualitative categories as the basis for semi-structured interviews.

2.5.4 Analysis of Building Function

2.5.4.1 *Overview of Previous Research*

As highlighted earlier in Chapter 1 (refer section 1.1 Introduction), deficiencies in building function can be identified through post-occupancy evaluation techniques. Building evaluation is well established as a concept within the construction industry. Baird et al's (1996) comprehensive text on building evaluation brings together the work of leading theorists and practitioners to summarise international thinking on building performance. It shows that post-occupancy evaluation techniques, theories and models have developed over a number of years and have been applied to a range of built environments. As there is no single or best way to conduct an evaluation (Gray and Baird 1996), a method has to be developed for the specific objectives of each unique situation.

Gray and Baird (1996) point to one of the key factors for the evolution and development of an increasing number of post-occupancy evaluation techniques,

> ***The diversity of methods that is revealed in the work of the contributing authors is a consequence of the complexity of modern buildings and the unique requirements of different user groups. Buildings, organizations, and the relationships between the organizations and the buildings they inhabit are increasingly complex and increasingly subject to change. Among the qualities that distinguish a good building from a bad one is the good building's capability to provide for different demands by owner and occupant groups and to respond quickly to the changing demands of its occupants and owners. These complexities, and the many permutations of demand and supply that can occur between users and buildings, help explain the profusion of techniques that have been invented to evaluate buildings."*** (Gray and Baird 1996)

The importance of the user, particularly in building *function* evaluation is emphasised by Kernohan et al (1992),

> ***"The more we use a facility, and the more familiar we are with it, the more we know about it. Such knowledge is based on direct experience of physical settings, gained while pursuing day to day activities. We do not just mean knowledge of technical***

aspects of a facility, such as how many electrical circuits are within a building, or whether the fire alarm system is in good working order, though it may include these things. Nor do we mean knowledge just of basic functional matters, such as whether the doors stick, or the carpet is worn, though it may include these matters as well. We mean deeper knowledge that people acquire through use of facilities, such as the way to get around a building or the image projected by a facility. We mean insights about relationships between activity and physical setting that experiential learning can provide with such assurance. We call this "users' knowledge" to distinguish it from conventional professional sources of knowledge about facilities." (Kernohan et al 1992)

The user perspective is, therefore, key in any evaluation of the functional performance of a building. An evaluation of food service system functioning, focusing on the user perspective, was adopted in this research methodology. Essentially, the technique adopted in the research was that of an enquiry into the match (or rather mis-match, since evaluation focused on the identification of functional *deficiencies*) between people (users) and the buildings they use (hospital food service systems).

In earlier research work in the general sphere of the construction product/process relationship, specifically that investigating the effectiveness of project organisational structures, researchers have had to develop techniques to measure project success.

According to Walker, this particular aspect of the research was complicated because,

"The major problem of evaluating the effectiveness of any project organisation structure or any approach to designing organisations is that the success of the structure in achieving its objective can only be measured against the client's satisfaction with the completed project." (Walker 1989)

Although Walker (1980) and Hughes (1989) adopted different approaches for assessing client satisfaction, both ultimately resulted in the conversion of subjective data into numerical scores. Walker developed a mathematical vector analysis approach to the measurement of a client's satisfaction with a completed project, whereas Hughes' assessment of client satisfaction was based on a broad brush post-occupancy evaluation of the construction project.

For the purposes of Walker's research, client satisfaction was measured against the three criteria or "components of client satisfaction" : function, time and price. These components were readily perceived by the clients of industrial projects in Walker's research, as having relevance to privately developed projects conceived to enhance the performance of the company. In other words, the clients expected that they would be fully satisfied with the functional efficiency of the building, that it would be completed on time and that the price they had to pay would be the price which they had expected to pay (for example, price as it related to building costs at tender stage). Identifying methods of measuring clients' perceived satisfaction against these different criteria was an important aspect of the vector analysis approach. This approach relied on clients placing their subjective judgement of satisfaction for each component, with the outcome of the completed project, on a scale of one to five. The lower the value, the lower the satisfaction. A limited scale was chosen because of peoples' limited ability to accurately choose a ranking from a wider scale (Walker and Wilson 1983).

The necessity to develop a more comprehensive evaluation framework and technique for use in public sector project research resulted in Hughes' development of a post-occupancy evaluation approach based on a three dimensional evaluation framework. Like Walker, Hughes recognised that any analysis of a construction project organisational structure had to be related to the level of success achieved by the project. Hughes' development of a three dimensional framework for measuring project success seemed to provide a systematic technique for appraising the level of project success within the construction industry. The three dimensions of success were:

(1) The viewpoint of the person making judgements;

(2) The point in a building's life when a judgement is being made;

(3) The criteria by which the judgement is being made.

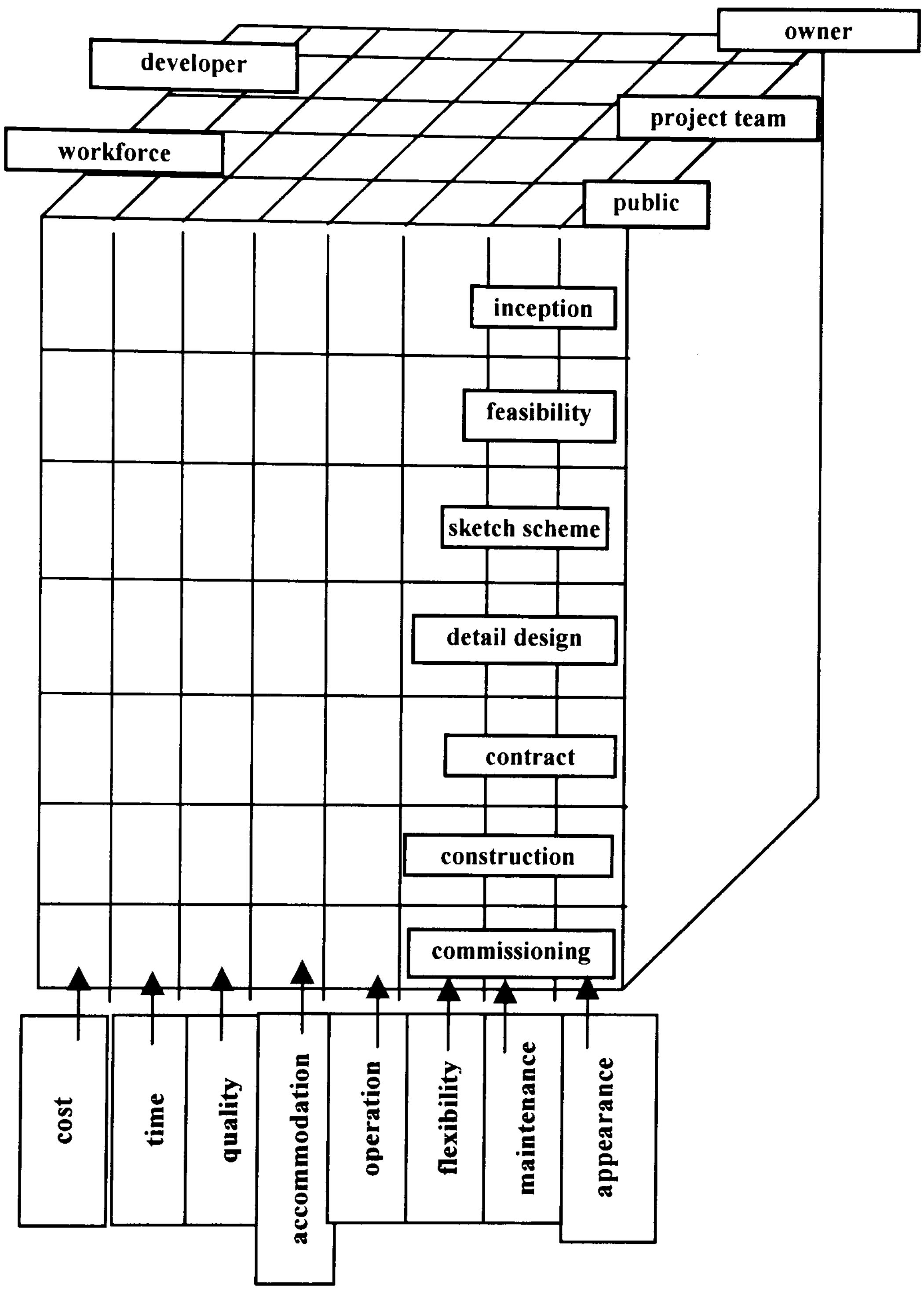
This three dimensional framework provided the basis for sorting out the relative weighting of different opinions of the success of different projects and from this a post-occupancy evaluation could be made. Hughes recognised that different perceptions of success would arise from the different position of the individual's point of view, i.e. perceptions of the owner, project team, workforce and other building users would all be different and all be valid. Since Hughes' work centred around analyses of building projects for public sector clients, the need to recognise these different viewpoints was paramount because of the difficulties in pin-pointing the client to one particular person or group of people.

Hughes also recognised the role that the progression of time has in changing peoples' perceptions of buildings. There is a need to take into account these perception changes due to the passage of time and physical building changes. Hughes' criteria for success were based on the part of his model that proposed that the project objectives arise from the environment, and should be used for a proper assessment of success. This meant that the criteria used to measure success had to fit into the Micro-environmental factor categories (such as legal, financial, policy, etc.) Within these main groups, Hughes suggested there could be many other possible sub-divisions, which should be made for each project, as appropriate. For the purposes of Hughes' work, he considered that evaluation of the project on completion would be sufficient to shed light on the relative adequacy of the project's organisational structure/management process. In Hughes' case studies, the relative success of different projects was ascertained by conducting the evaluations at the same stage in each project's life. Hughes' post-occupancy evaluations gauged the perceptions of contributors from all categories of viewpoint so in effect an analysis from one whole slice of the matrix was carried out, as depicted in figure 2.8. Hughes' Post-occupancy evaluation data was collected using a questionnaire that elicited responses on the performance aspects of function, environment, operation and time. Respondents were required to score their satisfaction on a five point scale ranging from "unacceptable" to "excellent". By applying certain arithmetical calculations, a weighted average satisfaction level (single numerical mark) was derived for each of the four areas of performance which were then further reduced to give a single score of success for a project.

Although Walker obtained useful results using the mathematical vector analysis method, it remains a very crude measure of client satisfaction and gives no indication of specific functional problems in the final building solution. There are also difficulties in using this method because, depending on which part of the client group is assessed, measurements on this scale can be very diverse. The project team, owner, workforce and other building users will each have their own views on how they perceive the success of the product in terms of function, price and time. Objective assessments for time and price performance indicators are much easier to devise than objective assessment of criteria such as function. However, as far as function is concerned, it is the users who are most familiar with building use on a day to day basis and can provide the most informed opinion of functional problems at the level of the building/user interface. The need to concentrate on users, as the most reliable indicator of functional problems legislated against Walker's quantitative vector analysis approach.

Figure 2.8 Matrix for Building Evaluation

from Hughes (1989)



Hughes' 3 dimensional framework technique for evaluating project success was much more rigorous than Walker's measurement of client satisfaction, which consisted of only the three aspects of time, cost and function, with opinions elicited only from the project team and client. However, the main drawback to Hughes' post-occupancy evaluation technique is that too much emphasis was placed on reducing subjective data (obtained by ascertaining individual's reactions to a building) to a single figure to be used as a measure of project success. Clearly, to facilitate comparisons of a number of different projects, the use of a single number to symbolise the total success of a building or construction project does have some merit. However, aggregating a range of scores for several different performance aspects has the disadvantage of obscuring potentially significant differences.

As the focus of the current research was on the identification of cause and effect for particular functional problems, rather than the overall comparison of project success, the reduction of quantitative data was not an appropriate approach.

According to Walker (1989), the major problem of evaluating the effectiveness of any project organisational structure, or any approach to designing organisations, was that the success of the structure in achieving its objective could only be measured against the client's satisfaction with the completed project. In terms of building function, it is suggested that the user group part of the client organisation can provide the most accurate information, since it is the users who experience the every day practical problems of buildings and their sub-systems. For example, in terms of hospital provision, there are many different user groups, each having detailed knowledge and experience of particular aspects of hospital functioning. The patient is the most knowledgeable user when any issues relating to patient comfort are considered, e.g. the location of the bedside locker or ward toilets etc. The part of the research methodology which assessed the *product* of the construction project procurement process was based upon a multi-user group assessment of the building/user interface. Specifically, analysis of building function focused on deficiencies identified by user groups involved with food service system operation.

2.5.4.2 *Post Occupancy Evaluation and Assessment of Food Service System Functioning*

A review of the literature relating to evaluation of hospital food service systems, and post-occupancy evaluation tools generally, provided a starting point from which to develop a user-oriented evaluation methodology. Much of the work which has been conducted in relation to assessment of food service system functioning has been undertaken in the USA.

Essentially, Matthews (1982) suggested that informed decisions cannot be made during planning when the ultimate effects of meal assembly, distribution and service processes on the quality of menu items are largely unknown.

Most of the research concerning evaluation of patient food services has been carried out by investigating patients' perceptions of meal acceptability. A paper by Cardello (1982) provided the detailed methodological approach necessary for such studies. Research by Dahl

(1982) in this area highlighted the effects of meal assembly, distribution and service on the sensory quality of food as perceived by patients. Evaluation studies tended to concentrate on functional efficiency in terms of financial, manpower and performance criteria without relating these to users' satisfaction with the food service system [Unklesby and Balsley (1979), Waters (1979), Mottishaw (1979) and Lewis (1979)]. Studies, such as that, undertaken by Turner and Waters (1979), and sponsored by the DHSS, have attempted to investigate patient and *staff* attitudes to hospital food. This study focused on staff perceptions as consumers of food. What it did not do, was to identify staff involved in the operation of the food service system, specifically that for patients, and gauge their views on system performance, i.e. it did not give staff involved in food service system operation the opportunity to identify problems with user activity interface with the system. Information obtained in such a way would have complemented the data provided from the consumer's viewpoint. It would have provided the means to trace the possible causes of consumer dissatisfaction to system functioning. This was an important element of the post-occupancy evaluation approach adopted in the current research. Within the NHS, there is no systematised evaluation methodology which can be used to gauge different user groups' satisfaction and perceptions of hospital in-patient food services and compare these across hospital developments.

The Best Buy Hospitals (Mark 1) Catering Department Evaluation Report contained a detailed critique of the hospitals' catering department design but was limited to observations made by the architect, engineer and catering adviser - hardly a comprehensive and holistic evaluation, since the criticisms they made of the food service system were not related to a survey of different user groups' perceptions of, and satisfaction with, the service (DHSS, 1980).

Assessments of food service system functioning which have taken into account the views of different user groups are rare. Research by Blakemore et al (1980), on the implementation of a new food service system in a district general hospital, did evaluate staff attitudes towards the new system. However, this was limited to seeking catering staff opinions only and focused on employee job satisfaction rather than performance of the system itself.

Though the following statement appears to be a very simplistic approach to measuring food service system performance it does, nevertheless, highlight the importance of the role of the user in determining functional success,

"The test of a well planned kitchen is the ease with which members of the catering staff can perform their duties, be it the catering officer or the kitchen porter. Staff who can work without getting in the way of their colleagues or thoughtlessly placed pieces of equipment, will work more efficiently and end the day without feeling the frustrations caused by "it was the only place to put it syndrome." (Anonymous 1973)

Essentially, the objective of this part of the research methodology was to carry out a functional evaluation of the kitchen and the other associated components of the food services sub-system, based on the knowledge of the different user groups that are involved with system functioning. Identification of problems, by reference to user groups, would indicate the existence of unsatisfactory aspects of the building relating to functional problems.

2.5.4.3 *Evaluation Approach Adopted for the Current Research*

2.5.4.3.1 *Development of User-Focused Questionnaires*

Escueta's (1986) food service configuration model was used in the current research to assist in identifying the three main areas which had to be targeted in an assessment of in-patient food service system functioning. Earlier work, such as that by Franzese (1981) and Matthews (1982), also focusing specifically on hospital food service systems, adopted similar methods to that of Escueta for characterising hospital food service systems. These classification, or configuration systems, are based on describing the steps which menu items follow, beginning with the initial purchase and preparation of food, through to service of menu items to patients. Escueta's classification system is particularly useful as it provides the most comprehensive differentiation between *all* forms of in-patient food service provision by determining the absence or presence of six component activities (central to the function of all hospital in-patient food service systems) and whether these activities are carried out in bulk or individual mode. These six activities are described briefly below:

Purchasing : This refers to the activity which procures materials which are consumed or are processed and result in a finished product;

Manipulation : This is sometimes referred to as preparation or pre-preparation and refers to those activities where food material is mechanically altered in preparation to actual cooking or processing;

Processing : This refers to the actual production activity where the food is chemically and/or physically altered to arrive at a specific menu item;

Preservation : This refers to the processes where the cooked or processed food item is subject to an environment which will remove one or more of the basic conditions that will cause spoilage, deterioration or decay of the menu item, e.g. freezing and chilling are the most prevalent food preservation techniques used by the hospital food service industry;

Reheating : This refers to reheat or rethermalisation; the food in the frozen or the chilled state is reheated to a specific temperature to render it edible;

Distribution : This refers to the activities whereby the food is assembled into individual patient or serving trays, moved from the food service processing or storage facility to the general patient or staff serving area and then served to the individual patient.

The first four activities of Escueta's model generally occur in the production unit/kitchen/catering department of the food service system. The fifth activity, reheating, occurs either in the production unit or in satellite units located elsewhere in the hospital. These are usually referred to as ward kitchens/pantries or floor supply kitchens, depending on how many wards they serve and where they are located. The final activity, distribution, is an activity which can be split into two parts. The first involves the bulk transport of the food to the service point and the second involves distribution of individual menu trays to patients at the point of service; this is usually the ward. Therefore, in conducting an assessment of food service system functioning, there are basically three areas which must be targeted. These are the central production unit; transportation system; and service loci (this includes ward kitchens and patient dining accommodation). Generally, different user groups operate in each different area so only an assessment which encompasses all the user groups will provide the most accurate indication of food service system functioning. The Catering Manager is able to provide the best overview of the whole service, but to avoid the presumption that there is a perfect match between actual operational policy and grass roots operation in the kitchen, on the wards and across the transportation system, it is essential to confirm managers' perceptions of function against the experience of user groups, since it is the user groups which have a greater practical understanding of the building in use.

The starting point for development of a technique to elicit information on aspects of food service system functioning was in the identification of the user groups most heavily involved in the three component areas of food service function. In each of the three project contexts, the following user groups (refer to table 2.2) were associated with the three component areas of food service.

Table 2.2 User Group Association with the Three Component Areas of Food Service Function

Project	Component		
	Production Unit	**Transportation System**	**Service Loci**
Longitudinal Project C	Catering staff	Portering staff	Patient
			Domestic staff
			Nursing staff
Retrospective Project A	Catering staff	Catering staff	Patient
			Domestic staff
			Nursing staff
Retrospective Project B	Catering staff	Portering staff	Patient
			Domestic staff
			Nursing staff

Self-report questionnaires were chosen as the method through which to elicit user information on aspects of food service system functioning. The decision to use self-report questionnaires was influenced by the following factors:

(1) The need for a data gathering instrument that would minimise intrusion into staff time: staff could complete the questionnaires when it was convenient for them;

(2) The need for a data gathering instrument that would minimise intrusion for patients;

(3) The advantage of the questionnaire over other more qualitatively based methods, such as focus groups and individual interviews, was that self-report questionnaires enabled a relatively large number of users to be targetted and provided comparable data;

(4) Given the limitations on time and resources available for fieldwork (and the potential costs for participating hospitals), self report questionnaires were the most pragmatic method.

Hospital patient food service evaluations have commonly used self-report questionnaires for data gathering from the patient's perspective. Various examples of such survey methods can be found in: Maller et al (1980); DHSS (1980); Cardello (1982); Kipps and Middleton (1990); and National Audit Office (1994). Self-report questionnaires are also a recognised means of collecting data, generally, from user groups on building performance. For example, Kroner et al (1996) reported on the use of the Tenant Questionnaire Survey Method (TQSAM) to determine the worker's attitude to the workspace. The TQSAM is an instrument for measuring worker comfort and satisfaction based on occupant surveys using a standardised questionnaire. Thorne (1996) also reported on the use of a self-report questionnaire used as a fine-tuning device for newly designed office space. This particular survey instrument was influenced by Weidemann and Anderson's work (1985). Farbstein and Kantrowitz (1991) also employed questionnaire techniques on research for the US Postal Service.

Self-report questionnaires were designed for the four user groups most heavily involved in food service system functioning. For project A, questionnaires were targeted at: production unit catering staff; transportation system catering staff; service loci domestic staff; and patients. At project B, questionnaires were targeted at: production unit catering staff; transportation system portering staff; service loci domestic staff; and patients. At project C, questionnaires were targeted at: production unit catering staff; transportation system portering staff; service loci domestic staff; and nursing staff. It was the intention to gauge an assessment of food service system functioning from the patients' viewpoint at each hospital. This was achieved, except at the longitudinal project. Project C represented re-development of a mental health hospital. After discussions with hospital staff, it was decided not to survey the patients at this hospital. The reasons for preclusion of this user group were as undernoted:

(1) Advice from clinical staff was that the mental condition of some of the patients was such that they would not be unable to answer survey questions meaningfully (for example those with senile dementia, learning disabilities etc.). Other surveys on patients' opinions of hospital food service, for example the National Audit Office (1994), have also excluded these types of patients because of potential difficulties in their responding;

(2) Problems in gaining access to some patients, for example those in forensic, high security wards;

(3) The possible harmful impact that the survey might have on the wellbeing of patients with eating disorders;

(4) General issues related to patient anonymity and confidentiality required researcher sensitivity to the stigma of mental health problems.

Although patients' views were not surveyed at project C, those of nursing and domestic staff were and, since these groups were involved in service at ward level, it was considered that they would be able to provide some patient-related data. This was not an ideal situation since nursing and domestic staff are not patients, however, care staff in this situation are used to acting as advocates in many areas and, without being judgemental on areas of expertise outwith the scope of the research, they were best placed to speak for the patients. The project was still used, despite the need to take a different approach, because it was able to provide a different kind of user experience and, crucially, it was the longitudinal one which was able to provide the means for testing the validity of retrospective data collection for projects A and B.

Questionnaires were designed to reflect the area of the food service system that each user group was familiar with: it would be pointless to ask the patients what they thought about kitchen functioning. Although the questionnaires at each different project were relatively comparable, it was important to take account of particular differences between each of the different systems. Slight adjustments were made to the questionnaires (for catering and domestic staff) at project A to accommodate the large proportion of staff who did not have English as a first language. It was envisaged that particular problems would be pin-pointed by one or a combination of user groups by cross-referencing the data supplied by each user group. Additionally, a broad brush evaluation form, based on the functioning of the production unit of the food service system, was developed for completion by the catering user representative involved in food service planning (where this person was still employed at the project). This is shown in Appendix 7.

Tables 2.3 to 2.6 show the different question categories used as the basis for information retrieval on particular design and function aspects for each user group questionnaire. A review of the literature relating to hospital in-patient food surveys provided the information from which to select a number of pertinent areas for investigation in relation to patient-focused aspects of system functioning. There was little similar existing information relating to staff user evaluation of food service system functioning. Evaluations that have been conducted, for example Blakemore et al (1980), tended to focus on employee job satisfaction rather than performance of the system itself. Examination of questionnaire methods used in building evaluation, for example, Kroner et al (1996) and Thorne (1996) indicated several general dimensions upon which questions on food service system functioning could be based. These were: thermal comfort; air quality; noise; spatial comfort; and lighting. The design/functional aspects which were investigated were considered to constitute the most pertinent factors in relation to function of a food service system's three constituent components: central kitchen; transportation system; and ward kitchen function.

Not all user groups which were involved in food service system functioning at each of the projects were incorporated into the evaluation. Table 2.2 indicates which user groups were surveyed. Staff that had limited input into food service provision were not included in the post-occupancy evaluations: nursing staff at retrospective projects A and B were not involved in the evaluations. Similarly, dietetic staff, speech therapists and ward receptionists were not involved at any of the projects. It was considered that the assessments for each project incorporated the primary user groups contributing to food service system functioning.

The questionnaires were compiled using a variety of question types. In order to simplify data collation, the majority of questions were designed as closed multiple choice. Several open questions allowed users the opportunity to explain problems in further detail and highlight problem areas which specific questions had failed to pick up. The questions comprising the self-report questionnaires for retrospective project B are detailed in Appendix 6. Similar questions were utilised to devise the questionnaires for the other two projects. Figure 2.9 details the questions put to the kitchen and stores staff at project B.

Table 2.3 Question Categories for Patients and Nursing Staff (Project B)

	Question Number on Questionnaire		
Aspect of Design/Function	**Project C**	**Project A**	**Project B**
1. User group specifics, nurse type and grade, ward location : patient ward location	1,2	1	1
2. Familiarity and experience with patient food service system	3, 13	4, 32, 33, 34	4
3. Extent of nursing involvement in patient food service provision	4, 5, 8, 22	-	-
4. Importance of the patient food service system	6, 9	31	31
5. Meal delivery and service times	10, 11, 12	12, 13, 20	12, 13, 20
6. The dining environment for the patient at ward level	14, 15, 16	-	-
7. Special diets	18	2, 3	2, 3
8. Service flexibility and responsiveness	17, 33	-	-
9. Ordering meals	19	6	6
10. Problems with system functioning : accuracy, wastage and presentation	20, 21, 35	10, 11, 21, 22, 18, 24, 19	10, 11, 21, 22, 18, 24, 19
11. Cleanliness of crockery and cutlery	23, 24	14, 15, 16	14, 15, 16
12. Patient complaints	27	-	-
13. Nursing staff and ward kitchens	26	-	-
14. Working with other staff involved in food service	25, 30	-	-
15. Operational problems	7, 28	-	-
16. Specific likes and dislikes about the system	31, 32	-	-
17. Suggestions for changes and improvements and additional comments	29, 37	17, 36	17, 33
18. Summing up the patient food service system	36	32, 35	32, 35
19. Variety of meals	-	8, 9	7, 8
20. Food service staff	-	5, 7, 23, 26	5, 9, 23, 26
21. Addition and replacement of meals	-	27, 28, 29	27, 28, 29
22. Beverages	-	30	30
23. User group involvement in food services planning	34	-	-

Table 2.4 Question Categories for Transportation and Distribution Staff (Project B)

Aspect of Design/Function	Question Number on Questionnaire		
	Project C	Project A	Project B
1. Involvement of portering staff in patient meal transportation and distribution	1,2	1,2, 3	1, 2, 3
2. Transportation time	3	4,5,6	4, 5, 6
3. Difficulties in transporting food to a particular ward	4	7	7
4. Transportation route and vehicular transportation of meals	5, 6, 7	8	8, 9, 10
5. Internal transportation of meals	9, 10, 11, 16, 17, 18	9, 10, 11, 17, 18	20, 21
6. External transportation of meals	19	-	12, 13
7. Specific problem areas either external or internal	8	-	11
8. Location of catering department with respect to food transportation around the site	12, 13	12	14
9. Access to and egress from the catering department	14, 15	13	15, 18, 19
10. Transportation of food in lifts	20	19	22
11. Additional comments and suggestions for change	21, 22, 25	22, 20	25, 23
12. Effect of transportation on meal quality	23	21	24
13. Space for loading and unloading food trolleys	-	14, 15	16, 17
14. Food trolley manoeuvrability	-	16	-
15. User group involvement in food services planning	24	-	-

Table 2.5 Question Categories for Domestic Staff (Project B)

	Question Number on Questionnaire		
Aspect of Design/Function	**Project C**	**Project A**	**Project B**
1. Familiarity with ward kitchen usage	1, 2, 3, 4	1, 2,3 4, 5	1, 2, 3, 4
2. Ease of and satisfaction with working in the ward kitchen compared to first working there	6, 7, 8	6, 7	5
3. Purpose of ward kitchen and domestic activities	5, 9, 16	15, 8	12, 6
4. Problems in the design of the ward kitchen which hinder work	10, 11, b, e, f, n, o, p	9, 10, b, d, e, k, l	7, 8, b, e, f, m, n, o
5. Physical attributes	a, c, d, g	a, c, f	a, c, d, g
6. Physical working environment of the ward kitchen	h, i, j, k, l, m	g, h, i, j	h, i, j, k, l
7. Likes and dislikes in the ward kitchen and additional comments	14, 15, 18	13, 14, 16	11, 12, 14
8. Necessity for changes to the ward kitchen	12	11	9
9. User group involvement in food services planning	17	11	9

Table 2.6 Question Categories for Catering Staff (Project B)

Aspect of Design/Function	Question Number on Questionnaire		
	Project C	Project A	Project B
1. Staff grade and association with activities and kitchen areas	1, 2, 3	1,2, 3	1, 2, 3
2. Familiarity with new kitchen	7, 8	6	5, 6
3. Ease of and satisfaction with working in the kitchen compared to first working there	4, 5, 6	4, 5	4
4. Importance of food service system to patient's health and welfare	9	7	7
5. Problems in the design of the kitchen which hinder work	11, 12, b, e, f, o, p	9, 10, b, d, e, o, p	9, 10, b, d, e, m, n
6. Physical attributes	a, c, d, g	a, c, f	a, c, f
7. Physical working environment of the kitchen	h, i, j, k, l, m, n	g, h, i, j, k, l, m, n	g, h, i, j, k, l
8. Trolley loading and unloading space	17, 18	-	-
9. Likes and dislikes in the kitchen	15, 16	13, 14	13, 14
10. Transportation of food in lifts, effectiveness of system functioning, suggestions for improvement and additional comments	10, 13, 20, 21	8, 15, 17, 11	11, 8, 15, 17
11. User group involvement in food service planning	19	16	16

Figure 2.9 Questions Used for Catering User Group Evaluation of Central Kitchen at Project B

1. What is your job title?
2. Briefly, list the main activities you do in the catering department.
3. Here is a list of general areas in a catering department. Number these places according to how much time you spend working in them. For example, if you work mainly in the pot/dish wash area, then label this box with a number 1. If you spend some other time in the preparation and cooking areas then label this with a number 2. Areas that you spend very little time working in number with a 0.
   Response options: Pot/dish wash area; Staff restaurant; Preparation and cooking areas Main stores; Trolley unloading and cleaning area; Offices; Meal plating and trolley loading area.
4. Has your overall satisfaction with the new catering department premises changed since you started working in it?
   Response options: Satisfaction has not changed; Less satisfied; More satisfied.
5. Did you work in the old kitchen immediately before transferring to the new catering department?
   Response options: No; Yes.
6. If you answered, NO to question (5), can you tell me approximately how long you have been working in the new catering department?
7. Do you consider the role of the catering department to be important to the patient's health and welfare?
   Response options: Very Unimportant; Fairly Unimportant; Neither Important nor Unimportant; Fairly Important; Very Important.
8. Do you think the system of patient meal service works,
   Response options: All of the time; Most of the time; Half the time; Some of the time; Never.
9. In your opinion, are there any problems in the design of the catering department which hinder your work?
   Response options: Yes; No; Don't know.
10. If you answered YES, to question (9), please explain what the problems are and how they affect your work.
11. Only tick ONE of the statements to complete the following sentence,
    Based on your knowledge and work in the catering department would say that,
    Response options:
    It requires major changes in operation to satisfy functional requirements;
    Minor adaptations or modest additions to the building structure and/or equipment is essential to provide an adequate functional standard;
    It provides a good total environment for functions for which it is used;
    Minor adaptation to its operation is essential to provide an adequate functional standard;
    It requires major equipment and/or building changes to satisfy functional requirements.

Figure 2.9 Questions Used for Catering User Group Evaluation of Central Kitchen at Project B (continued)

12. Below are some statements. Please CIRCLE the answer which best matches your opinion of the catering department.

(a) Space in the catering department is...
Response options: Inadequate; Satisfactory; Ample.

(b) Physical relationships between spaces, equipment and different work areas enables me to do my work in the catering department...
Response options: Easily; Adequately; With difficulty.

(c) The physical relationship and location of the catering department to the rest of the hospital is...
Response options: Bad; Satisfactory; Good.

(d) The general shape and layout of the catering department affects work flow...
Response options: Positively; Not at all; Negatively.

(e) Equipment in the catering department is located in such a way that I can operate it...
Response options: With difficulty; Adequately; Easily.

(f) Doors, windows and cupboards in the catering department are positioned...
Response options: Conveniently; Inconveniently.

(g) Cooking smells in the catering department are...
Response options: Intolerable; Tolerable; Not noticeable.

(h) The temperature in the catering department is...
Response options: Mostly too cold; Mostly about right; Mostly too hot.

(i) The ventilation of the catering department is...
Response options: Good; Satisfactory; Bad.

(j) Lighting in the catering department is...
Response options: Bad; Satisfactory; Good.

(k) Natural light from the windows in the catering department is...
Response options: Sufficient; Insufficient.

(l) Noise in the catering department is...
Response options: Intolerable; Tolerable; Not noticeable.

(m) The general design and layout of the catering department makes work activities...
Response options: Flexible; Rigid.

(n) The general design and layout of the catering department makes it possible to achieve food hygiene standards...
Response options: With difficulty; Satisfactorily; Easily.

13. What aspects do you LIKE MOST about the catering department? If none, write NONE.

14. What aspects do you DISLIKE MOST about the catering department. If none, write NONE.

15. What changes would you like to make to the design or operation of the catering department to improve the method of patient meal production and delivery?

16. If you were here at the time the new catering department was being planned and built, were you involved with any decisions relating to the design or operation of the catering department and food services?
Response options: Yes; No; Don't know; Wasn't here.

17. If you would like to make any additional comments about the new catering department and the service it provides to patients, please add them here.

2.5.4.3.2 *Implementation of User-Focused Questionnaires*

The nature of the different case study project contexts, and the different liaison mechanisms which developed in relation to the research, required different approaches to be adopted in terms of user-group questionnaire implementation.

With regard to patient questionnaires, at projects A and B, blank forms were supplied to the nurse in charge at each participating ward. Ward nursing staff were asked to distribute the questionnaires to patients. A collection box was left on each ward for the patients to post the completed questionnaires. These were collected on a regular basis and fresh supplies also provided to nursing staff. Therefore, calculation of a true response rate was not possible as there was no control over, and no accurate record kept by nurses of, the number of questionnaires they distributed. An estimated response rate was calculated on the basis of the number of questionnaires distributed to nursing staff, and the number of returned completed questionnaires. Thus, for retrospective project A, a response rate of 74% was calculated (156 distributed and 115 returns). For retrospective project B, a response rate of 48% was calculated (454 distributed and 218 returns).

At longitudinal project C, where nursing staff rather than patients were surveyed, the questionnaires were distributed to nurses through nurse managers. There were similar problems in calculating a true response rate from nurses, however, it was assumed that nurse managers issued all questionnaires forwarded to them. An estimated response rate of 65% was calculated (75 distributed and 49 returned).

In terms of the other user groups (domestic, portering and catering staff), the relevant line managers distributed questionnaires. Again, it was not possible to obtain a true response rate as it was not known whether, and how, all questionnaires were distributed by managers. Generally, the returns from these user groups were poor; the greatest response rates were from retrospective project B, refer to table 2.7.

It was not possible to estimate a response rate for the transportation component (portering staff) or central production unit (catering staff) for retrospective project A. This was due to the fact that the catering staff also fulfilled duties in relation to food transportation and distribution. Fifty questionnaires were distributed to catering staff: five were returned relating to food transportation and distribution; four were returned in relation to central kitchen function.

Table 2.7 Questionnaire Response Rates for Domestic, Portering and Catering Staff

Staff / Project	Domestic			Portering			Catering		
	Out	Ret	%R	Out	Ret	%R	Out	Ret	%R
Longitudinal Project C	50	29	58	7	2	28	40	17	43
Retrospective Project A	30	11	37	50	5	-	50	4	-
Retrospective Project B	50	30	60	12	9	75	40	9	22

As it was not known what ratio of catering staff were involved in transportation and distribution, and whether these staff were also involved in general catering duties, it was not possible to calculate response rates for these.

The response rates for staff at retrospective project A were particularly poor. This was perhaps, partly attributable to two factors: firstly, a large proportion of staff were familiar with English only as a second language and might have had difficulty in completing the questionnaires. Secondly, the timing of the user-group evaluations coincided with a review of the in-house catering contract. Although no formal decision had been reached, it was possible that the catering services contract would be awarded to an external commercial organisation. The political sensitivity surrounding catering services at that time might have had an impact on the catering staff response to the questionnaire.

For all three projects, the different user group evaluations were run concurrently over a two week period. For the longitudinal project, post-occupancy user evaluation was undertaken approximately six months after food service commenced from the new phase 1A catering department. For the two retrospective projects, the post-occupancy user evaluations were undertaken approximately 18 months after food services had become operational.

2.5.5 Selection of Case Studies

Identifying possible definitions of quality, as applied to contruction project performance (refer to Chapter 3, section 3.2.1 Quality as a Measure of Project Performance), assisted in categorising the different types of deficiencies that were elicited through the building function analyses. Those deficiencies arising from operation and design mis-matches (functional deficiencies) formed the case studies. Whilst other problems identified from the post-occupancy evaluations were equally significant to the users, they were beyond the scope of the investigation. These were problems that could be considered to have been largely brought about through the following:

(1) Poor workmanship

For example, poorly laid floor tiles in phase 1A catering department in project C.

(2) Incorrect translation of specifications

i.e. the contractor did not complete the job as specified in design drawings.

For example, incorrect floor screeding, in the trolley wash area in the phase 1A catering department of project C, would not allow water to drain towards a central floor drain;

(3) Lack of time for commissioning

Pressure of time forcing facilities to open with inadequate commissioning.

For example, the staff/visitor/patient dining area, in phase 1 of project C, opened with no crockery.

(4) Existing deficiencies

That is, the solution adopted was affected by existing structural/design deficiencies that could not be rectified.

For example, the sloping corridors and unreliable lifts in parts of the existing accommodation at project B.

(5) Problems in system administration

For example, poor communication between staff groups involved in food service system functioning.

Chapter 5 details all the problems that were identified through post-occupancy evaluation of the project contexts' food service systems. The functional deficiencies (case studies) were identified by one or more of the different user groups related to the three components of the food service sub-system (central production unit, distribution system and service points). Analysis of these functional problems are considered fully in Chapter 5. Although post-occupancy user evaluation data was generated from a variety of user groups, including patients, and in one case nursing staff (project C), the problems elicited through these two groups were not, in themselves, identified as functional problems (operational/design mis-matches). However, in many instances, the problems identified by the ultimate end users could be linked to other problems, often in quite complex relationships. For example, food wastage could be attributed to a number of factors related to transportation/delivery problems and ineffective system administration. In some cases, mis-matches between design and operation did have an ultimate negative impact on patients. In particular, refer to Chapter 5 (section 5.5.3.6 Retrospective Project A: Inadequate Space and Rigidity of Work Activities in Central Kitchen and Inadequate Space in Phase 1 Ward Kitchens) of this thesis in relation to the use of the day/dining room rather than the ward kitchens for the service of food at project A.

2.5.6 Mapping the Project Procurement Process

In order to investigate the relationship between building design and operational planning during the project procurement process, client project files (from which the case studies were drawn) were examined in order to compile detailed information on the roles, responsibilities and relationships of project contributors in relation to component project activities and decisions. A project diary was built up for the three case study project contexts detailing: key items of communication between project contributors; the outcome of key meetings related to project development; the content and influence of key reports on decision-making. The project diary was useful in establishing the extent and duration of project contributors' involvement in the project in relation to the seven project stages and their component Operations.

Interpretation of the project diary, which is in essence a historical record of the project, enabled a set of "3R" charts to be constructed for each of the three case study project contexts. The 3R charting technique developed by Hughes (1989) was synthesised from previous work by Walker (1980) on Linear Responsibility Analysis (LRA). Walker's LRA technique was, in turn, evolved from previous research work by, primarily, Burns and Stalker (1966), Lawrence and Lorsch (1967), Thompson (1967) and Cleland and King (1975). The original development of the Linear Responsibility Charting technique, by Cleland and King, arose from difficulties in application of traditional organisation charts; one of their main criticisms being that such charts only showed authority relationships, providing rather simplistic graphical portrayals rooted in the traditional school of organisation theory. Cleland and King (1975) noted, in particular, that the primary disadvantage of using traditional organisational charts was in the enormous quantity of additional text needed to fully describe an organisation's structure. This was usually incorporated in organisation manuals, which accompanied the charts. As Cleland and King (1975) stated, this made it impossible to undertake a meaningful structural analysis due to the problems of semantics in the organisational manuals. The main advantage of the 3R charts, over prior work, was that the same information could be presented in a more concise, clear and easily understood format and they are not cluttered by a high level of detail.

The 3R charts relating to the three case study project contexts are detailed in Appendix 5. An example of a 3R chart, derived from the current research, is shown in figure 2.10. Only data related to foodservices planning was sourced, since this particular aspect of the projects' development was the focus of the research. Essentially, the 3R charting technique, depicts in a relatively accessible format, the evolutionary pathway of the solution for food services planning.

Figure 2.10 Example of a 3R Chart

Retrospective Project A Stage 3 : Sketch Design → {4} → [5] →[6] → {7} – Decision {} Operation [ ] Sequential → Reciprocal ‖ **1972-1976**	Project Steering Group	Project Team	Project Manager	Planning Officer	Catering User Representative	Dietetic User Representative	Engineering Services Officer	Architect
4. Food services, including staff catering, included as a phase 1 priority	* → ✓	→	⇒ ↔ ↑					
5. Outline sketch plan of catering department for phase 1			⇒ ⊕		⇒ →			* ↔
6. Sketch plan viewing of catering department			⊕	↔ ↓	*	→	→ ⇒	→ ✓
7. Review of catering accommodation schedules	*	✓	⇒ ↑		→ ↑			

Key:

Operating system
* Operating
+ Co-operating
→ Consulting
⇒ Input
> Receiving

Control system
= Resourcing
⊕ Monitoring
↓ Supervising

Managing system
↔ Co-ordinating
O Directing
↑ Recommending
✓ Approving

The 3R chart is a matrix, with Operations described down the left-hand side, job positions specified across the top and the role symbols (with a key explaining their meaning) displayed at the intersections. The "3Rs" represent the roles, responsibilities and relationships which the 3R chart displays in graphical form. Figure 2.6 gives a definition for each of the role symbols specified in the 3R chart. For any Operation, or decision point, those contributing to that particular work package can be identified, and the nature of their input determined. As detailed in Hughes' (1989) work, the relationship between a contributor and an Operation is referred to as the contributor's role. There are a variety of such roles, and they may be combined for a particular contributor. They will be determined by the contributor's skill and ability and the purpose of the contribution being made.

Each Operation is related to the other through a precedence diagram at the top left-hand corner of each chart. The precedence diagram is important in showing the overall relationship between decisions and Operations and their sequence, i.e. whether they are reciprocally or sequentially organised. Decisions are represented in curly brackets, with Operations depicted in square brackets. The numbers in the brackets in the precedence diagram relate to the numbered Operations running down the left-hand side of the chart.

For each of the three different projects, a 3R chart is compiled showing the data for each stage of the procurement process: inception; feasibility; sketch design; detail design; tender; construction; and commissioning. Where data exceeds what is possible to depict on one side of A4 paper, the chart may run on to two or more pages, for example in Appendix 5, the 3R chart shown as table 5.17 runs to three sides of paper.

2.5.7 Analysis of the Project Environment

2.5.7.1 *Review and Critique of Previous Approaches*

In order to analyse a construction project procurement process, it is vital to obtain some kind of assessment of the environment in which it works. Since an "open-systems" view is adopted in this research, the construction procurement process cannot be considered in isolation: there are many transactions between the project and its environment. Since the process of providing a building is a response to the actions of the environment, then it is clear that the following is a natural assumption;

> ***"Environmental influences will be acting directly upon the client's organisation and should determine the organisation structure and mode of operation appropriate to the client's activities."*** (Walker 1989)

The environmental forces which act on an organisation can be very complex, yet a comprehensive understanding of the functioning of an organisation is not possible without a constant study of the environmental forces that impinge on it. The current research accepts Walker's (1989) view that the environment could act in two ways on the process of providing a project: indirectly, upon the client's normal organisational activities and directly, upon the process of building provision itself. For example, in the former case, the client may be a Regional Health Authority involved in the provision of a new district general hospital. Changes in statutory fire safety regulations may require the client to make changes in the proposed building during the design or construction stages. Thus, environmental forces acting on the client's organisation have become indirectly transmitted to the process of building provision. In the latter case, industrial action within the construction industry could produce a labour shortage which would inevitably delay building provision. There are a potentially vast number of environmental influences which can act on the construction project procurement process. With regard to this Walker noted that,

> ***"A system's environment consists of all elements outside the system that can affect the system's state,..."*** (Walker 1989)

These environmental forces can be classified in a number of ways. The relative importance of the various environmental forces and their impact upon the client's organisation and the process of construction varies between different clients and projects but the same types of environmental forces can be identified. Walker categorised these environmental forces under eight headings: political, legal, institutional, cultural and sociological, technological, economic and competitive. A more detailed account of these environmental forces can be found in Walker's (1989) work. Difficulties occur in environmental analysis because these individual environmental forces can be inter-dependent and create very complex environments. It is the complexity of the interaction of environmental forces and their level of activity upon a project which will determine the relative stability or instability of the climate in which the project exists. Indirect and direct environmental forces may act in a conflicting manner, in which case the project procurement process must reconcile any differences to the benefit of the client. For example, a contractor may wish to move labour from one site in order to increase the labour, and thus aid profitability, on another contract. This may put the completion of the building on time at risk, when the client's environment demands completion on time. The ideas developed by Walker stemmed from his visualisation of the process of construction as a sub-system of the client's system, therefore, the construction process is influenced by its own environment and also by the environment acting upon the client. In recognising that there was no easy or precise method of *quantitatively* assessing environmental forces and their impact on construction projects, Walker focused his assessment of environmental complexity on the following qualitative groupings:

(1) Certainty/uncertainty at the start of the contract;

(2) Certainty/uncertainty as the project progressed;

(3) Indication of the conflict identified within each project;

(4) Technical complexity: spatial, structural, services;

(5) Aesthetic complexity.

An example of Walker's environmental assessment can be seen in figure 2.11.

Figure 2.11 Example of an Environmental Assessment

modified from Walker (1980)

	PROJECT 1
Certainty/uncertainty at start of contract	Outline of functional and technical requirements known. Project formed part of a planned expansion programme.
Indication of the conflict identified within the project	Change in services engineering manager. Change in contractor's site agent. Shortage of bricklayers.
Technical complexity: spatial	Tight constraints on the relationships of areas. High level of specialist equipment. Relationship to existing facilities important.
Technical complexity: structural	Structurally difficult site. Variety of structures.
Technical complexity: services	Complex provision of specialist equipment. Ventilation and temperature control important.
Aesthetic complexity	Matching existing simple elevations.

In contrast to previous studies, Hughes' assessment of the project environment was based on a *quantitative* technique. This allowed Hughes to make a quantifiable connection between environmental complexity and organisational differentiation. One of the advantages of Hughes' numerical scoring method, over qualitative techniques, was that the technique was not solely dependent on the merits of the construction projects being analysed.

In attempting to define the environment in a more structured way, Hughes recognised the need to ensure that each observable environmental phenomenon should be capable of being classified into one or more generic groups of environmental forces. The groups that Hughes adopted for his environmental criteria, based on earlier views of environmental influences on projects, were: political; legal; institutional; cultural; social; technological; economic; financial; physical; aesthetic and policy. Some of these were common to those identified by Walker. Such environmental forces work at different levels but can be distinguished by their mode of action on either the immediate environment of the project or its wider environment. Previous researchers have made this distinction although it may not always be definite. Hughes (1989) adopted this approach for his model and used the terminology "Macro-environmental" to describe factors acting on all organisations and "Micro-environmental" to describe specific elements affecting organisations more directly. Hughes perceived the Macro-environmental factors as having a "soft" effect upon construction projects whereas he envisaged the Micro-environmental factors as the elements that surround and define a construction project. Figures 2.12 and 2.13 show in diagrammatic form the environmental concepts proposed by Hughes. The Micro-environmental factors could be visualised as acting as buffers between the project and corresponding Macro-environmental factors. The scheme originated by Hughes (figure 2.12) was not intended to be an exclusive relationship: one factor could not be described or analysed in isolation because of overlapping and inter-dependencies between the factors. The intention of the scheme was merely to identify predominant but not exclusive relationships.

Hughes suggested that the immediate environment of a project could be seen as consisting of five Micro-environmental variables (aesthetic financial, policy, legal/institutional, technological) each acting as a buffer to the five Macro-environmental variables. In this situation any influences from the Macro-environment, placing demands on the project would have to be "mitigated" (Hughes' terminology) through the utilisation of experience in the Micro-environment.

Figure 2.12 Hughes' Visualisation of the Project Environment

modified from Hughes (1989)

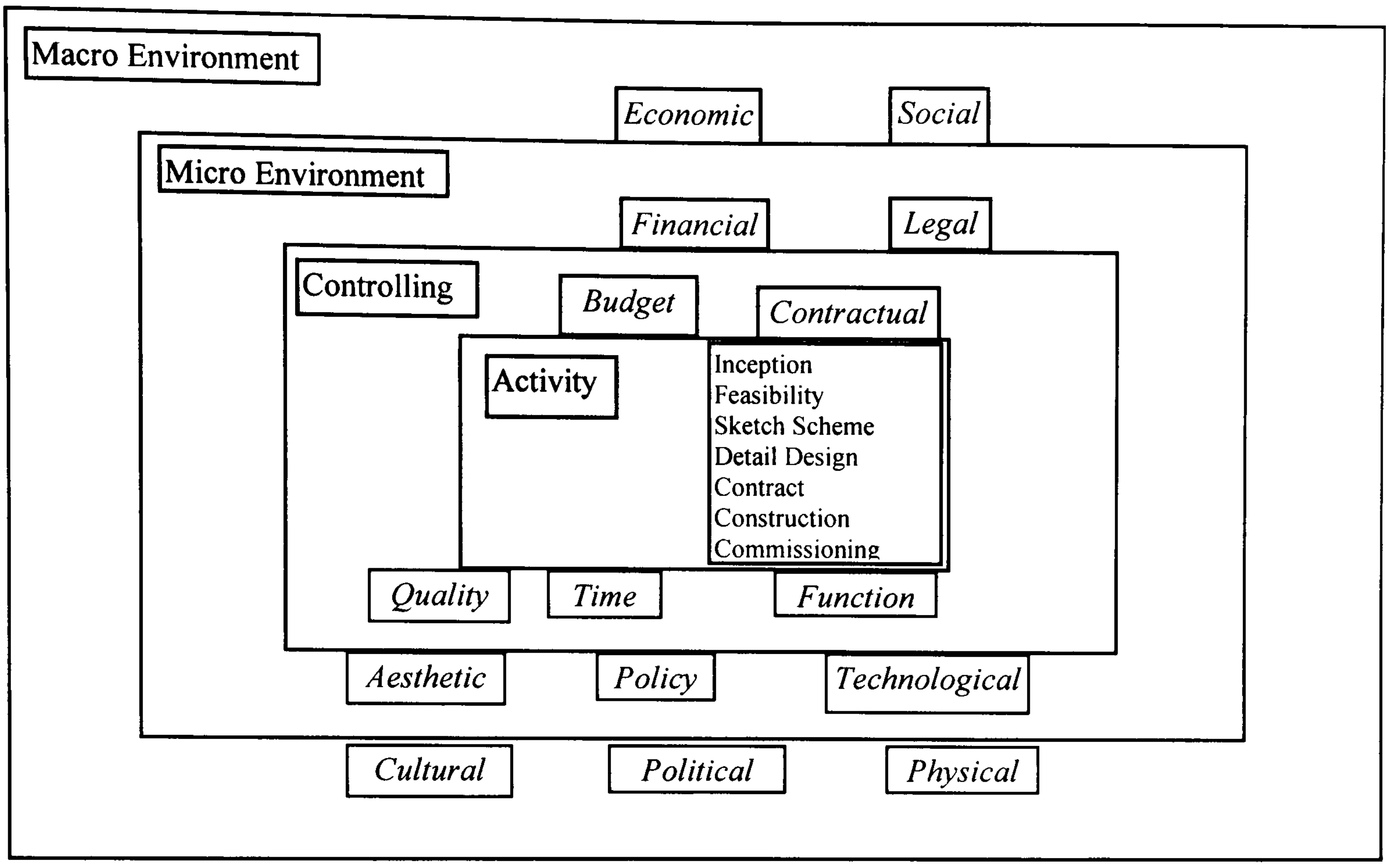


Figure 2.13 Macro and Micro-Environmental Factor Interaction

modified from Hughes (1989)

Macro Versus Micro-Environment

Macro-environment		***Micro-environment***
Cultural	⇔	Aesthetic
Economic	⇔	Financial
Political	⇔	Policy
Social	⇔	Legal/Institutional
Physical	⇔	Technological

The scoring system that Hughes developed for quantifying environmental complexity took into account interactions occurring in the five Micro-environmental elements which had to be analysed for each project. The environmental criteria are, however, subject to three different types of variability. According to Hughes this arises from the relative degree of

Definition of each environmental factor, its *Stability* and the ease with which it can be *Mitigated*. These variables are described fully in Hughes (1989).

In an ideal situation, in terms of Hughes' three variables, the environment would be "Defined", "Stable" and "Mitigable". However, this situation would tend to exist only for relatively simple and straightforward projects. Technologically complex projects, particularly those with complicated client bodies, are likely to incur difficulties through the varying effects of each environmental variable. In Hughes' environmental scoring system each type of influence was described in terms of both the nature and extent of its influence. These were then quantified in terms of the variables Definition, Stability and Mitigability. A score was assigned to each of the Micro-environmental influences for each variable, using a three point scale. An ideal state would score one (indicating that little attention to this aspect of the environment would be needed); the worst case scoring three (indicating a high level of importance) and an intermediate state would score two. An example of one of Hughes' environmental analyses is given in figure 2.14.

Each of the Micro-environmental factors was assessed and the scores for the three variables; Definition, Stability and Mitigability were added together. This produced a number out of a maximum of nine obtainable points for each factor. The five scores were then multiplied and the fifth root taken which gave the geometric mean. Hughes considered this a better reflection of the inter-dependence of the environmental factors than a simple arithmetic mean would have given. The geometric mean was then converted into a percentage by dividing by nine (the maximum score per factor) and multiplying by 100. This gave the Environmental Complexity Index (ECI).

The ECI developed by Hughes was used to investigate a particular aspect of construction project organisational design. In the context in which Hughes applied the ECI, it was of great use, but for the purposes of this research, *quantitative* analysis of the environment is not crucial. It is difficult to see how the quantitative method devised by Hughes could be applied consistently over a number of different projects. The quantitative method seems coarse and, without being tested against anything that offers a reliable indication of environmental complexity, it is difficult to see how this analysis offers a meaningful assessment of the environment. The Environmental Complexity Index is open to a large amount of subjectivity in its derivation. The subjectivity which is inherent in Hughes' technique can be seen by close inspection of an example of an environmental analysis. For example, in figure 2.14 the legal/institutional environmental factor has a total score of five, the qualitative description would infer that it appears to be a simple, uncomplicated factor.

The total for the aesthetic environmental factor was also five, yet qualitatively, this factor would seem to be much more complex and difficult.

In assigning figures to such qualitative statements about the environment, the experience and knowledge of the researcher should be borne in mind. Where such a small scale is used for assessment (one to three) there is a greater margin for error if the researcher is unfamiliar with environmental factors and environmental complexity surrounding construction projects. Although there is a only a three point scale used for scoring the three different environmental variables, different judgements by different people could result in very different scores for the same environmental conditions. This environmental scoring system does offer some kind of a common framework for describing the environment. An absolute quantification of environmental variables would be nearly impossible because of their inherent complexity and the degree of subjectivity involved in their assessment. The ECI is possibly best employed as a method of identifying potential problems which can then be followed through individually, not by comparing projects.

Neither Walker's nor Hughes' work could be applied directly to the current research as their environmental analysis techniques were both too broad and did not approach the level of detail required for investigating specific functional problems at the building/user interface. In order to relate functional problems to the procurement process it was important to identify the timing of environmental pressures, in relation to the timing of project activities. Although Hughes' and Walker's approaches afforded a general analysis of project environment, neither method attempted to pinpoint the periods during the procurement process at which environmental pressures impacted. Like Walker's work the environmental analysis, for the current research, is based on a qualitative approach but also relates the identified environmental pressures to specific periods during the procurement process. This aproach was essential in analysis of cause and effect of deficiencies in building function.

Figure 2.14 Example of Hughes' Environmental Analysis

from Hughes (1989)

Environmental Factor	Def	Sta	Mit	Tot
LEGAL/INSTITUTIONAL: English law applied. Well known Standard form of Contract was used. Familiar Conditions of Engagement for external consultants. Each consultant had a counterpart in the Health Authority for liaison.	1	1	3	5
TECHNOLOGICAL: The solution adopted involved non-traditional materials, some of which had to be imported from the continent. There was a very high services content for specialist equipment	1	2	3	6
FINANCIAL: Cost limits for the project were clear, but were subject to some changes over the years.	1	3	3	7
AESTHETIC: The design was aesthetically adventurous using large expanses of smoked glass which had to be specially imported from abroad.	1	2	2	5
POLICY: There was conflict between various parts of the client organisation which had to be resolved mid-way through the project. The objectives of the project were stable.	1	3	3	7

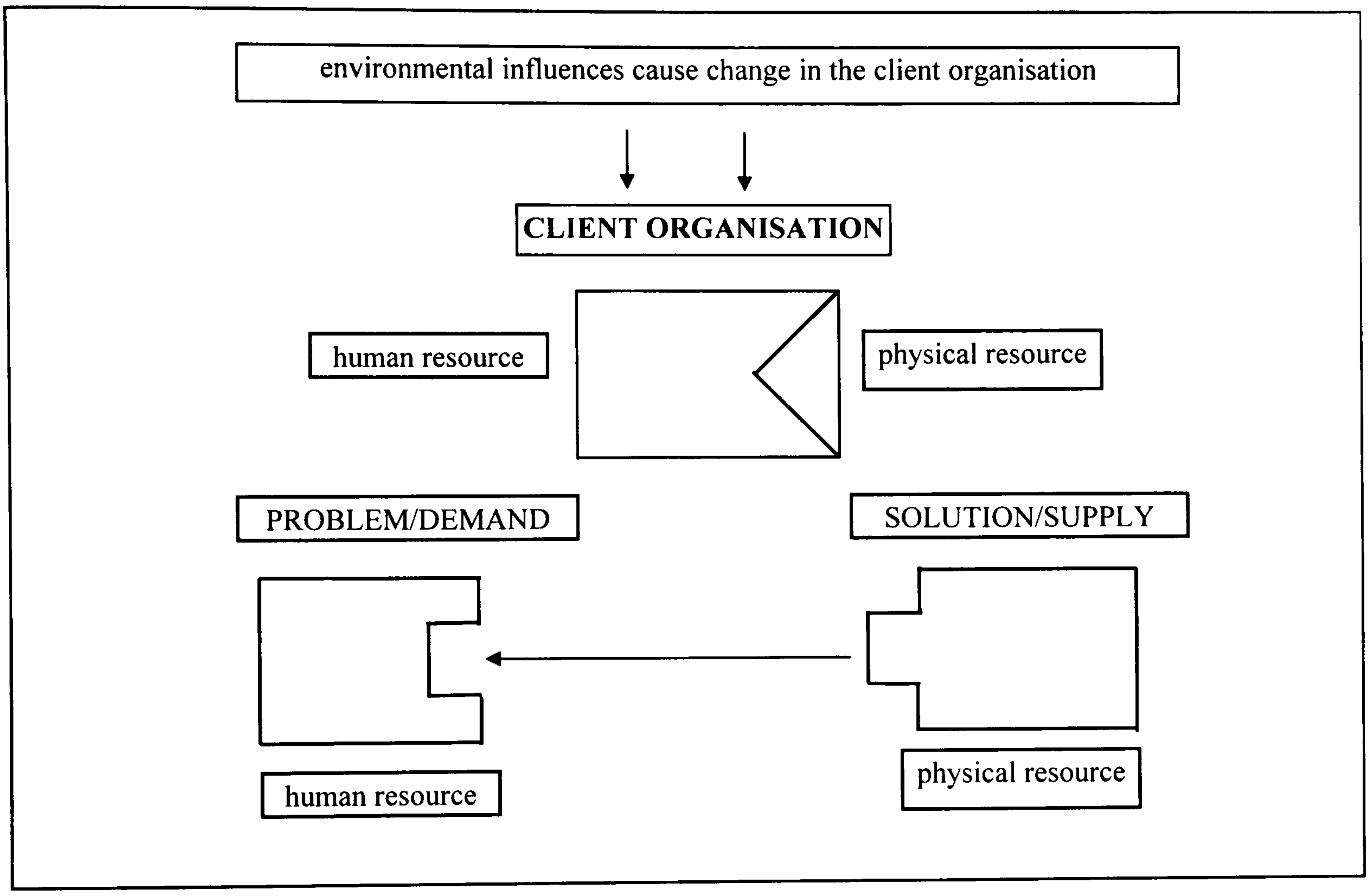
$$E.C.I. = \frac{(5 \times 6 \times 7 \times 5 \times 7)^{0.2}}{9} \times 100 = 66\%$$

Key: Def = Definition, Sta = Stability, Mit = Mitigability, Tot = Total

2.5.7.2 *Environmental Assessment : Methodology for the Current Research*

The construction procurement process has evolved as a mechanism for adapting the physical environment to suit the performance needs of an organisation where the organisation has determined that the most appropriate method for meeting these needs is by the construction of purpose built facilities. This can be thought of in terms of a demand and supply problem. A demand is created by the response of the organisation to environmental influences. The organisation envisages the solution to the problem as a new building. This constitutes a demand which must be satisifed by the evolution of a new building through construction project procurement. This is represented in figure 2.15. in which the human activities/goals of the organisation change in response to environmental influences. This creates a demand/supply situation in which the changes in the human resource component of the organisation can only be effected through the supply of new physical resources i.e. new facilities have to be built to accommodate the changing organisation.

Figure 2.15 The Demand/Supply Problem of Producing a Building to Fulfil the Needs of the Client Organisation



The procurement process must regulate the effects of the environment, reconciling competing environmental demands so that integrity is maintained between building design and operational planning. This is important as any potentially adverse environmental factors must not be allowed to impinge on the achievement of project objectives, for example building function. When the project's environment does impact on the building procurement process, it must respond ensuring that these outside influences (direct through the project, or indirect through the client organisation) do not cause divergence in building design and operational planning. In practice, regulating the effects of the environment is particularly difficult because individual environmental forces can be inter-dependent and create very complex environments. It is the complexity of the interaction of environmental forces and their level of activity upon the procurement process which will ultimately determine the impact of the environment on the project outcomes. Throughout the project, the procurement process must reconcile any problematic environmental factors to the benefit of the client but this is particularly difficult to achieve because, for example, environmental forces may act in a conflicting manner. In practice then, the effect of the project environment may compromise aspects of building function if such effects are not carefully monitored and evaluated. The very complex nature of the impact of the environment on the project also renders it difficult to measure.

For each of the projects, the project environment, specifically that relating to the development of the food services sub-system, was assessed. As in Walker's (1989) work, a qualitative approach was adopted. For each of the projects, a profile of the environmental complexity on each was developed through qualitative descriptions under the following categories:

(1) Certainty/uncertainty at the start of the project;

(2) Certainty/uncertainty as the project progressed;

(3) Conflict during the project;

(4) Technical complexity (spatial, structural, services);

(5) Aesthetic complexity;

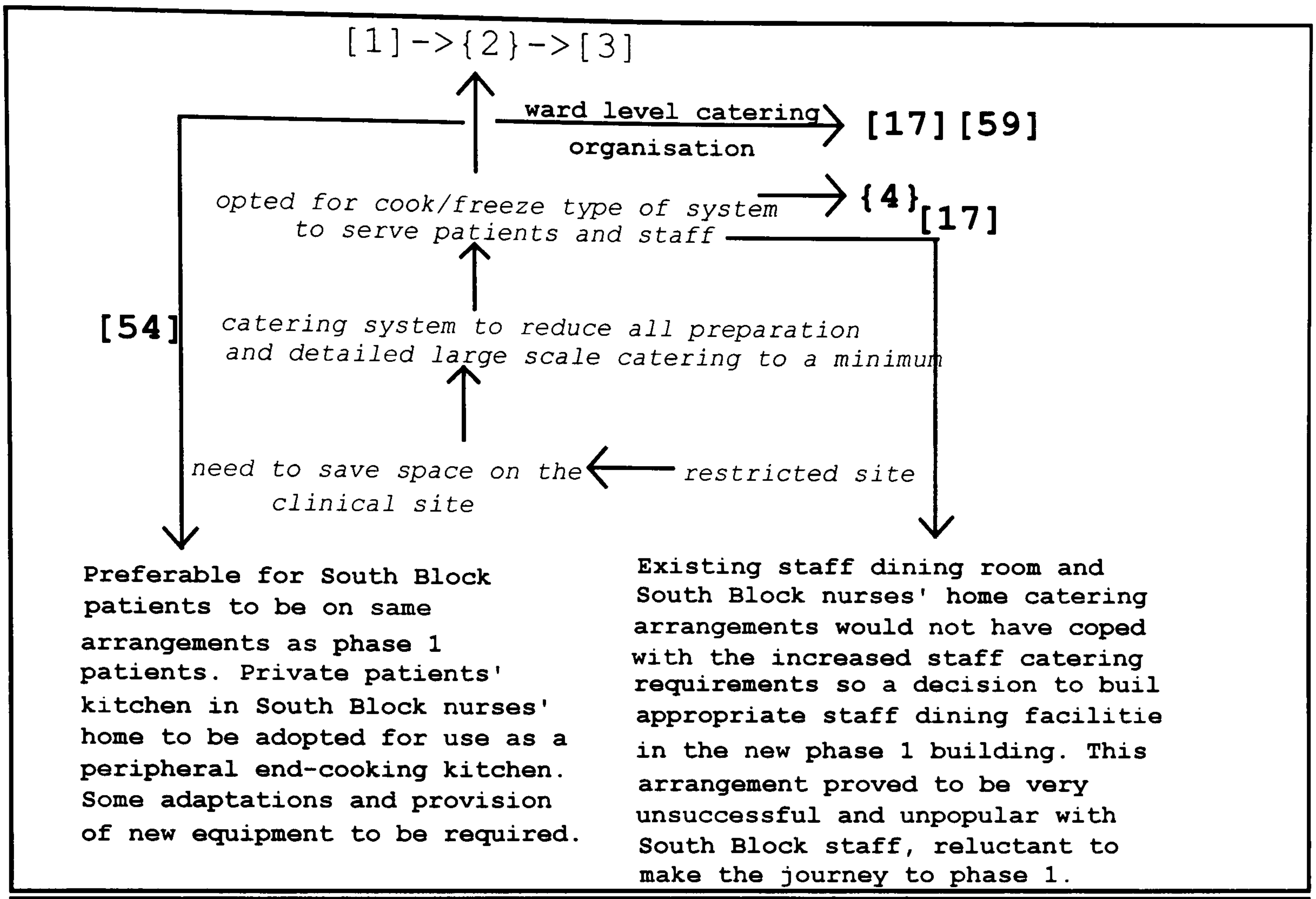
(6) Functional complexity.

In addition to this general profile, a series of environmental influence diagrams were constructed. The diagrams were developed in order to identify, as closely as possible, the timing of the impact of environmental factors upon the the construction procurement process. As a *quantitative* approach was not used, a *measure* of the *level* of impact was not gauged. Rather, the qualitative approach identified the most predominant factors, pin-pointed their timing and determined the effect they had on the planning process and impact on project outcomes, particularly in terms of building function. An example of one of these diagrams can be seen in figure 2.16. The diagrams are similar in nature to the precedence diagrams used in the 3R charting technique, described above. Operations and decisions are depicted in square brackets and curly brackets, respectively, and the numbers used to distinguish the Operations and decisions correspond to those used in the precedence diagrams. The text in boxes explains the nature of the environmental impact and indicates where, in the procurement process, this facet of the environment impacted. In addition, the diagrams show, where appropriate, the *interaction* of environmental factors and that factors impacting at a certain point in time may then have an effect later on in the procurement process. Hence, these diagrams impart information on: the *nature* and *timing* of the environment and the *interactions* of different environmental pressures. A better understanding of the very complex nature of construction project environments is gained. In particular, the diagrams assist in showing how environmental factors interact and accumulate and impact on planning. The qualitative descriptions of the construction project environments (from which the case studies were drawn) and environmental influence diagrams are detailed in Appendix 4 and summarised in Chapter 5 (refer section 5.4.1 Data on the Effect of Environmental Pressure).

The qualitative analysis, and the associated environmental influence diagrams, are dervied from information within client project files. Although the analysis is based on the interpretation of recorded historical information, this was corroborated, by discussion with key client project personnel. Specifically, key personnel were questioned about the project environment, using the six qualitative categories described above as the basis for semi-structured interviews.

The environmental influence diagram shown above, was derived from one of the project contexts researched in this thesis. It shows how different environmental factors (shown in italics) interacted with, and impacted on, each other, ultimately having an effect on decision {2} (Catering system to be based on a system of freezing prepared meals). The diagram also shows how the impact of the environment, on the decisions and work, at this particular period of planning, later had an impact on other decisions and Operations (identified in the diagram by their corresponding precedence diagram numeric identifiers {4}, [17], [54], [59]).

Figure 2.16 Environmental Influence Diagram



2.5.8 Investigation of Causes of Building Function Deficiencies

Correlation between data from the user-focused building function studies to data obtained from mapping the project procurement process; and data obtained from the associated environmental analyses, provided a method for determining the cause and effect relationships of deficiencies arising from inadequate building design and operational planning integration.

This was achieved through the development of a series of diagrams. These showed the interplay between the design and operational elements of planning activity and decisions, and the impact of the project environment. Thus, the ultimate effect on project outcomes in relation to functional deficiencies in food service system operation was shown.

An example of one of these diagrams is shown as figure 2.17. Details of all these diagrams for the outcome deficiencies are explored and analysed in Chapter 5.

The diagrams are developed through the following process:

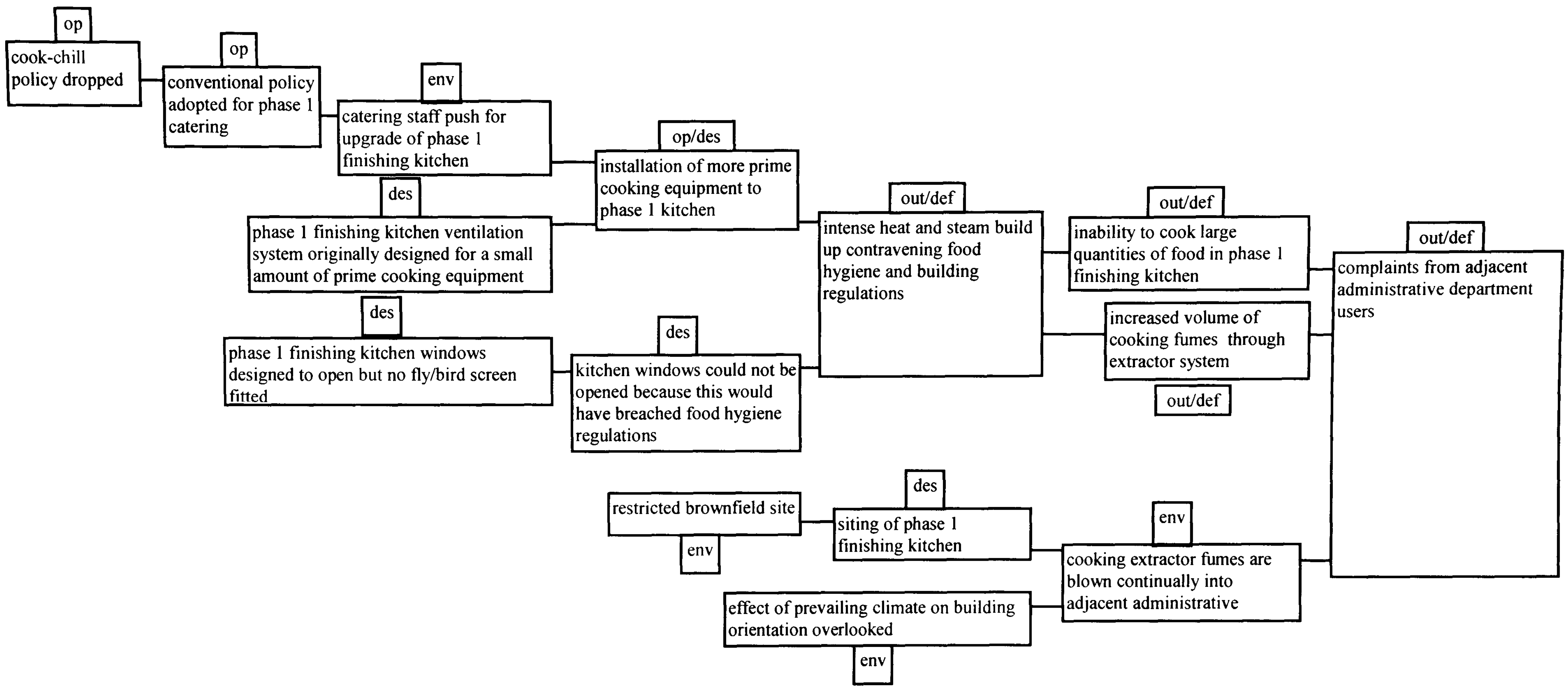
(1) A judgement was made as to the point of origin of the problem. The 3R charts provided the data from which to identify relevant activities and decisions and the relationships of project contributors to these. The 3R charts were also used to determine any periods, after the origin of the problem, where there was review/re-design/re-thinking over the initial decision/activity. The design and operational elements of the procurement process were labelled as *"des"* and *"op"* respectively. Where activity or decisions combined design and operational elements, these are shown in the diagrams as *"op/des"*;

(2) At the periods identified in (1) above, the qualitative analysis of the project context's environment provided data showing how and when environmental pressures impacted on the procurement process. Thus, for any numbered Operation within a 3R chart, it was possible to ascertain the effect of the environment on planning activity and hence ultimately its impact on the development of functional outcome deficiencies. Boxes labelled as *"env"* explain how the project environment impacted on design and operational planning activity and decision making;

(3) As different outcome deficiencies could be inter-related, these were also accounted for to give a complete picture. These are labelled as *"out/def"*.

In all of the diagrams, the determination of the cause of the functional deficiencies(s) works from right to left.

Figure 2.17 Exemplar of a Diagram Showing the Cause of an Outcome Deficiency



2.6 Conclusions

A choice of three projects (from which case studies were drawn) was made. One project (referred to as longitudinal project C) provided a check on the efficacy of the method in terms of how accurately data obtained from that retained in client project files (documented information or evidence), matched the reality of what actually happened during observations on a live project. Sufficient breadth of study was provided by the other two retrospective projects (and associated case studies).

The success of projects should be contingent on the success of the project procurement process, in maintaining integration between the activities of building design and operational planning, and is measured in relation to building function. In Walker's terms this related to 'client' satisfaction. In the current research 'client' is taken to mean end user. The analyses of building function focused on user identification of problematic aspects of system functioning.

The impact of the environment on the procurement process, and ultimately on project outcome, was an important factor which was accounted for in the research methodology.

The current research was in some ways a development of the work of Walker (1980) and Hughes (1989) but is very different in several respects:

(1) It rejected the approach of aggregating unlike variables which have been quantified subjectively;

(2) It went into greater depth in identifying functional problems in relation to users, rather than relying on vague statements of "client satisfaction";

(3) It relied on being able to trace cause and effect for functional problems, thereby avoiding the need for crude comparison between whole projects;

(4) It was able to investigate particular problems in much more depth by concentrating on a particular sub-system of a particular type of complex multi-user building.

The research methodology and philosophy was a development of the work originated by Walker (1980) and Hughes (1989). It was designed to do three basic things:

(1) Investigate how well the completed building functions and whether there are significant functional problems (later investigated as case studies);

(2) Investigate the procurement processes which evolve buildings by mapping/charting these processes in order to determine: the relationship and timing of project activities; and the roles, responsibilities and relationships of project contributors (individuals and groups) participating in these activities (used to investigate the development of functional problems);

(3) Investigate the construction project environment in order to identify the timing, nature and effect of the most influential environmental factors impacting on the development of the projects, focusing particular attention to their involvement in the development of functional deficiencies (the case studies).

Convergence of the findings from these three different investigative components allowed an examination of cause and effect between design and operational planning unity and building function. This enabled the formulation of recommendations on minimising the occurrence of functional problems.

Conceptually, the methodology adopted a similar systems based analytical approach to Hughes (1989). However, the approach to data analysis was far less reductionist than that evolved by Hughes. The research methodology was more diagnostic, attempting to make more explicit the causes of problems identified at the building/user interface, particularly in relation to environmental constraints.

The method relied on an understanding of both the functioning of the types of building system chosen (from which the case studies were drawn) and the nature of the process which gave rise to them. Chapter 3, therefore, deals with the "*product*" and Chapter 4 with the "*process*".

2.7 References

Anonymous (1973) "Planning A Kitchen Installation." Hospital Development, Jan/Feb : 21-23.

Baird, G., Gray., J, Isaacs, N., Kernohan, D. and McIndoe, G. (1996) "Introduction." In Baird, G., Gray., J, Isaacs, N., Kernohan, D. and McIndoe, G. (eds.) Building Evaluation Techniques. McGraw-Hill; New York.

Blakemore, A. E., Mozley, R. and Osner, R. C. (1980) "The Implementation and Evaluation of a "Finessa Grundy" Food Service System." in Glew, G. (ed.) Catering Equipment and Systems Design. Applied Science Publishers; London.

Burns, T. and Stalker, G. M. (1966) The Management of Innovation. Tavistock; London.

Cardello, A. V. (1982) "Patients' Perceptions of Meal Acceptability." in Proceedings of the Hospital Patient Feeding Systems Symposium. October 19th-21st 1981, Minneapolis, Minnesota. National Academy Press.

Checkland, P. and Scholes, J. (1990) Soft Systems Methodology in Action. John Wiley and Sons Ltd; Chichester, England.

Cherns, A. B. and Bryant D. T. (1984) "Studying the Client's Role in Construction Management." Construction Management and Economics, 2 : 177-184.

Cleland, D. I. And King W. R. (1975) Systems Analysis and Project Management. Second edition. McGraw-Hill; New York.

Crichton, C. et al (1967) Interdependence and Uncertainty. Tavistock Publications; London.

Dahl, C. A. (1982) "Effect of Meal Assembly, Meal Distribution and Meal Service on Sensory Quality of Food." in Proceedings of the Hospital Patient Feeding Systems Symposium. October 19th-21st 1981, Minneapolis, Minnesota. National Academy Press.

Department of Health and Social Security (1980) "Best Buy Hospitals (Mark 1) Catering Department Evaluation Report. HMSO; London.

Department of Health and Social Security (1980) "Health Service Catering : Hospital Meal Survey." HMSO; London.

Escueta, E. S. (1986) "A Foodservice Classification and Planning Model for Hospitals and Health Care Facilities." PhD Thesis.

Farbstein, J. and Kantrowitz, M (1991) "Design Research in the Swamp – Towards a New Paradigm", in Zube, E. H. and Moore, G. T., Advances in Environment, Behaviour and Design, volume 3. Plenum Press; New York.

Franzese, R. (1981) "Food Service Systems of 79 Hospitals Studied." Hospitals, February 1, volume 55 part 3 : 64-66.

Gray, J and Baird G. (1996) "Evaluation Processes." In Baird, G., Gray., J, Isaacs, N., Kernohan, D. and McIndoe, G. (eds.) Building Evaluation Techniques. McGraw-Hill; New York.

Handler, A. B. (1970) Systems Approach to Architecture. Amsterdam; Elsevier.

Hughes, W. P. (1989) "Organisational Analysis of Building Projects." PhD Thesis, Department of Surveying, Liverpool Polytechnic.

Kernohan, D., Gray, J., Daish, J. and Joiner, D. (1992) User Participation in Building Design and Management. Butterworth Architecture; Oxford.

Khandwalla, P. N. (1977) The Design of Organisations. Harcourt Brace Jovanovich; New York.

Kipps, M. and Middleton, V. T. C. (1990) "Achieving Quality and Choice for the Customer in Hospital Catering." International Journal of Hospitality Management, volume 9, No 1 : 69-83.

Koestler, A. (1978) Janus: A Summing Up. Hutchinson; London.

Kroner, W., Stark-Martin, J. A. and Willemain, T. (1996) "Rensselaer's West Bend Mutual Study: Using Advanced Office Technology to Increase Productivity." In Baird, G., Gray.. J, Isaacs, N., Kernohan, D. and McIndoe, G. (eds.) Building Evaluation Techniques. McGraw-Hill; New York.

Lawrence, P. C. and Lorsch, J. W. (1967) Organisation and Environment: Managing Differentiation and Integration. Harvard University Press; Massachusetts.

Lewis, G. (1979) Financial Evaluation of Four Alternative Hospital Catering Systems." in Maundy, T., Mercer, K. and Hayter, R. (eds.) HCIMA Research Register.

Maller, O., Dubose, C. N. and Cardello, A. V. (1980) "Consumer Opinions of Hospital Food and Foodservice." Journal of the American Dietetic Association, 76 (3) : 236.

Matthews, E. (1982) "Foodservice in Health Care Facilities." Food Technology, **36** (7) : 53-55, 58-60, 62-64, 71.

Miller, E. J. and Rice, A. K. (1967) Systems of Organisation. Tavistock; London.

Morris, P. W. G. (1974) "Systems Study of Project Management." Building, Jan 25th : 75-76, 79-80.

Morris, P. W. G. (1974) "Systems Study of Project Management." Building, Feb. 1st : 83-84, 87-88.

Mottishaw, J. (1979) "A Study of Food Quality in Four Alternative Catering Systems." in Maundy, T., Mercer, K. and Hayter, R. (eds.) HCIMA Research Register.

Napier, J. A. (1970) "A Systems Approach to the Swedish Building Industry." Stockholm : The National Swedish Institute of Building.

National Audit Office (1994) National Health Service : Hospital Catering in England. HMSO; London.

Rougvie, A. (1991) Project Evaluation and Development. Mitchell; London.

Stoelwinder, J. U. and Charns, M. P. (1981) "The Task Field Model of Organisation Analysis and Design." Human Relations 34, 9 : 743-762.

Thompson, J. D. (1967) "Organisations in Action." McGraw-Hill, New-York.

Thorne, R. (1996) Using Visual Methods to Focus Users' Response in Predesign and Post-occupancy Research." In Baird, G., Gray., J, Isaacs, N., Kernohan, D. and McIndoe, G. (eds.) Building Evaluation Techniques. McGraw-Hill; New York.

Turner, M. and Waters, J. (1979) Patient and Staff Attitudes to Hospital Food." in Maundy, T., Mercer, K. and Hayter, R. (eds.) HCIMA Research Register.

Unklesby, N. and Balsley, M. (1979) Foodservice Researched in Special Project." Journal of The American Hospital Association, 55 (20) : 113-117.

Von Bertalanffy, L. (1969) "The Theory of Open Systems in Physics and Biology." in Emery, F. E. (ed.) Systems Thinking. Penguin; London.

Von Seifers, L. (1972) "A Contingency Theory Approach to Temporary Management Systems." PhD Thesis, Graduate School of Business Administration, Harvard University.

Walker, A. (1980) "A Model for The Design of Project Management Structures for Building Clients." PhD Thesis, Department of Surveying, Liverpool Polytechnic.

Walker, A. (1989) Construction Project Management. Second edition, BSP Professional Books; London.

Walker, A. (1981) "A Model for the Design of Project Management Structures." The Quantity Surveyor, April : 66-71.

Walker, A. and Wilson, A. J. (1983) "An Approach to The Measurement of the Performance of the Project Management Process." in Proceedings of The Land Management Research Conference. London : Spon.

Waters, J. (1979) "Critical Appraisal of Hospital Catering Systems Performance." in Maundy, T., Mercer, K. and Hayter, R. (eds.) HCIMA Research Register.

Weidemann, S. and Anderson, J. R. (1985) "A Conceptual Framework for Residential Satisfaction." In Altman, I. And Werner, C. M. (eds), Home Environments. Plenum Press; New York.

Yin, R. K. (1994) Case Study Research : Design and Methods. Second edition. Sage Publications, Inc; London.

CHAPTER 3
The Product

3.1 Introduction

This chapter explores further the concept of function as a sub-component of the quality performance indicator in the construction industry. This theoretical study is crucial to the practical methodology developed in Chapter 2, as it:

(1) Identifies the three most commonly acknowledged measures of project performance used in the construction industry;

(2) Identifies different potential definitions of the quality performance indicator in construction, focusing in particular on a functional definition of quality;

(3) Explores the relationship between different project performance indicators in the contexts of health buildings;

(4) Examines the importance of functional performance in health buildings particularly in relation to hospital food service;

(5) Examines the relationship between food service design and system functioning.

3.2 Project Performance Indicators

Within the construction industry, it is generally recognised that there are three main objectives for any project and these serve as general performance indicators, (National Economic Development Council 1976, Department of Construction Management University of Reading 1979). These are speed (time), that is the time taken from inception to completion; cost, that is the final price paid for a building; and quality, that is the standard of design and construction attained. Project performance is generally assessed by measuring deviations in any of these. Cost and time deviations are relatively easily understood and measured. For example, a project which is completed behind schedule or with a cost greater than was originally tendered for, could be considered to be unsuccessful. The extent of time over-runs and excess expenditure will determine exactly how successful or unsuccessful a project has actually been.

The quality factor in project performance is an elusive subject. For example, Nahapiet and Nahapiet's (1985) research on construction project management omitted an assessment of quality in project performance because of difficulties in establishing comparable criteria for assessing the quality of design and construction. Similarly, a report by the National Audit Office (1989) relating to the performance of the hospital building programme did not analyse the quality factor in any great depth. In particular, *functional* assessments of building performance have tended to be undertaken less frequently than time and cost measures of project performance. In the public health sector, the dearth of such evaluations has been reported by the Committee of Public Accounts (1981), Scottish Affairs Committee (1987), National Audit Office (1989) and Committee of Public Accounts (1990).

3.2.1 Quality as a Measure of Project Performance

In the context of the construction industry, quality is a project performance indicator which is nebulous and more difficult to define and measure than associated cost and time indicators. Becker (1990) described the concept of quality in facilities as "elusive". What is clear about quality is that there is no universal definition or conceptualisation of the term which can be applied to all situations. There are various definitions of the term quality: different definitions apply in different circumstances and relate to specific fields or disciplines.

In the context of the built environment, Cold (1992) generated five possible concepts of quality in relation to architecture: metaphysical; linear-technological; dialectical-artistic; psychological-environmental and aesthetic-architectural. In relation to the construction industry, Walker and Hughes (1984) proposed an ostensibly simple, but all-encompassing definition of quality,

> ***"At its broadest level, quality in building is the degree to which a completed project satisfies the requirements of a client."*** (Walker and Hughes 1984)

The following definitions, drawn from a variety of general texts on the construction industry, postulates seven definitions of quality which may be pertinent to construction clients' requirements:

(1) Quality: relating to the quality of building materials used;

(2) Quality: relating to craftsmanship e.g. how well have ceramic floor tiles been laid;

(3) Quality: relating to the accuracy in translation of design specifications into the built structure;

(4) Quality: relating to aesthetics;

(5) Quality: relating to spatial design;

(6) Quality: relating to the need for maintenance and building life cycle;

(7) Quality: relating to function.

Generating these different possible definitions of quality was valuable in two ways. Firstly, it facilitated the development of ideas relating to a potential functional definition of quality, seen as distinct from other definitions of quality related to building performance. Following this through to the research methodology, it assisted in the selection of case studies by facilitating the identification of functional problems, as opposed to other problems elicited through post-occupancy user evaluation (refer Chapter 2, section 2.5.5 Selection of Case Studies).

A *functional* definition of quality, relating to building performance, was crucial to the study of complex built environments as the research focused on the user perspective. This emphasis, on a building occupant's ability to work efficiently and effectively, was based on Preiser et al's (1988) definition of function related to the quality of building performance. Therefore, the definition of function, as used in this research, is concerned with how well the building's design is integrated with the organisation it houses and the activities which the organisation has to perform inside the building; i.e. the ability of the building to provide a setting appropriate for the realisation of building users' needs and goals.

These differing definitions of quality, listed above, are all valid. In effect each definition is in itself an indicator of project performance and can be considered as a sub-component of the quality indicator. Time and cost indicators of project performance can also be sub-divided or more explicitly defined. For example, costs can be considered in terms of capital versus revenue costs. Hughes (1989) suggests that the degree of importance placed on any of these aspects of quality, or of any other specific project performance indicator, will be dependent on three factors: the viewpoint of the person making a judgement on a building; the point in a building's life when a judgement is being made;

and the criteria by which the judgement is being made. It is the relationship between client, users and other people with an interest in the project that will judge the ultimate relative success of the project.

3.2.2 Differing Concepts of Project Performance Indicators : Public Versus Private Sector

The point made above can be illustrated by a comparison between two related hypothetical performance indicators in the public and private health care sectors. Social acceptance and aesthetics are considered as fairly major priorities to be aimed for when building a new hospital in the private sector. Knobel (1985) indicates the reason for this in the following,

> ***"In the private sector the principal concern of clients is to attract patients and minimise the commercial risk,"*** (Knobel 1985)

Since private sector health care is driven by market forces, the physical image of the hospital has an important role to play in enticing potential customers. Therefore, social acceptance and aesthetics are significant project performance indicators.

In the public health care sector in the past, such assessment criteria may have seemed out of place in a service dominated by the necessity to keep all spending, including that on building, within strict financial limits and where the common feelings evoked by health and hospital buildings was of institutional, clinical and unwelcoming places. However, within the constraints of health service building, aesthetics and social acceptance have become increasingly important. For example, Humby (quoted by Anonymous 1987) speaking on behalf of an architectural practice specialising in health care design stated,

> ***"There's a realisation that hospitals have an effect on people coming in and there's a subsequent move away from the clinical image."*** (Anonymous 1987)

Subsequently there has been a move towards "humanising" the health care environment. The change in attitude has come about for a variety of reasons: the main factors are discussed but there are probably others which have acted as a catalyst for change. Information from environmental psychologists, such as Lee (1976) and their work on environment and behaviour has shown that a well planned hospital can minimise the inevitable feeling of disorientation, the separation from familiar routines and from the personal interdependencies that give a meaningful context to the personality. With increasing recognition of the needs of the patient in a hospital environment, and the proposals of the government's White Paper, "Working For Patients" there has been a greater move to cater for the patient as "customer" as the UK National Health Service has moved into the market place. Guinn (1990) writing on the introduction of internal markets into the British National Health Service draws a parallel with similar market developments in the United States of America. Abroad these market developments have forced far reaching changes in hospital design. In particular, Guinn (1990) states that,

> ***"Competition for patients can bring a new and vital edge to the industry as hospitals realise that the emphasis will now be on attracting and serving the customers (patients)."*** (Guinn 1990)

Changes catalysed by the NHS health care reforms in the 1990s have blurred the distinction between public and private sector care, so that *all* potential providers will be in the position of competing for clientele. An article in the popular Which? magazine provides an interesting insight into the way in which these reforms will affect interaction and competition between NHS and private sector health care,

> ***"In future, more NHS patients will be treated in private hospitals and NHS hospitals may do more private operations. Health Authorities can buy health services from their own hospitals, but also from other hospitals in other Health Authorities, as well as from NHS trust hospitals and private hospitals. GP practices with more than 7,000 patients can opt to hold a budget and buy services for their NHS patients from either NHS or private hospitals. NHS trusts can sell their services to Health Authorities, GP fund holders and to private patients. The number of NHS pay-beds might increase. And consultants employed by NHS trusts might be required to use their NHS trusts pay beds for their private patients."*** (Anonymous 1992)

Evidence of increasing concern about quality relating to end users' experience of health care buildings is demonstrated with increasing use of interior design specialists and community artists. The skills of such specialists are being more widely used as a vehicle for incorporating users' requirements into the design process, Anonymous (1992). This de-institutionalises the hospital and creates a more domestic or "homely" atmosphere. The changing philosophy of health care may also be changing attitudes towards hospital design. Nagasawa (1990) hinted at this in his paper delivered to the International Union of Architects at a conference relating to the role of the architect in health care,

> ***"As more emphasis is put on the quality of life rather than the length of life, the quality of health care facilities is becoming one of the key issues."*** (Nagasawa 1990)

Philosophies like this suggest some kind of link between human well being and the environment.

3.2.3 Prioritising Project Performance Indicators in Public Sector Health Building

In public sector hospital building what is the priority of different project performance indicators and their sub-components? The priority placed on different project objectives usually determines how much emphasis is placed on the different project performance indicators. The performance of hospital buildings against time and cost indicators is well documented by various government watchdog bodies. At a time when public accountability and scrutiny have never been more influential and all sectors of government are working to achieve "value for money" services, within a limited financial budget, the emphasis placed on budgetary performance indicators is great. This may be to the detriment of functional aspects. One representative of Argyll and Clyde Health Board, quoted by the Scottish Affairs Committee (1987) stressed that,

> ***"...an awful lot of time is spent during the gestation period for hospitals in trying to accommodate the design and costs within the fixed cost limit, which is applied very rigidly, and we often find that in that process we are removing things from the hospital specification which are going to cause the client endless chaos and problems and cost at a later stage..."*** (Scottish Affairs Committee 1987)

Reports by the Scottish Affairs Committee (1987), National Audit Office (1989) and Committee of Public Accounts (1981, 1990) have tended to concentrate on cost and time indicators of project performance. Budgetary blunders are well documented. When there are pressures on local budgets from different projects, it is essential that the necessary money is made available at the right time otherwise progress can be delayed. For example, in Walsall District Health Authority the Department of Health approved the Anchor Meadow Community Hospital project in February 1984. However, construction had to be deferred because of other commitments in the region's capital programme and the project did not start until March 1991, (National Audit Office 1989).

Although the emphasis is usually on capital costs, there has been increasing interest in revenue costs and life-cycle costing. More emphasis has been placed on revenue costing because of the difficulties which can result from mis-matching revenue funds to capital investment. For example, in 1987 Reaside Regional Secure Psychiatric Unit opened only 46 out of a possible 100 beds. Full utilisation of the facility was anticipated on opening but was not achieved primarily because of a sharp rise in nursing costs, (National Audit Office 1989). More importance has been placed on life-cycle costing, since the Department of Health and Social Security commissioned the Institute of Advanced Architectural Studies at the University of York (1988) to investigate the relationship between the design of health care buildings and their operating costs after completion. When the total operating costs of a health care building through its lifetime are considered, the initial capital expenditure begins to appear insignificant. The University of York study (1988) estimated that a hospital costing £17m to build would cost around £420m to operate over a design life of sixty years. The study indicated that some new hospitals cost apparently more to run than the old hospitals they replaced. In this context, the subjugation of functional, operational aims to aims focusing on the building process, such as cost constraints and delivering a building on time, makes little sense, and the need for a project such as this is clear. The most recent effort to rationalise design to operating costs has resulted in the construction of the first low energy hospital at St. Mary's, Newport on the Isle of Wight, as reported by Corcoran and Wilson (1990).

In the public sector, completion of hospital building projects on time is important. Service needs have to be met and new facilities brought into use as quickly as possible so that old facilities may be decommissioned and services rationalised. In March 1987, the Scottish Affairs Committee reported on the damaging effect of delays in planning and procurement and over-runs on time,

> ***"The result of delays is that the ultimate consumer of hospital services - the potential patients - get their new hospital later than expected and have to endure old and outmoded facilities for longer than planned."*** (Scottish Affairs Committee 1987)

When services are delivered too early there may be problems if revenue is not actually available to run the facilities. If facilities have been pushed into opening prematurely this can cause problems because items of equipment may not have been properly commissioned and staff may have had inadequate time to adjust to the new facilities and any new working practices which have to be adopted.

As well as time and cost performance indicators, performance of public sector hospital building is also measured against the ability of projects to meet service needs and quality standards. It has already been shown how underutilisation of hospital services can arise through a mis-match of capital and revenue funds and delays in planning. However, underutilisation can also arise because of significant changes in service requirements and resources between need recognition and project completion. For instance, the National Audit Office (1989) reported on the underutilisation of the Stafford (Phase 1) development. The underutilisation was partly due to a reduction in the number of births in the area and length of patient stay. Such demographic changes can complicate judgements on whether functional problems have occurred in the design process, yet remain open to communication between design and operational management as regards the need for flexibility in design. The construction procurement process must be sensitive to such environmental pressures in order that the final building solution is fit for purpose.

Both the National Audit Office and Public Accounts Committee emphasise the need to avoid underutilisation, but as far as "meeting service needs" is assessed as an element in measuring project performance, little else is said. The need to bring facilities into full use and on time is a very important part of patient care delivery but to allow the definition of "meeting service needs" to be fulfilled simply by the absence of underutilisation is short sighted and too simplistic. Of equal importance is a thorough investigation or evaluation of the function of the building post-occupancy, investigating the fit between building design and operational policies and the effect of this relationship on the building/user interface. This is a sub-component of the quality performance indicator which the research proposes as being of paramount importance to complex, multi-user buildings. A functional assessment of quality should not be limited to an investigation which merely discovers that on completion of a facility all beds are occupied and all services in use.

The Department of Health went some way towards assessing particular health-specific performance standards in 1988 by issuing guidance on functional suitability assessments and space utilisation analyses, as reported in the National Audit Office (1989) report on Hospital Building in England. This aspect of project performance measurement was first mooted, by the DHSS (1983) in the early 1980s. The functional suitability assessment determines how effectively a building supports delivery of a specified service after taking account of such factors as: the space available; the services and amenities being provided; and the location and environmental conditions. Space utilisation analyses are designed to identify under-used space and spare capacity which can be disposed of or used to enhance service delivery.

These assessments go some way towards expanding notions of building quality. However, as far as building quality is concerned, the Department of Health does not have responsibility for establishing primary building standards since these are nationally defined in building regulations and codes of professional practice. Most quality defects which are associated with hospital buildings, and made common public knowledge, relate to the first three definitions of quality described in section 3.2.1 (Quality as a Measure of Project Performance). The press has reported many stories of hospital construction catastrophes, for example, in The Observer (1984) and Building Design (Searle 1980, Abrams 1982, Thompson 1985). The Committee of Public Accounts

(1984) and Scottish Affairs Committee (1987) have been highly critical of the defects arising in some new hospital buildings. A definition of building quality, as applied to hospitals and other complex, multi-user buildings, should mean more than just building to satisfy the requirements of the building codes, fire regulations and other codes of professional practice. Building quality should incorporate some idea of how successfully the building functions i.e. how well the design incorporates the user activities it was designed to house.

The publication of the Health Buildings Evaluation manual by the DHSS (1986) was an attempt to encourage Regional and District Health Authorities to conduct more evaluatory exercises on health buildings. In 1989, the National Audit Office reported that 20 major health building schemes had been completed over the period 1985 to 1987 but by January 1989 the DHSS had received only eight evaluation reports. The health building procurement procedures are embodied in "Capricode" - this provides the mandatory procedural framework for managing and processing NHS capital building schemes. The Capricode procedures require, in fairly general terms, health authorities to evaluate schemes during development and in use, (DHSS 1986). Capricode states that the aim of post-occupancy evaluation is to provide feedback for management and designers to assist,

> ***"...strengthening decision taking and management throughout the health building process and improving the design and operation of health buildings."*** (DHSS 1986)

Moreover, Capricode states that evaluation during scheme development should,

> ***"Identify important lessons in planning, design, cost control, procurement etc. which can be applied quickly to other schemes."*** (DHSS 1986)

and that evaluation of the scheme in operation should,

> ***"Review and report on the scheme particularly the impact of accommodation and facilities on the operational effectiveness and efficiency of services : highlight performance in use including running costs."*** (DHSS 1986)

It is argued that the success of future projects depends to some extent on the lessons learned from the past so when post-occupancy evaluation studies are not carried out, this represents a missed opportunity for informing other schemes of past mistakes and successes in building function. Van Wagenberg (1990) makes this statement quite clearly in his contribution to a European seminar on "Building for People in Hospital", *"Until now, evaluation of the finished product has been left to the architectural critics who tend to focus on the aesthetic aspect of the building and on the historical development of the architect. Such criticism is not based on systematic research and tends to ignore the opinion of the users of the building. However, advances in medical technology, rising costs and increasing expectations of patients have fuelled demands for more systematic assessment. Such a procedure demands a systematic research methodology, explicitly stated goals and a comparison between these goals and the effects of the building on users. Finally, clear communication of the results of the evaluation is important for the improvement of future designs of similar buildings."* (Van Wagenberg 1990)

The lack of post-occupancy studies is largely connected to the problem of the cost of conducting evaluations, competing at authority level against other revenue demands, rather than being treated as an integral part of the capital activity. Inevitably, this means that post-occupancy evaluation of schemes becomes a low priority so information relating to health buildings' functional performance is rarely made explicit in any kind of systematic fashion. This type of information only becomes more accessible when there have been major blunders during project procurement: for example, the Liverpool Teaching Hospital, reported by the Committee of Public Accounts (1977), is a prime example.

3.3 The Importance of Function in Hospital Buildings

This section provides supporting evidence for the proposal that a functional definition of quality should be a more widely used performance indicator in measuring the success of project outcomes in large, complex, multi-user buildings, as exemplified by the hospital. The functional definition of quality, described in section 3.2.1 (Quality as a Measure of Project Performance), is concerned with obtaining a measure of the degree to which the building design is integrated with the organisation it houses and the activities which the organisation has to perform inside the building.

In terms of actual building performance, as opposed to project performance, Preiser et al (1988) suggested three major categories of elements which could be evaluated: technical, functional and behavioural. Indeed, Preiser et al (1988) considered these to be,

"...the most important in terms of physical performance implications affecting owners, organisations and building occupants." (Preiser et al 1988)

The technical elements were described by Preiser et al as,

"...the background environment, a kind of "stage set for activities." (Preiser at al 1988)

These technical elements include such factors as structure, sanitation, fire, safety and ventilation. Behavioural elements of building performance were, however,

> ***"...concerned with the impact of a building upon the psychological and sociological well being of the building's occupants."*** (Preiser et al 1988)

Distinct from these are the functional elements of a building which,

> ***"...directly support the activities within it, and they must be responsive to the specific needs of the organisation and occupants."*** (Preiser et al 1988)

It is this functional aspect of the human/building interface which is the focus of the research. The importance of function as an element of building performance should not be underestimated. In large, complex, multi-user buildings, such as hospitals, the ability of the building to work effectively with its users is essential.

In all organisations or businesses which provide a product or service, predicting future needs and determining the level of resources required to meet these needs is an ongoing process within the broad scope of strategic planning. Part of this rationalisation process naturally includes an appraisal, or an assessment, of the ability of current building stock to house effectively existing and future demands on services or processes. The performance requirements of new building stock should be based on predictions of future service or process requirements. Often, when the decision for new build has been adopted as the preferred option for meeting future requirements, the building is regarded as a solution to the planning problem. This is somewhat misleading since the building *per se* is not a means to an end in itself: without the users to undertake activities within the building, aided by the use of compatible operational policies, the building exists as little more than a monument. This view is supported by Shumaker and Pequegnat (1989) in their article on hospital design and effective health care which stated that,

> ***"The modern hospital is an evolving system rather than a finite architectural work."*** (Shumaker and Pequegnat 1989)

This statement could be applied to all buildings that are required to house organisations consisting of a variety of user groups. For most organisations, the practical issues of planning and executing the development of a new building places demands on the problem-solving ability of the organisation. However, these abilities lie outwith the everyday running of most businesses. Organisations must be able to evolve a physical environment which supports the activities of the organisation's different users.

The building solution is thus the reflection of choices which take account (or take insufficient account) of the requirements of different categories of users. In this context, the building works either as an aggravator or a facilitator of work. A non-functional building can impede activities of all types and can affect economic and other unquantifiable costs such as fatigue and stress. In the Editorial of the Journal of Health Administration Education, Filerman (1981) stated the importance of the built form and the organisation/activities it houses,

> ***"The physical plant either facilitates the objectives of the organisation or limits them. It imposes constraints on movement, mandates many aspects of personnel utilisation, equipment acquisitions, utilisation and maintenance, technological innovation and maintenance costs."*** (Filerman 1981)

In a paper given at the XII International Public Health Group Seminar of the International Union of Architects, Burgun (1989) indicates what can be expected when important functional needs are not met,

> ***"It has often been said that bricks and mortar do not make a hospital and that facilities without services are valueless. This statement is probably correct, however, so is its corollary. Services must have facilities to house them effectively, neither can operate fully without the other. The physical environment plays an extremely influential role. A good hospital not only permits, but actually stimulates good hospital care, and an inadequate hospital creates direct and almost insurmountable limitations on its personnel. It is difficult to practice 1990 medicine in a 1929 hospital, the building keeps getting in the way."*** (Burgun 1989)

Hunter (1972), the first Director of the Scottish Hospitals Advisory Service, also highlighted this problem,

> ***"...effective work can be done in out-dated and inconvenient accommodation but facilities which positively encourage correct procedures are, undoubtedly, safer and better than situations in which hospital staff are forced to improvise because the design has not met important functional needs..."*** (Hunter 1972)

The way in which building design affects the complex social and organisational machinery of different building users is extremely important. A building which responds to, and works with, its users will enable them to communicate better and integrate their complex tasks so that complex systems' goals can be achieved more effectively. Sagehomme and Laigle's (1990) paper on "Architecture and Working Conditions : Stress at Work", emphasises that the literature on occupational stress and work settings clearly demonstrates a relationship between work-space arrangement and such factors as job efficiency and productivity. Baird et al (1996) also point to,

"... growing evidence of a significant connection between job performance and various physical attributes of the workplace. The costs to organisations are considerable if employees are performing below their full potential because their workplace does not fully meet their needs. Buildings are the settings for people's lives, and while many of the costs of a user-environment mis-match may be intangible, the financial implications of the salary bill are real. This is a compelling reason for finding out more about the performance of buildings." (Baird et al 1996)

The physical surroundings should support and not work against users' objectives because when achievement of users' objectives is frustrated by poor design and building management, working conditions are adversely affected. Sagehomme and Laigle's (1990) quote from Tonneau's work identifies some of the problems encountered in hospital facilities,

"Everywhere, there are complaints of greater or lesser inadequacies: rooms too small, no areas reserved for workers or for preparation, corridors too narrow, lightless rooms with bad ventilation, lack of waiting rooms or offices, layouts unsuited to the specific needs of departments, long distances between departments which often work together, having to bring patients across freezing yards to get to the radiography unit, antiquated kitchens or laundries, badly designed circulation contravening the basic rules of hygiene, use of materials unsuited for hospitals..." (Sagehomme and Laigle 1990)

Failure to recognise and adequately plan for the very often complex and dynamic relationships between people, their activities, and the spaces that house them, can lead to compromised building function. As an exemplar, hospital buildings illustrate this point extremely well. Care providers perform tasks that are often stressful and hazardous and they, quite rightly, expect the building and its systems to help them perform effectively and efficiently. The problem is that poorly or inappropriately designed systems within the hospital will not achieve optimum personnel performance and, whether directly or indirectly, the ultimate effect is often felt by that part of the user group least able to tolerate poor system functioning : the patients. For example, Eardley and Waldsworth-Bell's (1986) study at a children's hospital in Manchester showed how functioning of ward accommodation was compromised because of a lack of space and this had a negative effect on different user groups. Cramped ward conditions led nursing staff to impose restrictions on ward usage, e.g. lights out at the same time for teenagers and toddlers alike. Parents interpreted this as an inflexible attitude on the part of the staff, and this affected the overall atmosphere. Of course, when buildings work in unison with their users then building occupants benefit. For example, Pearl's (1987) writing on the effect of the environment on patient care illustrates this clearly, *"Making the working environment more efficient for staff, cutting down the distance they have to walk, giving them a base to work from, automatically reduces stress and enables them to work better with the patients."* (Pearl 1987)

Where functional problems occur in existing buildings "soft" options, aimed at improving the behavioural environment at the expense of the functional environment, should be avoided. Enhancing the aesthetic appeal of a building by re-painting walls and laying carpets may instil more positive attitudes in the workforce but these measures might quickly deteriorate while the same functional working problems remain.

3.3.1 The Importance of Functional and Environmental-Psychological Aspects in Hospital Food Service Systems

Within the hospital building there are many processes and activities which accumulate towards the achievement of different goals. On this basis, the hospital building has become highly fragmented into many different departments and systems. Koncel (1977) stated that there are probably few systems in the hospital which have an influence on hospital users equal to that of the food service system. According to Beavan (1975), who was the Catering Advisor to the DHSS in the mid 1970s,

"No catering service is more complex or presents the caterer with greater problems and responsibility." (Beavan 1975)

Rawlinson and Whittlestone (1990), two prominent researchers working in the field of hospital design, have implied that over-emphasis on patient food service concerns detracts from investigations of the psychological environment. This view is expressed by them in the following,

"From the evidence of U.K. satisfaction surveys, the physical healthcare environment does not appear to rate very highly in importance against strongly held views about the need for better information and communications, boredom and pre-occupation with catering arrangements and the quality of food." (Rawlinson and Whittlestone 1990)

Whilst it is true that food service is still a highly criticised element of hospital care, the attitude above fails to recognise important functional and environmental psychological aspects of food service in hospitals. These are considered in the following section.

3.3.1.1 *Environmental-Psychological Elements of the Patient Food Service System*

Firstly, food service is, perhaps, one of the more familiar hospital functions that patients are able to relate to. We would all consider ourselves to be connoisseurs of food and such feelings are apparent whether we are dining in a restaurant or in a hospital bed. Each of us knows how we like our food cooked and we all have our individual expectations and pre-conceived ideas of what "good" food service is all about: as in-patients eating in a hospital bed we are just as likely to criticise the food service. Patients undoubtedly feel more qualified to criticise the food service than other services which are probably alien to them, in particular medical services. With regard to service quality, Brownridge's (1984) advice on the benefits of quality assurance in food service planning recognised that the best performance indicators relate to the experiences which patients are familiar with,

> ***"Patients can't assess quality of nursing care, but they are experts on the hotel aspects of their hospital stay. And food service is probably the most important aspect of that stay."*** (Brownridge 1984)

Secondly, there is a proven link between satisfaction with food service and other aspects of the hospital environment. Sheatsley (1965) showed that the greatest differences in attitudes towards hospital food are found not among patients of varying characteristics but among the patients residing in hospitals of varying characteristics. Thus, the size of the hospital, physical layout, location, staffing, financial resources and other similar factors are important in determining the success, through the eyes of the patient, of any particular food service system. More recent hospital catering survey work, undertaken by the National Audit Office (1994), also found that levels of satisfaction varied substantially between different hospitals. Research by Maller et al (1980) also found a significant correlation with the patients' opinions of the food and their satisfaction with the nurses and doctors' care and their comfort (ease) in the hospital setting. Information relating to patient satisfaction with food service can, therefore, be very important in investigating the physical environment of the hospital from an environmental-psychological perspective.

Food is important to the hospitalised patient because of its physiological, psychological and social values. The increasing recognition that food is a primary factor in: aiding a patient's recovery; the aetiology of some diseases; and in alleviating some disease states, has led to the rapid development of the dietetic paramedical profession. Important psychological and social values of food should never be overlooked when assessing physiological and nutritional requirements of the patient. This is particularly important for different ethnic groups. Dichter's (1954) early study on the psychological and social factors of food in the hospital setting vividly illustrates Sheatsley's (1965) and Maller et al's (1980) studies,

> ***"The cold cup of coffee, then, has deep emotional meaning. To the insecure patient it is a sign. Good hot coffee is symbolic of the home away from home, of being welcome. Bad coffee is the perfect symbol that he is receiving what amounts to the orphan's neglect."*** (Dichter 1954)

Albert Roux, quoted in the National Audit Office (1994) report on Hospital Catering in England, echoes Dichter's sentiments,

> ***"Food...breaks up the monotony of hospital life, giving us enjoyment, comfort and solace. Meal times should be a pleasurable experience, worthy of the wait. We don't want to be, and should not have to be, disappointed."*** (National Audit Office 1994)

What is true of coffee in the symbolic sense is actually true of all food - it should be served at the right temperature, as a sign that the hospital cares. All people in hospitals, or out, like food hot and for the hospital patient this is even more important. The patient's meal is not just a break in the day, it is a major event.

3.3.1.2 ***Functional Elements of the In-Patient Food Service System***

The importance of food to the hospitalised patient has long been known and has been the subject of continuous reports and surveys by the DHSS and other Health Service oriented research bodies, such as the King Edward's Hospital Fund for London (1966). A DHSS (1980) report on hospital meals stated,

> ***"The importance of the food provided to the patients in our National Health Service Hospitals to aid their recovery and their well-being cannot be over-estimated."*** (DHSS 1980)

Gregory's (1978) survey of patients' attitudes to the hospital service showed that 18% of the patients interviewed were dissatisfied with the food in some way. A more recent survey by the Patients Association, Marcus (1992) showed that hospital catering was one of the areas most heavily criticised by patients. As a result of this survey, the Patients Association (1993) issued guidelines relating to patient food service provision. Further work undertaken by the National Audit Office (1994) found that, of 24 randomly selected hospitals in England, 15% of patients considered the food to be poor or very poor. The statistics have shown no major improvement since the survey conducted by Gregory 24 years earlier.

Although great improvements have been made in hospital catering, there is still scope to improve patient satisfaction. Anecdotal evidence from patients is useful in pinpointing the problem areas. The following extract, from an account of a patient's stay in hospital, is at best a frustrating, at worst a potentially health endangering, and unfortunately a relatively common experience for some hospital patients,

> ***"And the food. I couldn't manage to stagger to the dining room that evening, nor would anyone bring supper to me in bed. Later, nothing could be found for me to eat - not a biscuit, not a slice of bread. A sleeping pill meant that I missed breakfast the next morning : I was asleep when it was served, and that was that!"*** (Anonymous 1993)

Looking closely at what the patient said, it is plain to see that the patient did not once complain about the *quality* of the food that was being served. The reason for this is clear : the patient never received any food. In fact, the patient did not have the opportunity to complain about the quality of the actual food. Clearly, there was a problem with the interface of the food service system with other systems e.g. nursing and medical systems within the hospital. A poorly timed sleeping pill meant that the patient missed breakfast and the food service system was unable to respond by providing food at a more convenient time for the patient. This anecdotal evidence illustrates Cardello's (1982) proposal that there are two interacting factors which must be considered when analysing problems in food service systems. These are the food itself, including recipes and ingredients and the second is the food service system: i.e. the cooking methods, delivery methods, menus, dining atmosphere etc. In the first instance, if the quality of food bought in is poor the likelihood of a patient enjoying a meal made from such food is small. Factors associated with the food service system are often characterised independently of the food but will also affect the patient's perception of the system and his/her perception of the food. For example, a poorly designed tray delivery system may result in cold food reaching the patients; this will affect not only the patients' perceptions of the system that delivered the food but also their perceptions of the food itself. Patients are the ultimate users of the food service system but other user groups directly involved in production, delivery and service can be adversely affected by a poorly designed system. A food service system which allows too many slack periods interspersed with periods of intense work or other inappropriately designed systems will not achieve maximum personnel performance. Bobeng's (1982) paper for the Hospital Patient Feeding Systems Symposium showed that not only are staff users upset by poorly designed systems but, at the end of the day, staff frustrations with the food service system are likely to have a knock-on effect on patients, *"A disgruntled or overworked labour force can affect food quality and meal acceptability."* (Bobeng 1982)

It is the link between the design and function of the food service system *and* the end product (meal experience for the patient and system functioning for other users groups) which forms the core of the information on the quality of product, as part of a research methodology linking product and process.

3.4 The Development of In-Patient Food Services

Some of the problems experienced by the patient, and common to many hospitals, are linked to the historical development of catering in hospitals. An appreciation of this is central to an understanding of problems which exist in current hospital catering systems.

During the evolution of hospital design there has been an increasing tendency to remove the so called "support services" such as laundry and catering to a centralised production/work unit within the hospital. This has meant that there has been a shift in food supply. The earliest hospital patients were totally reliant on relatives and friends providing food from outside the hospital. Nutrition was later provided by individual ward kitchens but is now provided by a centralised cooking and distribution point within the hospital.

Until the Second World War, catering and housekeeping generally remained in the charge of the matron and her assistants in most hospitals. In 1943 the first of a series of memoranda on hospital diets was published by the King Edward's Hospital Fund For London, as reported by Platt et al (1963). This memorandum noted that hospitals had been accustomed to providing only one full meal a day, and had relied very considerably on provisions such as eggs, butter and fruit brought in by patients' relatives. Wartime rationing stopped this source, and a study, by Sir Jack Drummond, on the nutritive value supplied in three hospitals, demonstrated serious inadequacies. The National Health Service, from its inception in 1948, undertook to make full dietary provision for hospital patients and the management of catering in larger hospitals passed to the catering officer, who managed the catering department.

Since the Second World War, welfare catering has seen a great deal of technological development and this is true of food service in hospitals. Jones (1988) indicates that the hospital sector has developed highly specialised systems, designed to overcome problems associated with centralised kitchens serving wards that are widespread throughout hospitals. The traditional method of delivering food to the wards was the bulk trolley method but central tray distribution systems have now been in operation in the UK since the early 1960s. A description of these two systems is contained in the DHSS (1986) Catering Building Note 10, Catering. The first of the central tray/plated meals systems to be introduced was the "Ganymede" system, originally developed in the USA. The system has been introduced in UK hospitals as reported by the King Edward's Hospital Fund for London (1966) and Platt et al (1963). There are many manufacturers that market central tray distribution systems but the systems all work around the same concept. The major differences between the systems available is their method of keeping food hot. Central tray distribution systems have been increasingly recommended for hospital and institutional catering as reported by Jonsson et al (1977). This system of patient meal distribution is recommended in the UK by the DHSS, is becoming increasingly common in Sweden and one specific type of system is in use in 15 different countries, (Beavan 1975, Jonsson et al 1977, de Fielliettaz Goethart et al 1980, Harvey 1980 and DHSS 1986). However, in a report by the National Audit Office (1994), on Hospital Catering in England, it was found that the majority of hospitals deliver meals using a bulk trolley system. In terms of production technology, nearly one third of NHS hospitals employ cook-chill in preference to traditional catering methods.

3.5 Centralisation of In-Patient Food Services and its Effect on System Functioning

This shift to a centralisation of in-patient food services has had obvious benefits in improved hygiene control; saving of catering labour and nursing time along with financial savings. However, these new high-tech systems have had other disquieting effects. In the mid 1970s the dietetic and medical professions were expressing concern over the number of hospital malnutrition cases appearing. For example, Butterworth and Blackburn (1975) highlighted the effect of institutional food services on patients' welfare, suggesting that some cases of hospital malnutrition were, at least in part, an unexpected and insidious by-product of sophisticated food service systems. An article in "Nutrition Today", supporting the work of Butterworth and Blackburn (1975), indicated that some of the problems of the unnecessarily malnourished could be ascribed to,

"...basic difficulties in the system..." (CFE 1975)

Zallen's (1975) support of the link between hospital food service design and hospital malnutrition is clearly illustrated by the following,

"...the nutritional difficulties patients suffer have almost been programmed into the institutional food service system which is now standard." (Zallen 1975)

Zallen (1975) also indicated that the root of the problem was the fact that food service had become divorced from patient care, this being instigated by the introduction of "high-tech", sophisticated food service systems,

"The synergistic relationship between food and nutrition within the hospital was neatly broken." (Zallen 1975)

Cases of hospital malnutrition were still being identified as late as the 1980s, for example in Fenton's study (1989) and in that of Sims' (1990) study. Moreover, according to the most comprehensive inquiry into hospital food in the last decade, by Davis and Bristow (1999) four in ten adults and 15% of children are under-nourished when they arrive in hospital and they lose weight during their stay. The report indicates that, on average, patients leave about 40% of their lunchtime and evening meals; therefore, not only does poor and inadequate food delay recovery but it makes patients prone to infection and can lead to post-operative complications. Davis and Bristow (1999) estimated the cost of all this to the NHS to be approximately an extra £300 million per year.

Edwards and Nash's (1999) recent research relating poor nutritional intake and high levels of food wastage in hospitals, to the food production system and style of service, showed wastage of approximately 35% and 58% for central plating and ward plating, respectively.

3.6 Building Design and Operational Mis-Matches in Food Service System Functioning

These types of problems are common to all modern hospital catering systems, however, there have been many other problems which have come about as a direct result of design and operational mis-matches during building procurement. For example, two errors in hospital planning involving catering functions are seen at one of the Best Buy Hospitals and at Bangor Hospital.

The Best Buy Hospital at Bury St. Edmonds was an attempt at saving space, money and time. Smith's (1984) British Medical Journal article on Hospital Building in the NHS reported that the kitchens were designed to handle ready prepared meals, which were, in the event, never used at Bury, rendering the kitchens inadequate. Of this same hospital, Stone (1990) reported, *"But the real crunch comes in the kitchen. Here the cooking and food distribution space is so tight that staff turnover is already a problem. Only one short belt distributes trays to all the wards and the general clutter and noise will be a real problem when all 550 beds are in operation."* (Stone 1990)

At Bangor Hospital in Wales, the waste pipes from the pathology department ended up running through the kitchens, and the positioning of the ventilation equipment made the kitchen unworkable, (Smith 1984). These particular design and operational mis-matches were peculiar to those actual hospitals. Although such seemingly obvious blunders are worrying, what is of equal concern is the less obvious, but equally problematic inadequacies which seem to be repeated again and again in hospital food service systems. For example, the positioning of cold air fans above the conveyor belt used for plated meal portioning help to cool down the kitchen staff working at the hot bain-maries. However, if the conveyor belt is stopped for any length of time e.g. for correcting errors, then food sitting on the belt rapidly cools, (Brownridge 1984). The crucial point is that the construction project organisational structure should ensure functional success by maintaining integration between building design and operational planning throughout the whole of the procurement process.

3.7 Conclusions

Clearly, function is a very important element of complex multi-user buildings and their component sub-systems, particularly where a variety of different building users and their associated activities are bounded by a complex organisational structure. Examination of the literature emphasises the need for a functional definition of quality which must be applied to complex multi-user buildings: at the start of the project so that functional efficiency assumes the role of a primary objective; throughout the project so that progress can be made against this objective; and at the end of a project so that the built form can be investigated to determine whether the finished solution does encompass and facilitate the needs of user groups within the building.

The health sector is largely dominated by complex multi-user buildings and in order to function effectively, these buildings must be designed to accommodate the needs of many different user groups. When such building designs are not effective in facilitating the achievement of organisational and user groups' goals and activities, then serious functional problems often result. A dysfunctional hospital building will affect not only the staff user groups but ultimately the patients; the most vulnerable user group in the building. Food service is an important sub-system of the hospital building since, as far as patients are concerned, it is the aspect of an otherwise unfamiliar environment which they can relate to.

Research carried out by Hughes (1989) into the organisational structure of public sector building projects demonstrated how project outcome was affected by the project management process. Hughes did not attempt a detailed investigation of the specific deficiencies identified by the building users on each project. However, close inspection of the data shows that the majority of these deficiencies can be attributed to a mis-match of building with operational requirements. In other words, the buildings were not entirely successful in facilitating building users' activities and achievement of goals within the final built form. In effect, the building procurement processes were not able to create functionally successful buildings.

What is needed, is a greater understanding of the process which leads to the design of an efficient and user friendly building. By engaging in a closer analysis of cause and effect in functional problems for large, complex, multi user buildings, relating defects in the product to the process which created them, this project aims to go further than previous research in contributing to this understanding.

This chapter has explored the concept of functionality, as it relates to quality measures of construction project performance. It has pointed to measures of quality which can be adopted by the methodology and identified a sample of buildings to be used in measuring this quality. Chapter 4 considers the complex project procurement process involved in the design of multi-user buildings. It involves discussion of the process of building procurement and aims to explain why decisions are made that can lead to an apparently sub-optimal building function.

3.8 References

Abrams, J. (1982) "Hospitals Face £30m Bill Says Whitehall." Building Design, February 5th : 2.

Anonymous (1987) "Hospitals with a Human Face." Interior Design, July/August : 40-42.

Anonymous (1992) "Is it Worth Going Private?" Which. August : 426-429.

Anonymous (1992) "Building The Best, Part 2 : Ideas on the Drawing Board." Hospital Development, April : 22-25.

Anonymous (1993) "Medical Mis-management." Patient Voice, Winter 1992/1993, Issue No. 5 : 12.

Baird, G., Gray., J, Isaacs, N., Kernohan, D. and McIndoe, G. (1996) "Introduction." In Baird, G., Gray., J, Isaacs, N., Kernohan, D. and McIndoe, G. (eds.) Building Evaluation Techniques. McGraw-Hill; New York.

Beavan, A. J. (1975) "Design for Health Service Catering." Hospital Development, January/February : 18, 20-21.

Becker, F (1990) The Total Workplace - Facilities Management and the Elastic Organisation. Va Nostrand Reinhold; New York.

Bobeng, B. J. (1982) "A Foodservice Manager's Perceptions of Meal Quality." Proceedings of the Hospital Patient Feeding Systems Symposium. October 19th-21st 1981, Minneapolis, Minnesota. National Academy Press.

Brownridge, E. (1984) "The Benefits of Quality Assurance." Foodservice and Hospitality, May : 35,37.

Burgun, J. A. (1989) "Meeting Patients' Needs - Providing a Caring Environment Under Extreme Conditions in the Middle East." 26th International Hospital Congress, The Hague, May 29th-June 2nd.

Butterworth, C. E. and Blackburn, G. L. (1975) "Hospital Malnutrition." Nutrition Today, March/April : 8.

Cardello, A. V. (1982) "Patients' Perceptions of Meal Acceptability." Proceedings of the Hospital Patient Feeding Systems Symposium. October 19th-21st 1981, Minneapolis, Minnesota. National Academy Press.

C. F. E. (1975) "A Common Cause." Nutrition Today, March/April : 19.

Cold, B. (1992) "The Dynamic Concept of Quality." Pre-Proceedings of First International Symposium of CIB Working Commission W82 : Futures Studies in Construction. Construction Beyond 2000 : Future of Construction - Construction of the Future. June 15th - 18th 1992, Espoo, Finland.

Committee of Public Accounts (1981) "Seventeenth, Report Session 1980-1981. Financial Control and Accountability in the National Health Service." HMSO; London.

Committee of Public Accounts (1990) "Eighteenth Report, Session 1989-1990. Hospital Building in England." HMSO; London.

Committee of Public Accounts (1984) "Sixteenth Report, Session 1983-1984. Manpower Control, Accountability ond other Matters Related to the National Health Service." HMSO; London.

Committee of Public Accounts (1977) "Ninth Report, Session 1976-1977." H.M.S.O.; London.

Corcoran, M. and Wilson, B. (1990) "St. Mary's Isle of Wight - Low Energy Engineering." Hospital Development, October, **18** (9) : 29,31,33.

Davis, A. M. and Bristow, A. M. (1999) Nuffield Trust Series No 10 : Managing Nutrition in Hospital. Nuffield Hospital Trust.

de Felliettaz Goethart, R. L., de Boer, J. P., Colen, A. A. M. and Lassche, J. B. (1980) "Comparison of Heat Insulating Properties of Three Different Food Service Trays." in Glew, G. (ed.) Catering Equipment and Systems Design. Applied Science Publishers; London.

Department of Construction Management, University of Reading and RICS (1979) "U.K. and U.S. Construction Industries : A Comparison of Design and Construction Procedures."

Department of Health and Social Security (1983) "Underused and Surplus Property in the National Health Service." HMSO; London.

Department of Health and Social Security (Health Building Directorate) (1986) "Health Buildings Evaluation Manual." HMSO; London.

Department of Health and Social Security (1986) "Capricode Health Building Procedures Manual." HMSO; London.

Department of Health and Social Security (1980) "Health Service Catering : Hospital Meal Survey." HMSO; London.

Department of Health and Social Security and Welsh Office (1986) "Health Building Note 10 Catering Department." HMSO; London.

Dichter, E. (1954) "The Hospital Patient Relationship." The Modern Hospital, **83** (5) November : 61-63.

Eardley, A. and Waldsworth-Bell, J. (1986) "Think Before You Build." Health Service Journal, May 1st : 596-597.

Edwards, J. S. A. and Nash, A. H. M. (1999) "The Nutritional Implicatons of Food Wastage in Hospital Food Service Management." Nutrition and Food Science, No 2 March/April : 89-98.

Fenton, J. (1989) "Some Food for Thought." Health Service Journal, June 1st : 666-667.

Filerman, G. L. (1981) "Editorial." The Journal of Health Administration Education, Fall 6, 4 (part 1) : 663-664.

Gregory, J. (1978) "Patients' Attitude to the Hospital Service." HMSO; London.

Guinn, R. (1990) "Hotel California." Hospital Development, June : 32-33, 36-37.

Harvey, J. (1980) "Meal Distribution Equipment for Institutions and Health Care Feeding." in Glew, G. (ed.) Catering Equipment and Systems Design. Applied Science Publishers; London.

Hughes, W. P. (1989) "Organisational Analysis of Building Projects". PhD Thesis, Department of Surveying, Liverpool Polytechnic.

Hunter, J. K. (1972) "Evaluating a New Hospital." World Hospitals, **7** (1) : 201-205.

Institute of Advanced Architectural Studies, University of York (1988) "Points System for Evaluating Development Options to Reduce Operating Costs."

Jones, P. (1988) "Foodservice Operations, Second Edition." Cassel Educational Ltd.: London.

Jonsson, L., Ohlsson, L. and Lindholm, B. (1977) "Comparison of the Temperature Holding Capacity of Three Different Tray Distribution Systems." in Glew, G. (ed.) Catering Equipment and Systems Design. Applied Science Publishers; London.

King Edward's Hospital Fund for London. Hospital Catering Advisory Service. (1966) "The Ganymede Tray Service in Hospital : A Joint Report by the King Edward's Hospital Fund for London and North East Metropolitan Regional Hospital Board on the Ganymede Tray Service at Bethnal Green Hospital."

Knobel, L. (1985) "Patients Rewarded." Designers' Journal, July : 50-53.

Koncel, J. A. (1977) "Food Service has Vital Role in Overall Hospital Operations." Hospitals, August 16th, **51** : 111-114.

Lee, T. (1976) "The Design of Hospitals." in Lee, T. (ed.) Psychology and the Environment. Methven; London.

Maller, O., Dubose, C. N. and Cardello, A. V. (1980) "Consumer Opinions of Hospital Food and Foodservice." Journal of the American Dietetic Association, 76 (3) : 236.

Marcus, N. (1992) "Patient Comment Form." Patient Voice. Issue 55 Winter : 3.

Nagasawa, Y. (1990) "Guideline on Programming and Design in Developing and Developed Countries." Joint Conference of The Public Health Group, Committee on Architecture for Health and Architecture for Healthcare Committee. The Role of Architecture in Health Care : Year 2000 and Beyond, Ottawa, May 25th.

Nahapiet, J. and Nahapiet, H. (1985) "The Management of Construction Projects : Case Studies from The USA and UK." CIOB.

National Economic Development Council (1976) "Engineering Construction Performance." HMSO; London.

National Audit Office (1989) "Hospital Building in England." HMSO; London.

National Audit Office (1994) Report by the Comptroller and Auditor General. National Health Service : Hospital Catering in England.HMSO; London.

Pearl, K. (1987) "Designs Made on Old Hospitals." Health Service Journal (Supplement), December 3rd : 1-3.

Platt, B. S., Eddy, T. P. and Pellett, P. L. (1963) "Food in Hospitals : A Study of Feeding Arrangements and the Nutritional Value of Meals in Hospitals." Oxford University Press for Nuffield Provincial Hospital Trust; London.

Preiser, W. F. E., Rabinowitz, H. Z. and White, E. T. (1988) "Post-Occupancy Evaluation." Van Nostrand Reinhold; New York.

Rawlinson, C. and Whittlestone, P. (1990) "Patient's Perspective." Joint Conference of the Public Health Group, Committee on Architecture for Health and Architecture for Healthcare Committee. The Role of Architecture in Health Care : Year 2000 and Beyond, Ottawa, May 25th.

Sagehomme, D. and Laigle, F. (1990) "Architecture and Working Conditions : Stress at Work." in Moran, R., Anderson, R. and Paoli, P. (eds.) Building for People in Hospitals : Workers and Consumers. The European Foundation for the Improvement of Living and Working Conditions; Dublin.

Scottish Affairs Committee (1987) "First Report, Session 1986/1987. Hospital Provision : Volume 1. Report together with the Proceedings of the Committee." HMSO; London.

Searle, O. (1980) "Witch-Hunt Launched over Hospital Defects." Building Design, November 14th No. 521 : 68.

Sheatsley, P. B. (1965) "How Total Hospital Experience Shapes Patients' Opinion of Food." Hospitals, **39** : 105.

Shumaker, S. A. and Pequegnat, W. (1989) "Hospital Design, Health Providers and the Delivery of Effective Health Care", in Zube, E. H. and Moore, G. T. (eds.) Advances in Environment, Behaviour and Design. Plenum Press; New York.

Sims, J. (1990) "Weighty Problem of Feeding the Elderly." Health Service Journal, December 13th-20th : 1858.

Smith, J. (1984) "Hospital Building in the N.H.S." British Medical Journal, **289** : 1437-1440.

Smith, J. (1984) "Hospital Building in the N.H.S." British Medical Journal, 289 : 1599-1602.

Stone, P. (1990) "British Hospitals and Health Care Buildings : Designs and Appraisals." Architectural Press; London.

The Observer, Sunday 9th September, 1984.

The Patients Association (1993) "Hospital Food Guidelines - Catering for Patients in Hospital." The Patients Association.

Thompson, A. (1985) "Welsh Office Plans to Sue Over Bangor "Hospital Nightmare"." Building Design, October 4th No. 758 : 6.

Van Wagenberg (1990) "Post-occupancy Evaluation of a General Hospital." in Moran, R., Anderson, R. and paoli, P. (eds) Building for People in Hospitals : Workers and Consumers. The European Foundation for the Improvement of Living and Working Conditions.; Dublin.

Walker, A. and Hughes, W. P. (1984) "Project Organisation and its Impact on Quality." in Brandon, P. S. and Powell, J. A. (eds.) Quality and Profit for Building Design. Spon; London.

Zallen, E. M. (1975) "Let's Reforge the Link." Nutrition Today, March/April : 27-28.

CHAPTER 4
The Process

4.1 Introduction

In the realisation of a conventional building the following statement, made in the National Association of Health Authorities in England and Wales NHS Handbook (1983), presents a rather simplified view of the complexity of the process which progresses a building from conception to its final completion and occupation,

> ***"In a conventional building project the client determines his brief on which the professional parties prepare a design for which competitive tenders are sought and on which the successful contractor is selected,"*** (National Association of Health Authorities in England and Wales 1983)

An alternative, more popularly held, view of building design is presented by Hill (1977) writing on workplace design,

> ***"Designing buildings is a complex and elaborate process. It involves many designers of differing skills as well as the client himself, and depends for its realisation upon a team of contractors, sub-contractors and suppliers. The process may well extend over several years and it is quite common for personalities involved with particular aspects to change, sometimes more than once. These complexities have often been compounded in buildings which are technologically more advanced."*** (Hill 1977)

Certainly, hospitals represent some of the most complex and technologically advanced building types and, within the hospital itself, there can be few systems equal to the food service function which have such a pervasive influence on the many different types of hospital user. Buildings are produced by many participants during successive stages of a design and construction process but those involved in the process may not necessarily be the ones that occupy and use the completed building.

The success or failure of the outcome of the project procurement process means that the functionality of a building is already determined to a high degree by the way the multiple project contributors relate to one another whilst undertaking work on the building procurement project. This is a crucial tenet of the research.

Two key issues, identified as being central to the research, have already been discussed in previous chapters: the impact of the project environment, in Chapter 2 (section 2.5.7 Analysis of the Project Environment); and the focus on a functional approach to building performance. Chapter 3. The building procurement process, and associated organisational structure, is only a temporary phenomenon, described by Cherns and Bryant (1984) as a "temporary multi-organisation", arising as a result of the client's response to environmental pressure. The client organisation's construction project activities are distinct from primary business activities. Throughout the lifetime of a construction project, the environment keeps impacting on the project: directly, through the construction project organisational structure; and indirectly, through the organisational structure that provides a framework for the client's primary business activities

Realising the client organisation's performance needs for the building is a highly complex process. A successful outcome requires a procurement process that facilitates communication between the client organisation and construction professionals. Effective dialogue is crucial for achieving the functional building objective as the client organisation must communicate operational requirements to the construction procurement professionals. Identifying who the "client" actually is, is not necessarily straightforward. Particularly for complex, multi-user buildings, the "client" may comprise many different user groups, existing in an elaborate organisational structure. In addition, a part of the management hierarchy within the client organisation will have decision-making authority on the building procurement project. Thus, with regard to the client, there is the potential for confusion in determining who the building is being built for. Client organisation complexity is an important issue and is explored more fully in section 4.2 Client Organisation Complexity.

As well as difficulties surrounding client complexity, effective communication between client organisation and design professionals can be negatively affected by differences in specialism and conceptual/perceptual differences, (Canter 1972), Medical Architecture Research Unit (MARU) (1975) and Wallace 1987). These difficulties are discussed in section 4.3 Conceptual Differences and Differences in Specialism.

As the focus of the research is on the *functional* performance of buildings, the user perspective is vital, since only the user can provide comprehensive information on activities that must be undertaken in the building, (Zeidler 1974 and Baxter 1983). As the user perspective is important, this chapter examines two methods of user input into design: direct user participation through the briefing process (refer to section 4.4.1 Briefing and Building

Design); and indirectly from post-occupancy user evaluations of similar existing buildings (refer to section 4.4.2 Post Occupancy Evaluation).

Successful projects, as defined in functional terms, require close and effective co-operation between the client organisation and construction procurement professionals. The effectiveness of the procurement process in bringing together the client organisation and construction procurement professionals (hence unifying operational planning and building design) is key in determining functional success. Clark (1990) acknowledged the importance of client integration in the building procurement process for successful building. An integrating process is essential in order to counteract the potential communication difficulties created by differences in specialism and conceptual differences. Section 4.5 (Unification of Design and Operation through the Procurement Process and the Impact of Guidance) examines the role of the procurement process in maintaining unity between building design and operational planning to achieve effective functioning.

Section 4.6 (Theoretical Constructs and the Complexities of the User/Building Interface) of this chapter develops theoretical constructs to assist in explaining the complexities of the user/building interface, particularly in terms of functional problems in complex, multi-user facilities. These are applied to the case studies in order to help to determine the cause of the functional outcome deficiencies.

4.2 Client Organisation Complexity

According to the renowned hospital designer Zeidler (1974),

> ***"The purpose of design is to create an environment sympathetic to the needs of man..."***
> (Zeidler 1974)

Few would argue with the sentiment behind Zeidler's view on design for humanity. There is, however, one fundamental problem with this view and this is centred around the potentially conflicting needs of different people within the same building. In the case of complex multi-user buildings, it is very difficult to produce a building which satisfies the needs of all the users. This is largely due to the fact that design solutions are the result of trade-offs and compromises between different user groups. Effectiveness for one function may decrease effectiveness in another and designs may not be equally efficient for all user groups occupying a similar setting, therefore, it would seem unwise to make one user group dominant over all others within a large, complex multi-user building. A historical quote by Nightingale (1863) shows that there is possibly one building where the needs of all other user groups should be subservient to the needs of one. This occurs in the hospital where,

> ***"The mode of construction in hospitals, it is presumed, to be determined by that which is best for the recovery of the sick."*** (Nightingale 1863)

In making such a statement, Nightingale assumed that the primary purpose of the hospital is for treatment of the ill; one could hardly imagine a hospital without patients. Since the patient is the ultimate consumer of hospital services and is the raison d'être of the hospital, justifying the existence of such a building, one could assume that the patient may be entitled to some involvement in the decision making process concerning the provision of new facilities. In practice, during construction of a new hospital within the public sector, the "client" (that part of the client organisation acting as the project generator) is usually either the Regional or District Health Authority. Although the Regional/District Health Authority is the primary decision maker, other tiers of NHS management have a role to play in new hospital developments. The DHSS, as an agent of central government, usually provides most of the capital funding for schemes and is responsible for their final approval. The financial provider is seen as distinct from the primary decision maker and these two groups are also distinct from the building users. Unlike most private sector building projects, construction projects undertaken in the public sector have a much less easily identifiable client. In complex multi-user buildings there may be a multiplicity of separately accountable parties which may all be involved in the decision making process and may all have a legitimate claim to make a judgement on a building. Problems in identifying the client have been discussed in both Walker's (1980) and Hughes' and Walker's (1988) work concerning project organisation and performance. The NHS itself is perplexed over this issue, although expresses an attitude which demeans the importance of the patient,

> ***"In the NHS it is difficult to determine the identity of the "client". Is it doctor, nurse, administrator, treasurer, works officer etc. or <u>possibly even the patient</u>. Early and effective resolution of this problem for each building scheme is probably the greatest single contribution to its success."*** (my emphasis) (National Association of Health Authorities in England and Wales 1983)

Difficulties surrounding our conceptions of the client organisation may be partially resolved if we envisage the client organisation as consisting of the "project generator" (a term used by

Walker (1980) to identify the individual or persons supplying the initial impetus, funding, manpower and other resources necessary to progress the project, (similar to Zeisel's (1984) "paying" client) and the users who work in or visit the building. However, even this does not clarify the complexities of the hospital client organisation where there is a distinct difference between building user groups: staff; patients; visitors; and the "project generator" consisting of a number of management tiers.

Lucas (1970) also recognised differences in the user groups of buildings, particularly those with a service function such as hospitals. Lucas (1970) noted that such buildings have a group operating the facility, which is stable, and a group for whom the facility operates and whose individual members change frequently. Hospitals illustrate these characteristics. When planning a building for a group that already exists, as in a company, data about needs can be obtained by asking the group members. Data about potential users of new facilities can only be obtained from present users of existing similar facilities. Thus, in hospital planning, influential views come from staff of existing hospitals and senior management personnel of Regional and District Health Authorities. The people who use the facility, future patients and their visitors, are transient and are, therefore, not consulted. There are sceptics in the NHS who believe that user involvement in design is a waste of time. These views are entrenched in some of the highest levels of health service management as illustrated by the following statement made by the Chairman of Argyll and Clyde Health Board to the Scottish Affairs Committee in 1987,

> ***"...the Health Service is unique, in that every time you decide there is a service lack somewhere that requires a capital project to fill the gap, everybody and his brother wishes to be involved in the consultation process that goes with it...it seems to me that the tradition in the Health Service is that you do not build anything unless everyone from the senior consultant to the porter at the door has agreed to where everything will go; and that wastes time."*** (Scottish Affairs Committee 1987)

The problem with this attitude, is that it ignores the fact that the user is really the only comprehensive source of information on the sensitivity to social and psychological factors in the environment which affect the user, (Baxter 1983). Baxter's conclusion on this could also be extended to functional elements of the built environment. As far as patient input is concerned, Rawlinson and Whittlestone (1990) indicate that if we are serious about taking account of the patient's perspective then this needs to be achieved at all stages in the planning and design process. Differences in specialism and conceptual differences between users and client (project generator) and client and designers increases the gap between the person who designs the building and the people the building is being designed for. This increases the probability that the final building solution will not support the important functional requirements of the building users. The next section investigates these differences and their effects in more detail.

4.3 Conceptual Differences and Differences in Specialism

During briefing, and subsequent stages of the procurement process, there is the potential for conflict and mis-understanding between the main interested parties, i.e. client organisation (which may comprise an elaborate structure of inter-related user groups and management tiers) and construction professionals. Research by Vischer and Cooper Marcus (1982) and Scott (1987) has shown the considerable potential for mis-match between building users and building user activities because of the very different values/perceptions between architects and non-architects. As Baxter (1983) indicated, the best results, usually in simple situations, occur when designer and client are one and the same. In more complex situations, where there are a number of intermediaries between the designer and the people who are actually going to use the building, problems may arise. This is explained by Zeisel's (1984) user-needs gap model which shows that "client users" have no control and no choice over building design because they are removed from both the designer and paying client. The problems have a multiple aetiology but are partly caused by confusion between the distinction of user and client roles. Additionally, work by Edwards (1974) found that when architects do not know enough about users they, quite wrongly, adopt their own lifestyles as a standard for design.

Baxter's (1983) work in relation to client and user role confusion was carried out in relation to livestock building but the underlying principles can be applied to hospital building. In livestock building the client (farmer) and user (cow) are distinctly different. Somehow the needs of the cow must be made explicit in order to provide accommodation which is appropriate to its needs. Similarly, in hospital building the "paying" or "project generator" part of the client organisation (Regional or District Health Authority) is distinct from the users within the client organisation but the problem is compounded because of the variety of potential hospital users (anyone from brain surgeon to mortuary attendant to patient). All these different user groups must make their needs explicit so that they can be incorporated into the final building solution.

One of the greatest barriers to effective communication between the client organisation and the designer is due to differences in conceptualisation. On this subject Allen (1984) noted that, *"A design team's perception of the benefits which a client obtains from his buildings may be fundamentally different to those which the client perceives. As such, it is vitally important, at the outset of a project, that the client's perception of the benefits the building will provide are diligently sought and understood by the design team. Omission of such understanding can cause the resultant design to be totally mis-directed."* (Allen 1984)

Jenks (1977) also noted that,

"Not only do clients lack an understanding of the effects of buildings, also those who design buildings can, and do, misapprehend the effect they have on users." (Jenks 1977)

To overcome such difficulties, Allen (1984) emphasised the necessity for interested parties to explore with the client, his *real,* as distinct from *apparent* requirements. This is a useful strategy although it is the requirements of the *building users* which should form the basis of such an approach. The users are the real beneficiaries of a process that evolves a successfully functioning building. The differentiation between users and that part of the client organisation that actually provides the funding/impetus/decision-making for the project (project generator or paying client) increases the gap between designers and users since it is the project generator part of the client organisation which is usually the primary contact point. The "gap" between clients (project generator) and designers, clients (project generator) and users and, therefore, designers and users was a focus of Sime's (1984) paper on social research and design and the nature of appraisal,

"Historically, architects used to have more direct contact with the building users for whom they were designing. In recent years there has been an increasing gap between designers and users. The paying clients whom the architects have contact with in large scale building projects may also have insufficient contact with the eventual building users." (Sime 1984)

The difficulties which arise in hospital building, due to differing perceptions and conceptualisations between designers and users, have been studied by Canter (1972). His research work at the Royal Hospital For Sick Children, Yorkhill, Glasgow, gave a useful insight into such difficulties. In this study, differences between the conceptualisations of designers and those of users was shown to affect user satisfaction. The senior nursing officer saw the cardiology department as related to the day bed area and the outpatients' department because it's distinguishing features were the lack of urgency of activity within it and the fact that the patients were not given total care in that department. The architect, however, associated the cardiology department with the operating theatres and other investigation units because of the amount of servicing and medical involvement. In this case, we can see that the user has based his/her knowledge on an intimate working relationship with an operational department, whereas the designer is more concerned with engineering and technological aspects. The fact that the senior nursing officer gave the cardiology department a satisfaction score of "6", compared with a score of "8" for the rest of the hospital in general, and a score of "10" for the wards indicates that the architect may have produced an environment for the cardiology department less likely to fit the conceptualisations of its users rather than his/her own conceptualisations of how the department should function.

Obviously, without an understanding of user needs, and a clear indication of the priorities and the main dimensions that cause satisfaction or dissatisfaction with the physical environment, decisions regarding design features will remain largely arbitrary, or at best, based on the experience of the "paying" client and designers which can vary enormously. A detailed and fundamental piece of research, by Wallace (1987), investigating communication between design team members suggested that there is a perceptible lack of understanding between architect and client and that differences in specialism are partly to blame. In hospital planning these differences have been acknowledged by the Medical Architecture Research Unit (1975),

> ***"...perhaps a more fundamental cause of the widening gap between professions is increasing specialisation."*** (MARU 1975)

One problem with the building procurement process for those in hospital administration is that the tools used in communication are unfamiliar. Falick (1981) suggested that the opportunity is there to create a new building but administrators are unfamiliar with plans and they do not know how to relate to the process,

> ***"...they do not know how to relate to this whole new team of other professionals they have hired (architects, medical equipment specialists and interior designers), who speak a different language."*** (Falick 1981)

Baynes (1971) study highlighted some of the communication difficulties experienced on the Greenwich Hospital project,

> ***"During the early stages of the Greenwich project comments concerning recently completed hospitals revealed that quite often, when a building was completed, the user had not got what he thought he was going to get. And worse, that this situation arose***

when user and designer each thought that they had understood the ideas, language and requirements of the other...Words that meant one thing in one discipline meant something quite different in another. Plans and drawings often seemed to confuse as much as they enlightened." (Baynes 1971)

The client organisation that is planning a building programme may have developed written documents outlining a strategic plan, a capital investment plan, and a functional space programme, but blueprints and specifications represent new written and graphic communication. When the process changes from a written set of documents that the client can control (the brief) to one where architectural sketches, technical drawings and three dimensional models and other unfamiliar instruments are used to create the solution, a bridge is needed. Falick (1981) suggested that the design process that works properly becomes the bridge between words, architectural tools and the resulting built form. Hill's (1977) words sum this up quite succinctly,

> ***"Good designs grow best where there is sympathy and understanding between client, designers, and advisers,...so that without foregoing any of the rigorous testing and questioning which must be part of the design process there still remains an openness on all sides to search for true meaning and try to express it."*** (Hill 1977)

If users do not have knowledge of the original intentions behind the design, then quite obviously buildings might not be used as intended. Perhaps it seems a little obvious that people could learn to utilise a building better if they understood the designer's intentions and could be persuaded that these intentions were appropriate to them and had been fulfilled. Yet, as Bishop (1984) points out, at least in the sphere of school building, architects have not always thought that users of a completed building might actually need some briefing on the designer's intentions. In the health building sector too, building users do not always have the appropriate knowledge to utilise a new building resource. On this point, Baynes (1971) noted,

> ***"...users prove not to have knowledge of the original intentions behind the design. A link in the chain has been left out, frequently leading to inconvenience and waste in operation."*** (Baynes 1971)

The client organisaition in multi-user buildings is extremely complex but in order to arrive at a building solution which encompasses different user groups' needs it is essential that these user groups take part in the building procurement process. The next section examines user participation in building procurement.

4.4 User Participation in Building Procurement

There is a story, used by Green (1975) in an article relating to design for user needs, which is analagous to the problems of the user part of the client organisation participating in design. This is the story of the animals on the farm who were so pleased at the way the farmer was looking after them that they decided to give him a present. So they elected a committee, consisting of a chicken and a pig. After some deliberation the chicken suggested that a suitable gift would be a lifetime supply of bacon and eggs. "That's all very well," said the pig, "You're only participating but I'm involved." In the context of the construction industry, in hospital planning, the chicken is represented by the project generator part of the client organisation, which generally holds all the decision making power. The pig, is represented by the building users who, although they may *participate*, or be involved, to some extent in decision making, are *involved* with the resulting solutions, that is, it is the users have to work within (and live with) the building solutions which are created. Thus, in the context of the construction industry, those most heavily *involved* in decision-making in the procurement process may not be *involved* with the final outcome of that process - they may not actually occupy or use the completed building.

The client organisation of most public projects is usually fairly complex and is reflected in the elaborate organisational structure of people and activities which the building must contain. In the previous section, it was shown that designer and clients cannot always communicate effectively because of conceptual differences and differences in specialism. However, one must agree with Zeidler's (1974) view that,

> ***"Since the architect cannot intuitively predict the functional requirements of a building, he needs an immense amount of data to start with and he naturally relies on the future user as one important source of such information."*** (Zeidler 1974)

The opponents of user participation argue that it would be impossible to speak to every hospital building user. In the case of hospitals, research has shown that interviews with the patient user group do not produce really useful planning data, (MARU 1975). However, various researchers and practitioners, for example, Becker and Poe (1980), Reizenstein Carpman et al (1986), Ambrose (1990) and Butler (1992) have adopted more imaginative and creative ways of involving potential users, particularly patients, in the design process, and have been successful in incorporating their requirements into the final built form. The Medical Architecture Research Unit (1975) argued that as the planning teams were all potential patients, the combined knowledge and experience of the team of doctors, nurses, administrators and design trained collaborators could represent the patient's needs. Although these professionals can empathise with the patient, they cannot really understand the needs of patients unless they have been in this role before. Suggestions such as the following, made by one leading British consultant, may seem rather extreme, but would give non-users a real understanding of the design concerns which affect particular user groups,

> ***""Designers should be put to bed, trundled around and frightened out of their wits," said one leading West London consultant, as he demonstrated how difficult it was to get out of, let alone move around in, a wheelchair. "We might then," he added, "get better hospitals.""*** (Anonymous 1987)

The fact is that mis-matches between the occupants and the facilities delivered for their use do arise because of differences in perceptions and conceptualisations of clients, designers and users: quite simply, the user is the most exact source of information relating to the user. Approaches to hospital design which fail to recognise the importance of patient requirements are at odds with a hospital design philosophy embodied in the views of Nightingale (1863) and emphasised by more recent professionals who uphold the idea that the patient's welfare is central to hospital construction. On this topic Kraegel et al (1974) say the following,

> ***"As the primary purpose of hospitals is to take care of patients, the care needs of patients should directly dictate the character of every care function throughout the hospital. Otherwise, the mechanics become an end in themselves. Departmental, environmental or organisational needs may siphon off the resources and energy to the detriment of the patient."*** (Kraegel et al 1974)

Evidence from Canter's work (1972) shows that users may be dissatisfied with building function because the design solutions which have evolved have not reflected users' real needs and perceptions and values. This view is reflected in Jones' (1967) highly critical overview of design processes,

> ***"..design decisions ought to become less the responsibility of managers and designers and more the responsibility of consumers."*** (Jones 1967)

Jay (1972) noted that some planners and consumer advocates were showing increasing protest at the lack of consumer participation in planning and design. All users are, by definition, involved in the results of planning and design, but they seldom get the chance to participate in the process of making decisions about what should be planned, how it should be designed, or where and when it will be built, (Green 1975). Such questions were mostly decided long before any consultations took place with those who were using the facility, if in fact they were consulted at all. Green's (1975) article on design for user needs stated that,

> ***"In physical or organisational planning one can distinguish broadly between decision makers and those whose existence is affected by decisions. The latter are "consumers" of planning activity."*** (Green 1975)

Within the sphere of hospital design, the building procurement process is very complex. Decisions are made by people representing patient user viewpoints such as management, medical and nursing staff but they are not the patients. The patients are the consumers, and as a group they have had little say in decisions on alternative forms of service, location of facilities, or design of patient area equipment. As a consequence, many decisions are false. They simply do not reflect either the needs, or opinions, of those for whom the facilities are being provided.

Maxwell's (1989) views on medical choice are also illustrative of the chicken/pig philosophy mentioned previously,

> ***"...medical choices often raise ethical questions about what ought to be done, especially as the opportunities expand to intervene at the beginning and end of life, to choose who will live and who will die. These are fundamentally choices in which the professional should be the agent, not the principal. Finally, in the allocation of scarce resources, professionals and managers are once again the agents. Their insights are illuminating, but in the end the choices should lie in some sense with society."*** (Maxwell 1989)

Essentially, what Maxwell believes is that the selection of choices or decision-making should rest with the real consumers or users of services rather than professionals/managers who act as pseudo consumers. In relation to the chicken/pig scenario, Maxwell's "agents" are roughly equitable to the chickens, similarly the "principal" is the pig.

Part of the problem in hospital design lies in the complexity of the project generator part of the client group which usually consists of several tiers of Health Service management. Many other interested specialist consultants are also involved and there is an emphasis on accountability at all levels. This can make the procurement process appear particularly clumsy. Brauer and Preiser (1976) indicate a particular phenomenon common to complex organisations such as the NHS,

> ***"As organisations grow in size and complexity, the future occupants of facilities become more and more removed from the process that provides the facilities they require. This phenomenon results in misfits between the occupants and the facilities delivered for their use..."*** (Brauer and Preiser 1976)

Preiser and Vischer (1991) also comment on the gap between those who provide a building and those who work in them,

> ***"...ever larger sponsoring organisations and agencies plan, program and design environments for "remote" or "unknown" patrons/occupants whose needs and value positions may differ from those of the often well-meaning decisions makers."*** (Preiser and Vischer 1991)

In the past during the hospital design process, the users, whether staff, visitors or patients, were likely either not to be consulted or only to be consulted very late in the design process when equipment details were being finalised. On this Baynes (1971) noted,

> ***"At this point the scene is set, the rules of the game clearly defined, and the range of choice strictly limited. Yet, this may give staff a sufficient feeling of participation in decision making, and to help overcome difficulties in visualising the physical and organisational environment within which choices are to be made."*** (Baynes 1971)

The extent of user participation in the above scenario is limited and can be viewed as little more than a "carrot". Bayne's (1971) Greenwich Study recognised the direct benefits obtained by a thorough study of user needs and the fact that users feel more assured when they have been involved in the decisions affecting the operation and design of their departments,

> ***"When key staff are appointed after the main decisions have been taken they are bound to feel less sympathetic to the planning proposals than if they had been involved in contributing to them from the start."*** (Baynes 1971)

There are many different types of user embodied in the health building client organisation and this contributes to the complexity of the hospital building procurement process. It is essential to look at sub-divisions within this group because of the effects that the choice of design and operation decisions, made by the project generator part of the client organisation, can have on the user members of the client organisation. When it is recognised that the differing perceptions and conceptualisations among these various groups can affect user satisfaction with function of the built form, it becomes easier to appreciate how user problems can develop. For example, Lucas (1970) cites the tale of the old peoples' ward in a hospital. A lounge was re-furnished with chairs and a few tables. The furniture arrangement was determined by the administrators, who placed the chairs in lines with their backs to the walls, and in a line back to back down the middle of the room. This arrangement was good for the administration because the furniture was easy to clean around, did not obstruct the food trolleys and looked tidy. It totally ignored the needs of those who used the room, the old people who were never consulted or *involved* (the old folks were involved with the *outcome* but not in the *process*). When the arrangement was changed to allow for the formation of intimate groups around small tables, the number of conversations that took place between patients in a typical day nearly doubled. The point is not that the administration wished to discourage conversation between patients, but that they were totally unaware that furniture arrangement affected the lives of patients in any way. Such examples of insensitivity to the influences of the environment abound. The management has a legitimate interest in making its job easier but any clashes with interests of other user groups should be made explicit.

Therefore, it seems particularly important for the users to participate in the development of design ideas and solutions, and similarly for the designers to involve themselves in the development of operational policies and practices : the two are inextricably linked. Designers would then be able to design knowing as much as possible about the user requirements they attempt to meet, and would be able to share directly with the users in deciding just what their requirements were. Involving users in the building procurement process is not an easy task and as Woolley (1985) demonstrated, simple participation is not enough to guarantee user satisfaction.

User participation in the building procurement process has been most visible at the briefing and post-occupancy evaluation stages of construction. These processes are more accessible to users and, therefore, have the greatest potential for users to influence design. The following two sections will explore briefing and post-occupancy evaluation as methods of user participation in the building procurement process.

4.4.1 Briefing and Building Design

Before any conceptual or outline design work can commence, it is essential to have a clear statement of client needs which can be embodied in a formal document, usually called "the brief". Development of the brief and design are exploratory processes which may involve resolving conflicts of interest. Defining the client's requirements and communication of these to the designer is the central activity of the briefing process. Briefing is in effect, a two way education process which takes place between the client and designer. By extended discussion, investigation and analysis of requirements, it aims to set up an agreed baseline suitable for secure design development. There are times during design development when the reason for taking decisions will be questioned: the material in the brief should be the dependable background against which to test them, (Green 1985 and Building Research Establishment 1987).

That there exists an essential link between briefing and building function cannot be disputed. The following excerpt, from an article by Jenks (1977) on the relationship of briefing to building appraisal, illustrates that this is the case and also emphasises the complexity and necessary detailed communication which should occur between client and architect,

> ***"The expression of needs into an operational form as published in design guidance represents a significant input to the briefing process. Briefing for a building should consist not only of a written document presented by the client department to the architect, but should involve a complicated, detailed and cyclical process including a series of meetings and discussions at varying levels from the inception of a building, through into the stages of outline and detailed design. The briefing process is an information seeking process."*** (Jenks 1977)

The link between briefing and successful food service facility design and function was considered in a paper by Furnivall (1977) at a catering equipment and systems design symposium. The paper stated that,

> ***"Any kitchen layout produced by an architect or kitchen planner can only be as good as the brief developed with, by and for the client. It is imperative that the client first decides exactly, albeit within a flexible framework, what type of catering is to be undertaken, how many people are to be fed and in what period of time. Following this, it is necessary to decide whether the food will be all prime cooked from raw, or whether there will be partial or virtually complete reliance on the use of the wide variety of convenience foods now available. Such decisions are needed whatever the size of the operation. In making them the client is forced into establishing his policy and writing his operating manual, deciding as he does what staff he will need, at what times, and incidentally, what staff changing space must be provided."*** (Furnivall 1977)

The briefing stage of the building procurement process is a vital area in that it provides the opportunity for designers to meet clients and users in time to influence future buildings. Bishop's (1984) paper on briefing described the process as,

> ***"...a sadly unexplored territory..."*** (Bishop 1984)

"...not an entirely happy area..." (Bishop 1984)

"...a very ignored part of all architectural theory, discourse and teaching..." (Bishop 1984)

Experience from research carried out during the Greenwich Hospital development project indicated that,

"A design brief may be produced in considerable detail by the briefing team but, unless it is completely comprehensive and fully understood by the designers and users, there are likely to be failures in performance which are only identifiable when the operational stage is reached." (Baynes 1971)

The brief sets the scene for the rest of the procurement process and must be referred to at all stages during project development. The briefing process leads directly into design, then construction and operation. Throughout the process, the timing of decisions and exchange of information is vital. Late decisions can hold up the design process and a general lack of discussion between client and designer on the timing of information needs can have an adverse effect on building design. Bishop's study on school designs illustrated that only occasional attempts were made, at the start of the project, to outline all those who might need to contribute to design and where the contributions might best be made. Baynes' (1971) critique of Greenwich Hospital's briefing process also indicated that there were similar difficulties with the process in hospital planning,

"Instances have occurred in many projects where decisions have been altered without reference back to the people who originally made them. This may occur where a department head or room user decides to use the facility in a different way... A link in the chain has been left out, frequently leading to inconvenience and waste in operation. But the implementation of decisions is just as crucial between the briefing and design stages as it is between design and use." (Baynes 1971)

Input of information to briefing comes from various sources among which are: the experience of those involved in the briefing process; design guidance; knowledge gleaned by appraisal from previous built solutions to similar problems. However, using the experience of those involved in the briefing process as an information source, particularly where the client exists as a complex organisation of multiple user groups, has many difficulties. Where the client consists of a complex group of users it is vital that the different user groups communicate their needs to the designer so that a building solution which is truly functional i.e. a building which acts as a facilitator of work activities is evolved.

Although briefing appears to occur as a singular event at the start of a project, it should have a major influence throughout the construction procurement process, perhaps even throughout the life of a building. As the environment surrounding a project may impact at any time, it is essential that any deviation arising from environmental pressure is checked against what was originally agreed between the client organisation and designer. This continual feedback cycle is vital, and helps to ensure that progress is being achieved which is fulfilling the client's objectives. It is an important checking or validating mechanism which assists in identifying to what extent the client organisation's requirements are being translated into the architect's drawings, and ultimately in the built solution. In this respect, the brief could be considered to embody a set of rules, formulated at the outset primarily by the client, but evolving with input from the architect and as the client organisation better defines its requirements. Essentially, it forms the basis against which design decisions can be tested and should broadly define the parameters of successful function.

4.4.2 Post-Occupancy Evaluation

Evaluation is an essential part of the building procurement process. Not only do evaluatory exercises generate ways of improving current building function, they are also useful in identifying problems and potential solutions to such problems across buildings of similar types. Post-occupancy evaluation is an important strategy for applying lessons learnt in the past to future building schemes, as extolled in the DHSS (1986) Health Buildings Evaluation Manual. Although there is a very strong case for user participation in hospital design, the logistics of such an undertaking, particularly for complex multi-user buildings, create difficulties in organising procedures for users to express their needs and objectives. Information input at the briefing stage, from user appraisals of similar existing buildings, is one mechanism of achieving greater user participation in design, albeit in an indirect way. Various researchers have highlighted the need to transfer the results of post-occupancy evaluation back into the design process, (Marans and Spreckelmeyer 1982 and Moore 1983), reiterating issues first raised by the Building Performance Research Unit (1972).However, it has been a neglected aspect of the construction procurement process as indicated by Baird et al (1996),

> ***"Our knowledge about how buildings respond to corporate, organizational and individual goals is sadly (and we believe expensively) lacking. There is a dearth of information on these matters. Even among professional building managers, conventional practice rarely includes the systematic performance evaluation of previous designs."*** (Baird et al 1996)

There appears to be two underlying causes for the lack of architect-driven post-occupancy evaluation. These relate to the reward system for architects and the way in which architects judge architecture.

The contractual arrangements by which buildings are produced mean that the architect is only legally liable for the building as specified in the final drawing. The chief reward system for architects is based in the drawing, not the building, and is embedded in the use of architecture as a fine art, similar to painting. Vischer (1991) notes that in architecture, excellence is primarily judged on extrinsic scales. Thus, there is a tendency for the architect to "walk away" once the building is complete, and, therefore, to be removed from the finished product. Wools (1970) likened this to a cuckoo laying its eggs and then abandoning them in the hope that some other bird would rear them. Cooper (1983) claims that it is doubtful whether many architectural practices have ever attempted to undertake the evaluation stage of the RIBA plan of work.

Bishop (1984) suggests that one of the reasons for lack of post-occupancy evaluation is due to the fact that architects gain most kudos from the presentation of recently built products to their peers rather than from feedback from clients and building users. This view is also expressed by Van Wagenberg (1990), who is critical of building evaluation which,

> ***"...has been left to the architectural critics who tend to focus on the aesthetic aspect of the building and on the historical development of the architect."*** (Van Wagenberg 1990)

Bishop (1984) also notes that this emphasis on the product serves to devalue success in terms of building use (the users are the only group who will have practical experience of the working building), good relationships with the client or anything at all about *process*.

These factors, coupled with the fact that post-occupancy evaluation can also serve as the basis for litigation and court testimony in cases of design and planning malpractice means that there is minimum incentive for architects to become involved with the building's use and function.

In hospital design, there has been similar apathy to building appraisal. For example, at a conference organised by the Scottish Health Service Management Executive Group, in 1987, on quality in hospital building, one of the speakers (an architect) admitted,

"I must say that I have no information on consumer satisfaction or dissatisfaction and have to assume that all is largely well." (Spencely 1987)

Sime (1984) believes there is a need for,

"...integrating a form of building appraisal into the design process which takes greater account of the building user." (Sime 1984)

Central to the hypothesis, is the notion that to repeat design successes and avoid failures it is simply not enough to evaluate the product without, somehow, attempting to analyse and evaluate the process which evolved it. The necessity to relate product to process, to increase the depth of understanding on building design and function, is an issue which is becoming increasingly important. The environmental psychologist Canter (1972) emphasised this point in an article written for the Architects' Journal,

"Criticisms of a building's form has little value without a knowledge of the processes which produced it and the designer's aims." (Canter 1972)

With apathy from designers, and in the case of the NHS, lack of financial resources, it is not surprising that there is a dearth of hospital building appraisal.

The potential benefits of post-occupancy evaluation are made explicit in the DHSS (1986) Health Buildings Evaluation Manual. This manual states,

"Evaluation is a process of measurement, comparison and interpretation which should influence the planning and design of new buildings through its impact on briefing and building guidance. It should also improve the functioning of existing buildings. Evaluation is essential in order that successful features can be identified and repeated, unsuccessful features can be eliminated and lessons learned from past mistakes." (my emphasis) (DHSS 1986)

However, hospital post-occupancy evaluations are few and far between. Information from building appraisals could provide the basis for the input of reliable and tested information into the briefing process about the overall performance of buildings, and the effect they have on the users, and to transmit the views of those who work and live in buildings. This process would seem to be a necessity given the difficulty, outlined by Reizenstein (1975), that designers, and equally clients, use their own experiences from which to generate environments for building users,

"...may often differ from the prospective users of the environment they create in such characteristics as age, sex, race, socio-economic status, education etc. It is difficult to imagine how designers can create appropriate settings and spatial systems based only on their own experience." (Reizenstein 1975)

User participation in the design process is vital. Through post-occupancy evaluation, the building solution can be tested to determine whether the needs of users have directed design rather than the imposed wishes of designers or the project generator part of the client organisation. Preiser et al (1988) note that there appears to be a growing commitment to the inclusion of post-occupancy evaluation in the building procurement process.

4.5 Unification of Design and Operation Through the Procurement Process and the Impact of Guidance

The procedural framework, within which the process of planning and constructing progresses, can have an effect on client organisation and designer communication, as noted in Morris' (1974) work for the Tavistock Institute, examining the pattern of communications in the building process,

"...communications could not be studied in isolation from the organisation structure of the building process." (Morris 1974)

As previously stated in this chapter, the success or failure of the outcome of the project procurement process means that the functionality of a building is already determined to a high degree by the way the multiple project contributors relate to one another whilst undertaking work on the project. Since the research hypothesis postulates the project procurement process as the key to functional success, it is essential to examine the dynamics of the procurement process, in particular, client organisation (particularly the users) integration into the process and designer communication with the client organisation.

There exists a profuse and widely ranging body of officially produced guidance material relating to hospital planning. The guidance, produced from the inception of the NHS in 1948, has been categorised generally by Moss (1977) as: design guidance; design procedural guidance; and systems and standards. The procedural guidance relates to the project organisational structure and, as such, is the machinery through which decisions are made. This guidance impacts on the actual timing of the process through its effects on briefing, designing, building and commissioning: it largely determines the organisational structure and decision making responsibilities, i.e. the *process*.

The procedural guidance for health buildings planning is largely embodied in the DHSS (1986) Capricode procedures. The need for some kind of organisational structure to maintain client organisation and designer integrity is vital. Hill (1977) conveyed this requirement in the following,

> ***"Though client requirements differ from project to project in scale, scope, method of operation, time allowed and finances allocated, a good building which works well will be the aim and it will not be achieved without close working and hard thinking by the client and designer together. It is necessary, therefore, to have an effective technique and framework within which this combined operation can be carried out."*** (Hill 1977)

Traditionally, in hospital building, client organisation and designer have been brought together in the Multi Professional Planning Team (MPPT). The principle of the MPPT is to translate the needs of hospital users, which can roughly be divided into clinical, support and building/engineering user groups, into policies and programmes which are then used by construction professionals to design and build an appropriate solution. The MPPTs are composed of people who could be considered as "proxy" clients or, more commonly, user representatives. Their job is to represent the views of all classes of hospital user, with whom they are in touch continually, and who are, at the same time, aware of the designer's problems. The MPPT is able to communicate in three ways: with those who want the hospitals (client organisation, incorporating user groups); with those who pay for them (project generator part of the client organisation) and with those who design and build them (construction professionals). The MPPT provides the focus for communication between hospital users on the one hand and the project design team on the other.

The task of the MPPT has never been easy. It is clear that any organisational/procedural framework such as Capricode would have to measure up to Allen's (1984) requirement that,

> ***"...in view of the many specialisms involved in the process, the achievement of a coherent and effective whole necessitates teamwork of the highest order. As with other forms of teamwork, direction, co-ordination and integration are a pre-requisite."*** (Allen 1984)

The effect of specialism on the MPPT has been strong, and is a factor which has resulted in the concentration of design effort on the department rather than on the hospital as a whole. Thus, one of the effects of specialism on the MPPT is the increased potential for conflict. Van Hoogdalem's (1990) design guidelines for architects and users pin-pointed one of the reasons for conflict during health building planning,

"...too often Health Buildings not so much reflected "co-operation under one roof" than "competition for the largest and most desirable space under that one roof". In many cases not even that one roof but several neighbouring roofs existed, reflecting disciplinary autonomy or isolation, instead of "interdisciplinary co-operation"." (Van Hoogdalem 1990)

As MARU (1975) highlighted, squabbling between users for a bigger "piece of the pie" does not make for equitable planning among all user groups within the client organisation. In particular, operational function and the design which is intended to serve it are pulled progressively apart, which means hospital design and hospital operational efficiency are suffering as a result. With all the problems faced by MPPTs, there has been a tendency for function and design to become separated which in turn has resulted in function-based planning becoming increasingly difficult, (MARU 1975).

The complex tasks of briefing, designing and building hospitals, and the complementary task of monitoring their progress (in terms of cost, general design and construction standards) in such a way as to ensure that individual projects conform to a national or regional plan, has prompted a number of countries to develop a capital projects management code. In England and Wales, the Capricode procedural guidelines form the basis of control. In Scotland, there are different guidelines but they are similar in direction and content. The purpose of such a code is to provide a "route-map" through the project for all the parties involved and at all levels. It also serves as a reference point through which all planning team members can relate to the tasks of their colleagues within the framework of the project as a whole.

Building and planning methods and related information systems, in general, reflect a biased mix of approaches and viewpoints. The RIBA/RIAS have been biased towards the design professions. Similarly, the Capricode procedures have been heavily criticised and labelled as "bureaucratic" and a "stringent institutional mechanism", (Canter 1972 and Moss 1977). Capricode procedures are biased towards the project generator part of the client organisation, i.e. central government and regional and district tiers of Health Service management. Planning and design methods tend to be based on the need to optimise cost, produce a structurally sound building, or to enable the project to be managed efficiently from a time and manpower viewpoint. Planning methods have been almost wholly concerned with the building and contract management aspects rather than with the user functions the building was to serve, (Best 1972).

Directing more attention to this mass of design and procedural guidance is not necessarily the solution to improving the functional performance of health care buildings. Moss (1977) has highlighted the negative impact of this guidance, the major drawbacks to over-emphasis on this guidance being:

(1) Guidance tends to be interpreted as instruction;

(2) Procedures are given the same weight as the problem;

(3) Some architects working in the NHS feel stifled by the amount and nature of officially produced guidance and resentful of the influence that it puts into the hands of people, not considered by them, to be genuinely contributing members of the project team;

(4) The guidance is seen to come between designers and users in a negative way: the project team spending more time arguing about matters of interpretation of the guidance than about understanding one another's problems.

Dogged adherence to design guidance and procedures, as a strategy for expediting a bureaucratic planning process, without any other reason founded in good design practice, or based on the real needs of users, is likely to have a detrimental effect on the resulting built solution.

The critique may be damning and severe but given such a scenario it is hardly surprising that guidance has not always been a successful planning tool in creating functionally successful buildings. In the wider, more general sphere of building design, Mackinder and Marvin's (1982) study of design decision-making in architectural practice in the UK also identified problems in designers' use of guidance. Specifically, the study showed that:

(1) Designers based their decision largely on personal and practice experience and that they used few publications;

(2) Any information that designers consult had to be quick and easy to absorb;

(3) In the early stages of design they used the few publications they did consult mainly to check or develop concepts they had already formed;

(4) From the detailed design stage onward designers had to consult more publications but the level of use was often still low;

(5) Manufacturers were the main source consulted, they were preferred to official publication;

(6) Designers tend to know and use a repeatedly small, random personal selection of the technical information available;

(7) The research gave a strong indication that designers tend to seek written information as a last resort.

4.6 Theoretical Constructs and the Complexities of the User/Building Interface

This part of the thesis offers some theoretical constructs to explain the complexities of the user/building interface. The constructs are applied to the research data presented in Chapter 5 and used as a means of exploring the case studies (functional outcome deficiencies). The theoretical constructs are developed around the following:

(1) The relationship and interaction between building users and fixed and unfixed elements within and between different sub-systems and component sub-systems of complex multi-user buildings;

(2) The associated concepts of adaptability, tolerance and flexibility in the context of (1) above;

These theoretical constructs are discussed in detail in sections: 4.6.1 Relationship and Interaction Between Users, Fixed and Unfixed Elements; 4.6.2 User Adaptation to Inadequate Design Solutions; and 4.6.3 Tolerance and Flexibility, and illustrated by reference to hospital food service system functioning.

4.6.1 Relationship and Interaction Between Users, Fixed and Unfixed Elements

For any building, it is suggested that three distinct interacting elements can be identified, as undernoted:

(1) ***Building users*** - in complex, multi-user buildings, users are defined as those groups of people that occupy and interact with buildings. Generally, *users* can be divided into two distinct groups: those that are permanent (usually people who work in the building) and those that are transient (those visiting the building). Of course, depending on the type of building, these distinctions are not necessarily that clear-cut. For example, in hospital buildings, patients are normally considered to be transient but some types of patients may have a more extended relationship – such as some elderly people in long term care;

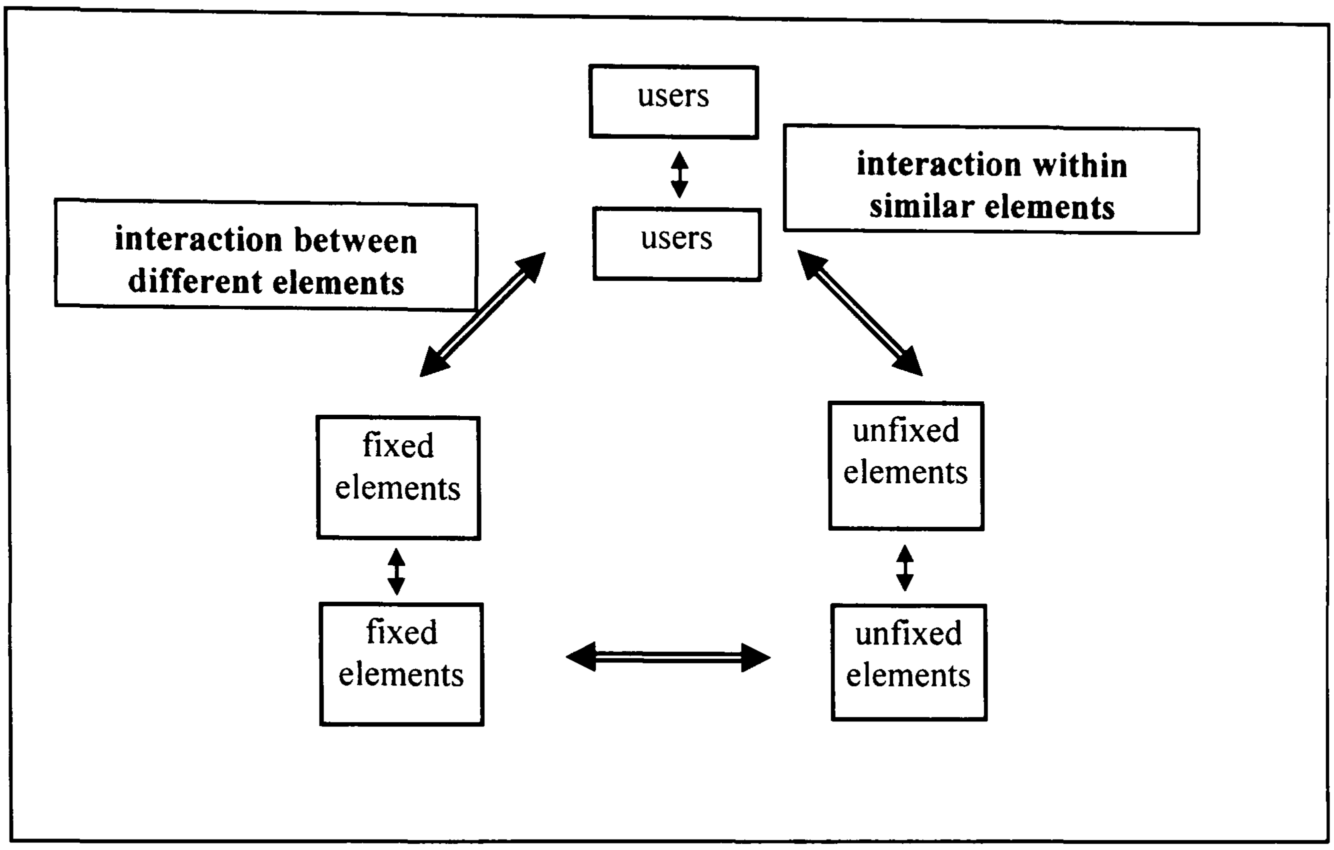
(2) ***Fixed elements*** - are defined as those elements of the building within the domain of the architect/designer, for example, the building envelope;

(3) ***Unfixed elements*** - are defined as those elements for which the users could be considered to be expert, for example, items of equipment.

Interactions or relationships exist *within* and *between* these three elements. This tenet is illustrated in figure 4.1. The arrows in the diagram represent these interactions or relationships. In practice, interactions *between* different *user groups* are common attributes of complex multi-user buildings. In terms of food service functioning, the three project contexts indicated the variety of user groups that are involved in food service provision: catering; nursing; portering; and domestic staff, with patients being the ultimate end users, are the main user groups. Depending on the type of food service system that operates, catering staff within the kitchen might interact with portering staff in the kitchen when meals are collected for delivery: then when meals are served at ward level, there might be interaction between domestic and nursing staff. The nature of these user group interactions will depend on where responsibilities lie for different food service activities, as defined in the operational policy (refer to Appendix 2 Outline of Current Food Service System Functioning for all Projects).

Relationships *between fixed elements* are important and some are absolutely fundamental. For example, as a very simple illustration, all buildings have a roof structure held up by walls. There is an obvious crucial structural relationship between these two different fixed element components. At a more detailed level of design, these fixed element relationships also exist. Relationships *between unfixed elements* are also important but perhaps less prevalent or less easily conceptualised/identified than user-user and fixed element-fixed element relationships. For example, ill conceived dining arrangements can be annoying when chairs, with arm rests, are prevented from sliding to a comfortable eating distance under tables.

Figure 4.1 Inter-relationships Between Users and Fixed and Unfixed Elements



These three elements, however, do not exist in isolation. Interaction *between* these three elements is crucial in shaping design solutions. Thus in any building solution, each particular function can be envisaged as a set of interactions combining different: users; fixed elements; and unfixed elements. The following identifies the different types of interaction that may occur:

(1) Users-users (For example, the relationships between the activities of nursing staff and domestic staff in service of food at ward level);

(2) Unfixed elements-unfixed elements (The relationship between table and chair is important for a comfortable dining experience);

(3) Fixed elements-fixed elements (For example, the relationship between walls and roof structure);

(4) Users-unfixed elements (Users interact with a variety of equipment, such as food trolleys, equipment trolleys, mobile service counters, ovens);

(5) Users-fixed elements (Users interact with a variety of fixed elements, such as doors and staircases);

(6) Fixed elements-unfixed elements (For example, relationships between doorway access/egress points and mobile equipment);

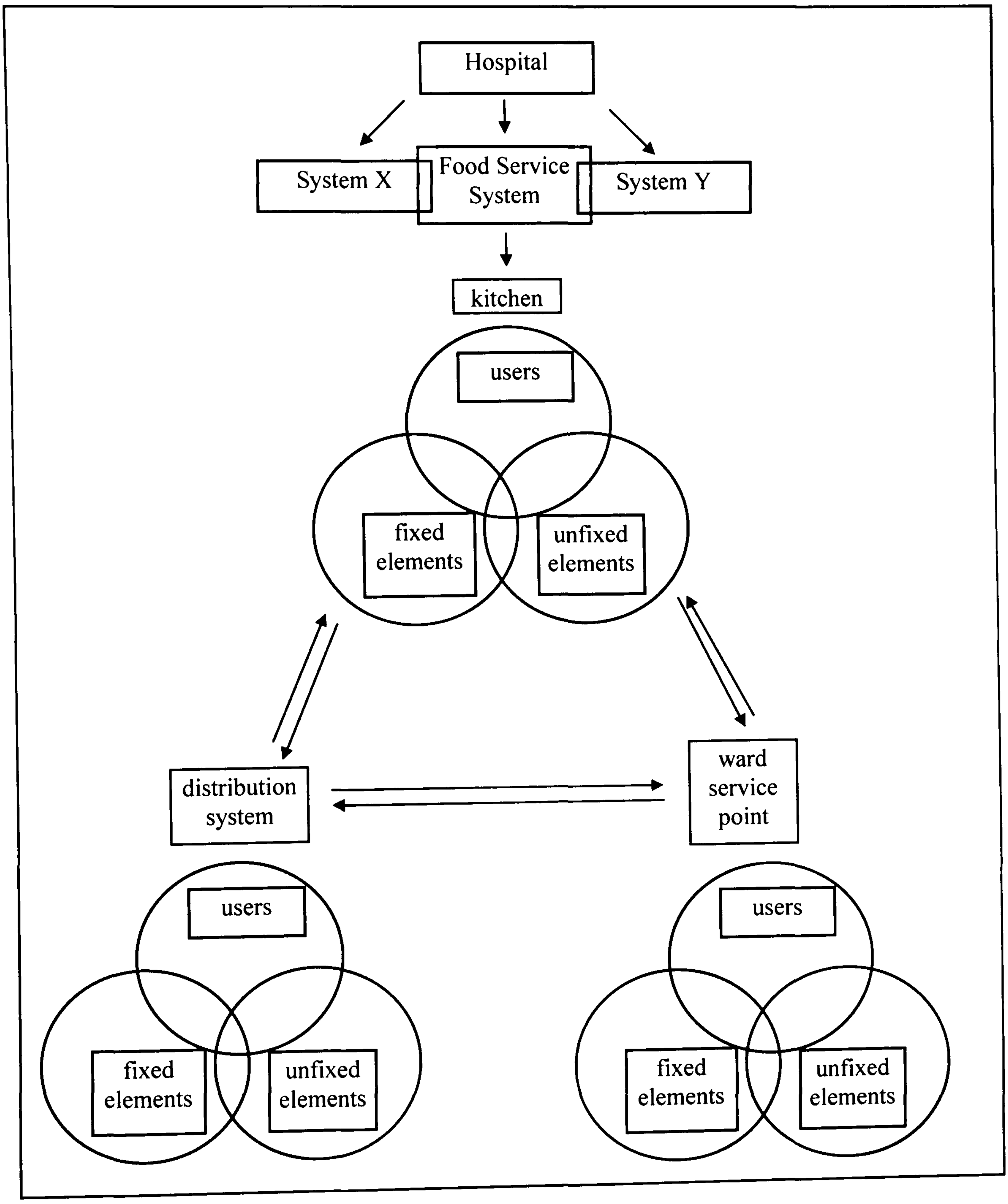
(7) Users-unfixed elements-fixed elements (Since all activities are contained within the fixed building envelope then the design solution will always relate to the fixed element, i.e. there will always be interaction involving fixed elements. Even where activities might be undertaken outwith buildings, for example transportation of goods on a dispersed site, there will be important relationships between different buildings on the site and hence in the design of communication routes.

Thus, innumerable outcome deficiencies can emerge given the complex interactions that exist between users, fixed and unfixed design elements. It is contended that these theoretical constructs are not specific to health care buildings but are applicable to the built environment in general.

This tripartite relationship involving users, fixed and unfixed elements can be determined throughout all levels of design, from the strategic level right down to the detailed design level and can be identified between the components of sub-systems. For example, for hospital food services, figure 4.2 shows that food service function is achieved through interaction of the three component parts of: production unit (central kitchens), distribution system and ward service points.

At the most detailed level of functioning, individual users interact with other user groups and with fixed and unfixed elements of the building. There is also interaction between and within fixed and unfixed elements of the building structure. These interactions can occur within and between different sub-systems and their component parts of the whole. These relationships can be determined for any building type and are particularly useful in explaining the interaction of the sub-systems, and their components, of complex buildings such as hospitals. For effective functioning, the relationships between users, fixed and unfixed elements, within and between the sub-systems and their components must be fully accounted for.

Figure 4.2 Interaction Between the Component Sub-systems of the Food Services System



When this does not happen, then outcome deficiencies might result and these deficiencies will directly, or indirectly, affect users. It is suggested that the most complex problems will result when critical relationships between elements of different component parts are overlooked.

4.6.2 User Adaptation to Inadequate Design Solutions

User interaction with the design solution is complicated by the fact that users can show adaptive behaviour when presented with facilities that are not an ideal solution for the activities that must be supported. At a very simple level, this is demonstrated when a person (user) entering a room takes off their jumper because the room is too hot. The person adapts their behaviour to provide a more comfortable environment. Buildings are normally designed to allow users to control aspects of their environment such as temperature. Thus, if the room is still too hot then the next alternative might be for the user to modify an aspect of the building. For example, a window might be opened or heating turned down. These controllable aspects of the building solution were clearly designed to allow this sort of user/building interface adaptability. If the room is still too hot because, for instance, it was sited too close to a plant room then this is indicative of an inadequate design solution. The user is unable to effect a change in their environment because of an inherent fault in the building solution because of an inappropriate physical proximity between a user occupied part of the building and a part of the building housing heat-producing mechanical/electrical plant.

When buildings become more complex, sub-dividing into many sub-systems, and are required to support the activities of many different user groups, then this user adaptability becomes increasingly important and complex particularly since the user is the element of the solution that has the greatest potential for adaptability. Adaptation of fixed and unfixed elements is possible but is likely to involve expenditure of resources, i.e. changing equipment or modifying the building structure.

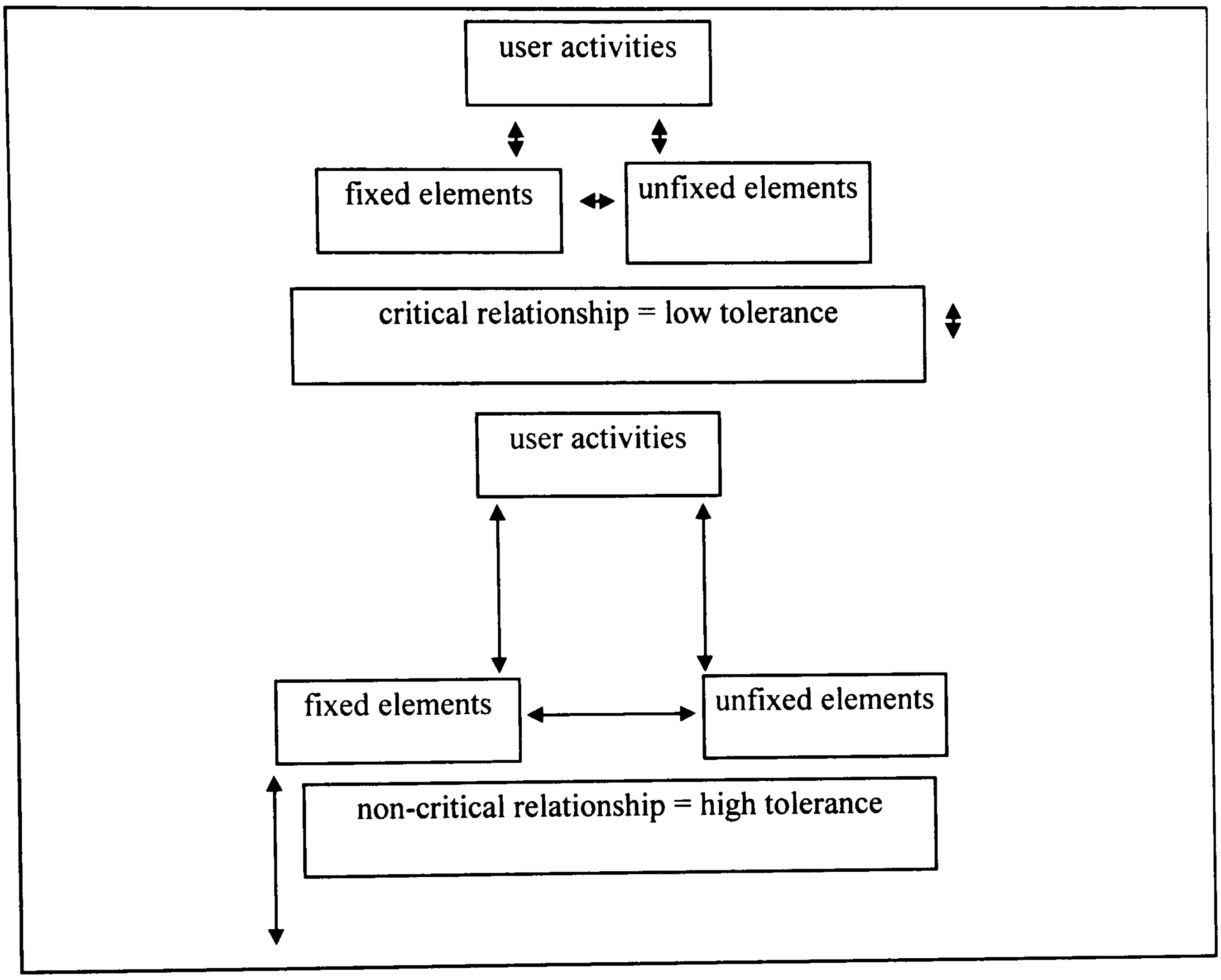
It could be assumed that there is always an exact solution to the client organisation's problem, i.e. that interaction between users, fixed and unfixed elements in a new building is able to provide a precise human/physical resource "fit" for housing the needs of the client organisation's different user groups. For all practical purposes, an ideal fit between the three elements (users, fixed and unfixed elements) is rarely achievable. This is the nature of the design process: there is a continuum of "right" to "wrong" solutions depending on how well, or not, the building supports the activities of its user groups.

In a building as complex as the hospital, the different user groups do not necessarily have the same goals and, therefore, a setting has to be created which is the best solution for all user groups. This necessitates a certain degree of flexibility in the relationships between users and the fixed and unfixed elements of the building solution. Since client organisations are subject to change throughout their life-spans, if physical resources are designed precisely for one mode of operation, or one set of client organisation activities, then change in response to new external pressures may be impaired because the physical resources have been designed for only one mode of operation. This would be very constraining on a client organisation's activities. No organisation can afford to change its physical infrastructure every time there is a change in the human resource/activities of the organisation. At the outset of a new capital project, physical resources must be designed with a certain amount of flexibility within which the client organisation activities can change. To a certain extent, physical resources can successfully remain static when human activities in the organisation change because building users show a certain amount of adaptability. Users can ameliorate a certain degree of mis-fit between themselves and the fixed/unfixed elements at the building/user interface.

4.6.3 Tolerance and Flexibility

The degree of mis-fit between users, fixed and unfixed elements inherent in a design solution, which can be ameliorated to a certain extent by adaptation (usually by the users), could be thought of in terms of tolerance, i.e. the extent to which mis-matches can be overcome before a deficiency is recognised. For the purposes of this research, tolerance could be considered to be a function of the relationship between fixed and unfixed elements of the physical environment, the activities which are performed in this environment and the users who perform these activities. The degree of tolerance inherent in a specific design solution will depend on how easy it is for users to adapt their activities within the constraints of the physical environment, or how easy it is for unfixed or fixed elements to be adapted. In some situations, activities are heavily dependent on a high degree of fit between user activities and the fixed and unfixed elements of the physical environment, i.e. low tolerance is exhibited in the built solution and the extent of amelioration which users can apply to maintain the building/user interface is limited. In such a scenario, relationships between users and the physical environment (fixed and unfixed elements) are critical. In other situations, activities are not so dependent on a high degree of fit between activities and the built environment, i.e. there is high tolerance in the built solution and users can effect a large degree of amelioration at the building/user interface. Thus, these relationships could be identified as non-critical. Figure 4.3 illustrates the concept of tolerance. The length of the arrows represents the extent of tolerance, the nature of the relationship (critical or non-critical) and the extent of amelioration inherent in a building solution, defined in terms of user activities and fixed and unfixed elements. The shorter the arrows, the more critical the relationship, the less tolerance in the solution and the less amelioration that can be sustained.

Figure 4.3 Diagram Illustrating the Concept of Tolerance



The degree of tolerance exhibited in any particular building solution will be dependent on the nature and extent of adaptability which users have to show and each individual building user will exhibit a threshold limit beyond which they can show no more amelioration. Where tolerance is low, this is indicative of a critical relationship between users, fixed and unfixed elements where there must be a good degree of fit otherwise problems will manifest post-occupancy. Tolerance is also applicable to interaction within and between fixed and unfixed elements. Examples are commonplace, even at an every day lay level. For example, how many times have people bought furniture that just will not fit through the doorways of their homes? Of course, in complex multi-user buildings there are multiple elaborate critical relationships which must be given due consideration within the overall design solution.

Flexibility and tolerance are closely related factors. Increasing flexibility demands increasing tolerance between fixed/unfixed elements and user group activities because flexibility tends to generate physical environments that are not as task-specific as more rigidly defined physical settings. The degree of flexibility which the built form can accommodate will be dependent on the extent of tolerance inherent in a design solution, i.e. if activities require a very specific, well defined physical environment, where there must be a very close fit between users and fixed and unfixed elements, then the solution adopted will tend towards rigidity and inflexibility. As a simple example, an empty room has few restrictions in terms of the pathway that an individual may choose to cross from one side to the other. However, as soon as furniture is added then these "obstacles" will constrain the number of possible options for crossing the room. In much more complex, multi-user facilities the relationship between tolerance and flexibility within the design is much more complicated. Thus, the most successful solutions should occur when critical relationships have been properly identified, defined and prioritised within the overall design solution and the extent of flexibility required accounted for.

Functional problems at the macro level are likely to be of a more serious nature than problems at the detail level since the whole building or a large sub-system may be affected, thus involving many different user groups. For example, when critical functional relationships between departments are not recognised then there will be a considerable impact - take for example Tonneau's alarm at *"having to bring patients across freezing yards to get to the radiography unit"* (refer Chapter, 3 section 3.3 The Importance of Function in Hospital Buildings). At a more detailed level, problems are likely to affect much more specific work areas and hence a much smaller number of user groups. A relatively minor problem would be one that could be overcome by a modest change in user activities to bridge any gap between building design and operational policy. A more serious problem may necessitate the modification of the physical environment (fixed and/or unfixed elements). This could be as straightforward as moving around pieces of furniture or equipment but may involve changing the actual fabric of the building. The most troublesome problems to overcome are ones where user goals cannot be achieved unless both the physical environment and operational policy (user activities/practices) are changed. The level of planning that is affected is a factor determining the severity of a functional problem and to what degree it undermines the achievement of users' goals.

4.7 The Effects of the Product/Process Relationship on Functional Success

It is the designer, as part of the design team, who must sort through the competing needs and seemingly irreconcilable goals of different user groups. A practical, working knowledge of how different users interface with the building design is a pre-requisite for understanding conflict between the differing goals and needs of the various user groups. At the onset of a project, the architect often has to work with an incomplete, sometimes incorrect outline of functions, because real activities are different from theoretical tasks. During the design process, the architect is continually postulating hypotheses about the impact of design decisions on the way the building will function. In a complex, multi-user building it would be impossible for an architect to appreciate how a particular operation or arrangement might cause problems for different types of building users. The multitudinous conflicts inherent in complex buildings, demands reaching a compromise solution through user group communication. Users are the specialists on working conditions. They experience the practical nature of problems, which can be described in terms of the relative ease or difficulty with which users achieve their objectives.

To some extent, the decisions taken by architects will partly condition building users' work organisation. Clearly, the designer relies on the building users for information relating to building use and function. The greater the designer's understanding of the intentions and needs of users and the political, organisational and interpersonal context of these processes, the more appropriate the building solution is likely to be. User input to design is most often in the form of performance statements which means the designer is informed of the desired end state without being informed of how this might be achieved. It is, therefore, the task of the designer to translate these performance goals into spatial reality. Baxter (1983) suggests that better communication could be achieved if the user representative was able to create bridging statements between the user and designer: these would link something the designer understands like articulating and dimensioning physical spaces with the original user activity requirements. Service requirements which arise through strategic planning should directly dictate and relate to the functional building solution.

Operational planning and building design must develop in close unison throughout the whole of the building procurement process, otherwise disharmony between users and the buildings results. This, however, may not always be the case. There is a certain amount of tolerance between building design and operational planning. That is to say, theoretically there will be an optimum point at which building design and operational planning fit together perfectly. If building design and operational planning do not reach this point, then one would expect to find problems at the human/building interface with building function. However, this optimum point is an ideal, which is probably rarely attained for all practical purposes because of the trade-offs and compromises that have to be made between different departments, systems and spaces during development of a building. The design choice made by the architect reflects the compromises made between many different criteria which have to be weighted and prioritised.

In fact, it would probably be unwise to have a building specifically designed for one mode of operation since this would exclude flexibility and be too prescriptive. The extent to which design and operational planning should agree is thus also dependent on the degree of flexibility required, since a precise solution will naturally exclude drastic changes in operation or use without the involvement of building re-design. In reality, this planning or problem solving process proceeds so that a solution evolves through the project contributors attaining a balance between the ideal fit and flexibility. The final solution may be close or far away from the ideal depending on conflicts, compromises and trade-offs which have to be made along the way. Reaching an acceptable compromise is not easy since efficiency for one function may decrease efficiency in another and designs may not be equally efficient for all user groups occupying the same space.

Usually, the users show a degree of adaptability so that buildings, systems and spaces can be designed which never attain the ideal state but still function effectively because users can adapt to the demands of the situation. Specifically, the users will modify their work activities or behaviour to bridge any misfits between building design and operational planning. For example, users may adjust to poorly organised equipment or convoluted pathways between functions without being aware of the extra time it takes them to perform a specific job or the amount of unnecessary walking they are forced to do on a typical shift. The question is how much adaptability should users be expected to show? Users may adapt work practices or work behaviour subconsciously, possibly without realising that they are ameliorating a lack of fit between building design and operational planning. Of course, if users have to mal-adapt because of a large discrepancy between building design and operational planning, then they will conclude that the system does not work as intended.

The degree of deviation tolerated by a building solution will depend on the nature/quality of the adaptation required and how much adaptation the users can withstand before this threshold level is reached at which they will express dissatisfaction. Deviation between building design and operational planning may be so great that user adaptability cannot overcome the lack of fit and thus the building design or operational policy or both have to be modified. Such an outcome is rarely satisfactory as it involves extra costs and disrupts users. However, not correcting design/operational mis-matches may force the building into serving needs that it cannot support properly; this could result in dangerous working conditions and the unpredictable consequences of mal-adapted behaviours. What is essential, is that components of the functional building with low tolerance must be described or specified explicitly and critical behaviours must be identified.

The procurement process which progresses a project through its various stages must organise problem solving in such a way that project contributors can assess the impact of different building design and operational planning decisions on building function i.e. the human/building interface. Changes in planning information brought about through the impact of environmental influences must also be reconciled with building function. The results of more compatible building design and operational planning achieved through a project procurement process which is more effective at integrating project contributors, are threefold. Firstly, the resulting building solution should be more responsive to user needs. Secondly users develop a better understanding of unavoidable problems caused by compromises between criteria which are sometimes contradictory. Lastly, through a more active stance in the decision making process, the users are more satisfied with the resulting building solution.

4.8 Conclusions

The building procurement process is particularly long and involved for schemes such as hospitals, which are considered to be technologically complex and which comprise a client organisation consisting of a multitude of different user groups. In hospital building procurement in particular, the client organisation is defined by several levels of decision making authority. This ranges from the DHSS, as an agent of central government, down to Regional and District Health Authority to individual hospital management teams and eventually, user group level. The extent of involvement of these different groups, and other affiliated consultative bodies, in the building procurement process will be largely determined by the size and scope of the scheme.

Guidance related to hospital design has been heavily criticised in the past. It is seen to be too restrictive and dangers lie in using it as a prescription for all health building problems. In order to find solutions which are functional, in the sense that the building and its component sub-systems facilitate user group activities, it is essential that there is user input into the design process. Differences in designer and client specialism and differences in conceptualisation, even among different users of the client group, form a barrier to effective communication. Effective communication is essential during the briefing period, and indeed, throughout the whole of the building procurement process. Integrating building design and operational planning is a pre-requisite for successful building function. Post-occupancy evaluation of existing similar building types provides another mechanism for users to influence design, by information input into the briefing process. Although post-occupancy evaluations are becoming more common there is no systematic method, at least in the health sector, for post-occupancy evaluation information to influence new building schemes.

Decisions relating to what goes into the scheme, in terms of the design and operation of the building and its sub-systems, are matched in importance by decisions relating to how this is achieved; how is scheme content and operation decided. In other words, the relationship of individuals and groups making decisions can be equally, if not more important, than exactly what the decisions are. The way in which decisions are made can have either an inhibiting or facilitating effect on contributors' communication. This in turn, will affect the integration of building design with operational planning and thus the outcome of building function is affected. The project procurement process has a key role in providing the machinery through which important decisions are reached and through which the building solution evolves. The crux of the research lies in investigating the effect of this process on one of the outcomes of the process, namely building functionality.

4.9 References

Allen, D. (1984) "Towards the Client's Objective." in Brandon, P. S. and Powell, J. A. (eds.) Quality and Profit for Building Design. Spon; London.

Ambrose, I. (1990) "Improving Buildings through Involving their Users." in Moran, R., Anderson, R. and Paoli, P. (eds.) Buildingfor People in Hospitals: Workers and Consumers. European Foundation for the Improvement of Living and Working Conditions; Ireland.

Anonymous (1987) "Hospitals with a Human Face." Interior Design, July/August : 40-42.

Baird, G., Gray., J, Isaacs, N., Kernohan, D. and McIndoe, G. (1996) "Introduction." In Baird, G., Gray., J, Isaacs, N., Kernohan, D. and McIndoe, G. (eds.) Building Evaluation Techniques. McGraw-Hill; New York.

Baxter, S. H. (1983) "Biology Into Buildings." in Baxter, S. H., Baxter, M. R. and MacCormack, J. A. C. (eds.) Farm Animal Housing and Welfare. Martinus Nijhoff; The Hague.

Baynes, K. (1971) "Hospital Research and Briefing Problems." King Edward's Hospital Fund for London; London.

Becker, F. D. and Poe, D. B. (1980) "The Effects of User Generated Design Modifications in a General Hospital." Journal of Nonverbal Behaviour, 4 (4) Summer : 195-218.

Best, G. (1972) "Health Plans and Life Spans." Built Environment, December : 597-599.

Bishop, J. (1984) "Briefing - The Missing Link." in Powell, J. A., Cooper, I. and Lera, S. (eds.) Designing for Building Utilisation. Spon; London.

Brauer, R. L. and Preiser, W. F. E. (1976) "Impact of Organisational form on Identification of User Requirements in Building Delivery." Proceedings of W65 International Symposium on Organisation and Management of Construction. Department of the Army Construction Engineering Research Laboratory, Champaign, Illinois.

Building Performance Research Unit (1972) "Building Performance." Applied Science Publishers; London.

Building Research Establishment (1987) "Better Briefing Means Better Buildings." Building Research Establishment.

Butler, M. (1992) "Building the Best, Part 1: Bridging the Gap." Hospital Development, March, 23 (3) : 33,35.

Canter, D. (1972) "Royal Hospital for Sick Children, Yorkhill, Glasgow: A Psychological Analysis." The Architects' Journal, September 6th : 525-563.

Cherns A. B. and Bryant D. T. (1984) "Studying the Client's Role in Construction Management." Construction Management and Economics, 2 : 177-184.

Clark, T. (1990) "Thinking Ahead for Project Managers and their Employers in the NHS and Related Sectors, Research Paper No. 27." Institute of Advanced Architectural Studies, University of York.

Cooper (1983) "Whatever Happened to Architectural Feedback." Building Designs, 29 August 1983: 7.

Department of Health and Social Security (Health Building Directorate) (1986) "Health Buildings Evaluation Manual." HMSO; London.

Department of Health and Social Security (1986) "Capricode Health Building Procedures Manual."

Edwards, M. (1974) "Comparison of a Sample of Housing Architects with Known Data." in Canter, D. and Lee, T. (eds.) Psychology and the Built Environment. Architectural Press; London.

Falick, J. (1981) "The Design Process, or How Not to be Afraid of Building." The Journal of Health Administration Education, Fall 6,4 Part 1 : 761-770.

Furnivall, M. E. (1977) "Designing for Minimum Effort and Maximum Efficiency." in Glew, G. (ed.) Catering Equipment and Systems Design. Applied Science Publishers; London.

Green, R. (1985) "Architect's Guide to Running a Job." Architectural Press.

Green, J. R. B. (1975) "Design for User Needs." National Hospital and Health Care, November : 28-34.

Hill, E. (1977) "Designing the Workplace." in Glew, G. (ed.) Catering Equipment and Systems Design. Applied Science Publishers; London.

Hughes, W. P. and Walker, A. (1988) "The Organisation of Public Sector Building Projects." Building Technology and Management, August/September : 29,30,35.

Jay, A. (1972) "The Householder's Guide to Community Defence Against Bureaucratic Aggression." Jonathan Cape; London.

Jenks, M. (1977) "The Relationship of Briefing and Building Appraisal to the Needs of Elderly People." Research Review, December 9th.

Jones, C. (1967) "Trying to Design the Future." What is Designing, No. 225 September : 35-38.

Kraegel, J., Mousseau, V., Goldsmith, C. and Arora, R. (1974) "Patient Care Systems." J.B. Lipincott Company; New York.

Lucas, G. (1970) "Pre-Design Decision Process." Building Technology and Management, 8 (10) : 8-9.

Mackinder, M. and Marvin, H (1982) Design Decision Making in Architectural Practice, BRE Information Paper IP 11/82. Building Research Station, Garston; UK.

Marans, R. W. and Sprecklemeyer, K. F. (1982) "Measuring Overall Architectural Quality: A Component of Building Evaluation." Environment and Behaviour, 14 : 652-670.

Maxwell, R. J. (1989) "Shaping the NHS for the 1990s." King Edward's Hospital Fund for London; London.

Medical Architecture Research Unit (1975) "The Planning Team and Planning Organisation Machinery - Draft Report Prepared for the World Health Organisation." Medical Architecture Research Unit; London.

Moore, G. T. (1983) "Teaching Design Evaluation, with Results from Case Studies of Playgrounds, Schools and Housing for The Elderly." Design Studies, 4 (2) : 100-114.

Morris, W. P. G. (1974) "Systems Study of Project Management: 1". Building, January 25th : 75,76,79,80.

Moss, R. (1977) "Hospital Design and the National Health Service. An Assessment of the Main Methods Used to Give Guidance on Planning and Design and the Procedures to be Followed, Part 3." Medical Architecture Research Unit; London.

National Association of Health Authorities in England and Wales (1983) "NHS Handbook", Second Edition."

Nightingale, F. (1863) "Notes on Hospitals, Third Edition." Longman; London.

Preiser, W. F. E., Rabinowitz, H. Z. and White, E. T. (1988) "Post-Occupancy Evaluation." Van Nostrand Reinhold; New York.

Preiser, W. F. E. and Vischer, J. C. (1991) "An Introduction to Design Intervention: A Manifesto for the Future of Environmental Design", in Preiser, W. F. E., Vischer, J. C. and White, E. T. (eds) Design Intervention: Toward a More Humane Architecture. Van Nostrand Reinhold; New York.

Rawlinson, C. and Whittlestone, P. (1990) "Patient's Perspective." Joint Conference of The Public Health Group, Committee on Architecture for Health and Architecture for Health Care Committee. The Role of Architecture in Health Care : Year 2000 and Beyond, Ottawa, May 25th.

Reizenstein Carpman, J., Grant, M. A. and Simmons, D. A. (1986) "User Participation in Health Care Facility Design." in Reizenstein Carpman, J., Grant, M. A. and Simmons, D. A. (eds.) Design that Cares - Planning Health Facilities for Patients and Visitors. American Hospital Publishing Inc.; Chicago.

Reizenstein, J. E. (1975) Linking Social Research and Design." Journal of Architectural Research, Vol 4 No 3, December : 26.

Scottish Affairs Committee (1987) "First Report, Session 1986/1987. Hospital Provision : Volume 1. Report Together with the Proceedings of the Committee." HMSO; London.

Scott, B. (1987) Aesthetic Evaluation: A Comparison of Architects and Non-Architects. (Wellington: Barch Research Report, School of Architecture, Victoria University of Wellington.)

Sime, J. (1984) "Social Research and Design: The Nature of Appraisal." in Powell, J. A., Cooper, I. and Lera, S. (eds.) Designing for Building Utilisation. Spon; London.

Spencely, J. (1987) "Quality in Hospital Building." in France, G. H. (ed.) Quality in Hospital Building. Scottish Health Service Management Group; Edinburgh.

Van Hoogdalem, H. (1990) "Design Guidelines for Architects and Users." in Moran, R., Anderson, R. and Paoli, P. (eds.) Building for People in Hospitals : Workers and Consumers. European Foundation for the Improvement of Living and Working Conditions; Ireland.

Van Wagenberg, A. F. (1990) "Post-Occupancy Evaluation of a General Hospital." in Moran, R., Anderson, R. and Paoli, P. (eds.) Building for People in Hospitals : Workers and Consumers. European Foundation for the Improvement of Living and Working Conditions; Ireland.

Vischer, J. C. (1991) "Summing up Opinions on Architectural and Social Change," in Preiser, W. F. E., Vischer, J. C. and White, E. T. (eds) Design Intervention: Toward a More Humane Architecture. Van Nostrand Reinhold; New York.

Vischer, J. and Cooper Marcus, C (1982) "Design Awards: Who Cares?", in Knowledge for Design: Proceedings of the Thirteenth Environmental Design Research Association Conference, edited by P.Bart, A. Chen and G Francescato. EDRA; Maryland.

Walker, A. (1980) "A Model for the Design of Project Management Structures for Building Clients." PhD Thesis, Department of Surveying, Liverpool Polytechnic.

Wallace, W. A. (1987) "The Influence of Design Team Communication Content Upon the Architectural Decision Making Process in the Pre-Contract Design Stages." PhD Thesis, Heriot-Watt University.

Woolley, T. A. (1985) "Community Architecture : An Evaluation of the Case for User Participation in Architectural Design." PhD Thesis, Oxford Polytechnic.

Wools, R. (1970) "The Assessment of Room Friendliness." in Canter, D. (ed.) Architectural Psychology. RIBA Publications; London.

Zeidler, E. (1974) "Healing the Hospital." Zeidler Partnership.

Zeisel, J. (1984) "Inquiry by Design: Tools for Environment-Behaviour Research." Cambridge University Press; Cambridge.

CHAPTER 5
Presentation and Analysis of Results

5.1 Introduction

This chapter presents and draws together the key data and findings, and analysis of these, for the three methodological components of the investigation. Data from project mapping and environmental analyses were applied to the functional problems identified through post-occupancy user evaluation, in order to trace the cause of these functional defects through the project procurement process. This provided a method for testing the research hypothesis. The technique allowed a determination of the factors affecting the maintenance of building design and operational planning integration in the three project contexts by examining the functional problems on a case study basis. Where appropriate, reference is also made to raw data provided in the appendices.

This chapter is structured in the following manner:

(1) Section 5.2 (Overview of Case Study Project Contexts) provides an overview of the case study project contexts to aid in comparison and differentiation between longitudinal project context C and the retrospective project contexts, A and B;

(2) Section 5.3 (Results of Post-Occupancy User Evaluations) details the problems that were elicited through post-occupancy user evaluation of food service system functioning for the project contexts. Problems are listed as per the categories identified in Chapter 2 (refer section 2.5.5 Selection of Case Studies). The component of the food service system where the problems were identified are also indicated, i.e. central kitchen production unit, transportation/distribution system, or ward/service point;

(3) Section 5.4 (Environmental Assessment) is concerned with the project contexts' environments, and brings together the findings of the analysis of the environmental impact on development of the functional deficiencies. In section 5.4, a summary of the data contained in Appendix 4 (Assessment of the Environment Impacting on Food Service Planning for all Case Studies) is provided. The two main effects of the project contexts' environments, in causing uncertainty over the *timing* and uncertainty over the *nature* of various aspects of food service system functioning are explored fully;

(4) In section 5.5, (Analysis of Functional Outcome Deficiencies) each of the functional outcome deficiencies (case studies) as listed in table 5.6 is considered in detail. Drawing on environmental analysis data and the project mapping data, analysis focuses on pinpointing the causes of the design/operational mis-matches;

(5) Section 5.6 considers the findings of the research against the theory and literature presented in Chapters 2, 3 and 4 of the thesis.

5.2 Overview of Case Study Project Contexts

Table 5.1 provides an overview of seven main features of the case study project contexts to assist in comparison and differentiation between the three. As the project contexts were all developing similar building solutions, for a similar client body, and overlapped to a certain extent in terms of procurement period, there was considerable commonality between the three. In this regard, the effect of environmental pressures on project outcomes was particularly interesting and is considered further in section 5.4 (Environmental Assessment) of this chapter. There were also noteworthy differences. With regard to the planning histories, retrospective project A was developed so that a new catering department was provided in the first phase of re-development. The longitudinal project and retrospective project B were similar in that new catering departments were not a priority and existing kitchens were anticipated to fulfil the hospitals' needs until new kitchens were provided in later phases. This planning assumption proved to be untenable in both cases leading to a change in priorities and an urgent requirement to provide replacement catering department facilities much sooner than expected. The fact that both re-developments were on brownfield sites restricted options for location of these facilities. Two very different solutions were adopted using different project procurement processes. These differences are considered more fully in section 5.4.

In relation to food service system functioning, both the longitudinal project and retrospective project A had been developed with a certain degree of duality in system functioning. For retrospective project A, duality related to a mixed cook-chill and conventional method of food production in the phase 1 kitchen. For the longitudinal project, duality related to a mixed food distribution/service method - plated meals and bulk, although only the bulk meal distribution/service method was in operation at the time of post-occupancy evaluation. For retrospective project B, there was system duality but this was much more limited, relating to food distribution/service method. Although this dual modality had advantages in terms of food service flexibility, there were also several drawbacks, as identified through case study data analysis. These are explored in detail in section 5.4.2 (Analysis of Environmental Pressure Data) of this chapter.

Table 5.1 Overview of Case Study Project Contexts

Feature	PROJECT		
	Longitudinal C	**Retrospective A**	**Retrospective B**
1. Site	Brownfield - re-development of existing hospital site.	Brownfield - re-development of existing hospital site.	Brownfield - re-development of existing hospital site.
2. Construction procurement method	Traditional	Traditional	Turnkey design and build
3. Timing of incorporation of food services into planning	Planned as part of whole hospital re-development but planning of new kitchen facilities had to be brought forward. The solution was a stand alone, permanent department, physically linked to phase 1.	The food services component of the re-development planned so that a new catering department was provided for in phase 1 of the scheme.	Planned as part of whole hospital re-development but planning of new kitchen facilities had to be brought forward. The solution was a stand alone, temporary department, not physically linked to the rest of the hospital.
4. Food services operational from	October 1992	November 1990	November 1990
5. Current mode of production	Conventional – staff. Conventional – patients.	Conventional – staff. Bought-in cook-chill – patients.	Conventional – staff. Conventional – patients.
6. Current method of meal distribution and service to patients	Multiple portions in heated trolleys transported in bulk. Some transportation in insulated box. Food served at ward level.	Multiple portions in regeneration trolleys, reheated in main kitchens. Individual courses served together on a tray at ward level.	Centralised plating in new kitchen and transported in heated trolleys. In some cases the method is multiple portions in heated trolleys transported in bulk. Individual courses served sequentially at ward level.
7. Current dish washing provision	Decentralised in ward pantries (new wards) and ward kitchens (old wards).	Central dish washing in new kitchen.	Central dish washing in new kitchen.

5.3 Results of Post-Occupancy User Evaluations

Key user groups were surveyed on food service system functioning using self-completion questionnaires. The survey questions focused on several general dimensions for evaluating food service system functioning and included aspects such as: thermal comfort; air quality; noise; and spatial comfort in relation to work activities. Chapter 2 (refer to tables 2.3 to 2.6) shows the different question categories applied to the different user groups. An example of the questionnaire survey instruments used for surveying the different user groups is provided in Appendix 6 (Questions Used for User Group Evaluation of Food Service System Functioning at Retrospective Project B). These relate to project context B. Although the questionnaires used at the other project contexts were not identical, because of the need to take account of the peculiarities of each of the project contexts, they were broadly comparable. The questionnaires were compiled using a combination of closed multiple choice and open question types. The open questions were useful in allowing users the opportunity to explain problems in further detail and highlight problem areas not covered by the closed multiple choice questions. Questionnaires were designed so that users were asked to assess the component of food service system function most relevant to them: i.e., catering staff assessed the central kitchens (and transportation/distribution system, where they were also involved in this); portering staff assessed the transportation and distribution system; domestic staff evaluated food service points at ward level. The ultimate consumers, the patients, were also surveyed except at longitudinal project C, where the nursing staff were surveyed instead. Information on food service system operation was also provided by broad-brush appraisal completed by the Catering Manager. However, this was only obtained for project context B (refer to Appendix 7 Broad Brush Appraisal of Retrospective Project B). General discussions with the Catering Managers, on food service operation, and researcher observation of the operational food service systems also provided corroborating evidence in identifying deficiencies.

Tables 5.2 to 5.6 detail the problems that were elicited through post-occupancy user evaluation of food service system functioning. Problems are listed as per the categories identified in Chapter 2 (refer section 2.5.5 Selection of Case Studies) and the case studies are those defined by category five below:

(1) Deficiencies attributable to a combination of poor workmanship and/or incorrect translation of specifications;

(2) Deficiencies attributable to lack of time for commissioning;

(3) Deficiencies attributable to problems in system administration;

(4) Deficiencies attributable to existing problems;

(5) Operational/design mis-matches identified through post-occupancy user evaluation.

The component of the food service system where the problems were identified are indicated (central kitchen production unit, transportation/distribution system, or ward/service point).

Table 5.2 Deficiencies Attributable to a Combination of Poor Workmanship and/or Incorrect Translation of Specifications

CD = Central Dining Accommodation
CK = Central Kitchen

	Project		
Deficiency	**C**	**A**	**B**
Doors installed with no locks			
Servery could only operate on large quantities of extension cable	CD		
Fryers were fitted with cold water taps on drains	CK		
Fuses blew when the power was turned on	CK		
Incorrect bin room floor screeding	CK		
Incorrect drainage in trolley wash area	CK		
Poor floor finishing	CK		
Poor floor finishing rendering floor cleaner obsolete	CK		
Incorrect drainage for boilers	CK		

Table 5.3 Deficiencies Attributable to Lack of Time for Commissioning

CD = Central Dining Accommodation

CK = Central Kitchen

	Project		
Deficiency	**C**	**A**	**B**
Patient/visitor/staff dining area opened with no crockery			
Patient/visitor/staff dining area opened without curtains	CD		
Patient/visitor/staff dining area was supplied with furniture only two days before opening	CD		
An attempt was made to open facilities without functioning ovens	CD		
The bains-marie would not keep food hot	CK		
Food display cabinets needed continuous repair	CK		

Table 5.4 Deficiencies Attributable to Problems in System Administration

WA = Ward Areas

A = All User Groups

Deficiency	Project C	Project A	Project B
Lack of availability of menu cards		WA	WA
Lack of assistance to complete menu cards		WA	WA
Poor design of menu cards		WA	
Inadequate labelling of food	WA		
Ineffective meal ordering system leading to under and over ordering	WA		
Food received not as ordered		WA	WA
Inadequate portion control leading to wastage	WA		WA
Poor presentation of food leading to wastage	WA		
Food not always attractive and appetising			WA
Food wastage caused by system problems		WA	
Meals delivered too early	WA		
Late delivery of meals	WA		
Cold food		WA	WA
Missing specialist dietary items		WA	
Missing sundry food service items (napkins etc.)		WA	
Inadequate quantities of crockery and cutlery	WA		
Too long between supper and next day's breakfast		WA	WA
Overlap of supper time with visiting time			WA
Patients rushed to finish meals		WA	
No gap between service of individual courses		WA	
Lack of assistance with patient feeding		WA	
Lack of provision for patients to eat alone	WA		
Unresponsiveness of food service system	WA		
Missed meals		WA	
Inflexibility of meal voucher system	WA		
Lack of dining facilities on some wards		WA	
Poor organisation of meal service at ward level	WA		
Poor user group communication	A		
Food service system responsibilities split between four different user groups	A		
Poor staff relations		A	

Table 5.5 Deficiencies Attributable to Existing Problems

WA = Ward Areas

TD = Transportation and Distribution System

Deficiency	Project		
	C	A	B
Uneven road surfaces around site	TD		TD
Inclement weather affecting meal deliveries			TD
Delivery routes blocked by vehicles (external)			TD
Delivery routes blocked by equipment (internal)			TD
Steep slopes on site			TD
Long distance between catering department and wards	TD	TD	TD
Need to uncouple food trolleys from electric tug to move around "L" shaped corridor			TD
Difficulty in manoeuvring food trolley through narrow link tunnel		TD	
Entrances to some wards very narrow			TD
Unreliable lifts/lack of lifts	TD		TD
Inability of lifts to cope with food trolleys (too small)		TD	
Inadequate manoeuvring space outside lifts		TD	
Non-automatic opening of doors		TD	
Inadequate space in ward kitchen for food service		TD	
Awkward manipulation of food trolley containers (porters, no protective mitts)	TD		
Unsatisfactory dining environment at ward level			WA

Table 5.6 Operational/Design Mis-matches Identified through Post-Occupancy User Evaluation

WA = Ward Areas

CK = Central Kitchen

TD = Transportation and Distribution System

Deficiency	Project		
	C	A	B
Mis-match between kitchen function and ventilation	CK		
Cooking extractor fumes cause problems in adjacent buildings	CK		
Excessive condensation in cold weather	CK		
Excessive heat and poor ventilation		CK	
Excessive heat and condensation			CK
Space inadequacies and rigidity of work activities			CK
Obsolescence of central dish washer	CK		
Obsolescence of plated meals equipment	CK		
Inappropriate use of trayed meal preparation area	CK		
Inappropriate design of main kitchen store	CK		
Refuse room and bin dimensions mis-match	CK		
Awkward positioning of daily store	CK		
Inadequate space		CK	
Rigidity of work activities		CK	
Inadequate space		WA	
Inappropriate wall finish	CK		
Inappropriate food trolleys			TD

Upon further consideration of the 17 functional problems (i.e. those representing operational/design mis-matches), there were elements of commonality between them and it was possible to theme them into three different groups according to these commonalities, as undernoted:

(1) Problems related to the work environment, specifically problems of excessive condensation and heat;

(2) Problems related to spatial deficiencies, specifically: lack of space; under-utilised or mis-used space; problematic relationships between space/equipment to workflow/activities;

(3) Problems relating to finishing and equipment.

Almost all of the problems identified were found in the central production unit component of the food service systems (15). One of the problems related to the transportation/distribution component (project context B). One of the problems related to the ward service point component (project context A). However, this problem, combined with two others that affected the central production unit at project context A (refer to numbers 13 and 14 in table 5.7), produced a rather complex set of deficiencies that ultimately impacted on the patients (refer to section 5.5.3.6 Retrospective Project A : Inadequate Space and Rigidity of Work Activities in Central Kitchen and Inadequate Space in Phase 1 Ward Kitchens, for a detailed analysis).

The 17 deficiencies arising from operation and design mis-matches (functional deficiencies) formed the case studies and are listed in table 5.7. The user groups identifying the problems are detailed, along with the aspect of system functioning that was affected (central production unit, transportation/distribution system or ward/service point.

Table 5.7 Data Relating to the Case Studies

User Group	WORKING ENVIRONMENT PROBLEMS	Component of System Functioning
CM	1. Mis-match between kitchen function and ventilation	Phase 1 finishing kitchen Longitudinal project
CS, CM	2. Cooking extractor fumes cause problems in adjacent buildings	Phase 1 finishing kitchen Longitudinal project
CM	3. Excessive condensation in cold weather	Phase 1A kitchen Longitudinal project
CS	4. Excessive heat and poor ventilation	Phase 1 kitchen Retrospective project A
CS, CM	5. Excessive heat and condensation	New catering department Retrospective project B
	SPATIAL PROBLEMS	
CS, PS, CM	6. Space inadequacies and rigidity of work activities	New catering department Retrospective project B
CM	7. Obsolescence of central dish washer	Phase 1A kitchen Longitudinal project
CM	8. Obsolescence of plated meals equipment	Phase 1A kitchen Longitudinal project
CM	9. Inappropriate use of trayed meal preparation area	Phase 1A kitchen Longitudinal project
CM	10. Inappropriate design of main kitchen store	Phase 1A kitchen Longitudinal project
CM	11. Refuse room and bin dimensions mis-match	Phase 1A kitchen Longitudinal project
CS, CM	12. Awkward positioning of daily store	Phase 1A kitchen Longitudinal project
CS	13. Inadequate space	Phase 1 kitchen Retrospective project A
CS	14. Rigidity of work activities	Phase 1 kitchen Retrospective project A
DS	15. Inadequate space	Phase 1 ward kitchens Retrospective project A
	FINISHING AND EQUIPMENT PROBLEMS	
CM	16. Inappropriate wall finish	Phase 1A kitchen Longitudinal project
PS	17. Inappropriate food trolleys	Distribution system Retrospective project B

CM = Catering Management CS = Catering Staff

DS = Domestic Staff PS = Portering Staff

5.4 Environmental Assessment

5.4.1 Data on the Effect of Environmental Pressure

In all three projects, environmental pressures had a significant impact on the project procurement process and ultimately on project outcomes. Tables 5.8(a) to 5.8 (c) present this component of the research data for each of the project contexts, identifying in particular: the timing of important environmental factors (certainty/uncertainty at the start and during the projects; instances of conflict during the projects; project complexity -

technical, aesthetic and functional), and showing repetition of Stages of Work. The effect of the environment, drawing on the findings presented in tables 5.8(a) to 5.8(c) is discussed fully in section 5.4.2 Analysis of Environmental Pressure Data. This data was compiled based on information obtained through scrutiny of client project files and corroborated, by discussion with key client project personnel (refer to Chapter 2, section 2.5.7.2 Environmental Assessment : Methodology for the Current Research).

With regard to Walker's (1989) view, that the environment could act in two ways on the process of providing a project: indirectly, upon the client's normal organisational activities and directly, upon the process of building provision itself, the results of the environmental analyses show that, indirect environmental influences predominated. Furthermore, the case study project contexts illustrated the complexity of the interaction of environmental forces, creating relatively unstable project environments, at least in so far as food service planning was concerned. Inability of the project procurement processes to reconcile the complex environmental pressures, to the benefit of the client, was an important factor in the development of functional outcome deficiencies.

5.4.2 Analysis of Environmental Pressure Data

Environmental pressures included those that specifically affected food services planning and also other factors that had an impact on the whole project. These "whole project" factors were particularly significant for retrospective project A when, in the mid 1970s, planning for the whole hospital re-development ceased due to government concerns with serious problems on other large scale hospital projects (Committee of Public Accounts 1977). As a result, the DHSS would not fund even a first phase of re-development on the scale originally envisaged. This meant abortion of the work, which had been achieved up until that point and repetition of the feasibility and sketch design stages [refer to table 5.8(a)].

Table 5.8(a) Data Indicating the Timing and Impact of the Project Environment for Project A

(R) = a repeated Stage of Work

Project A		
Time Frame	**Stage of Work**	**Environmental Impact**
1968	Inception (Operations 1-2)	*Refer Appendix 4, figure 4.20* DHSS fears regarding public expenditure on large-scale capital developments forced a halt to planning in 1976. Drastic re-appraisal of the scheme was required. To keep within the space allocated for catering services after this radical review of the scheme, areas scheduled for catering were kept well below Building Note standard.
1968-1972	Feasibility (Operations 3-4)	*Refer Appendix 4, figure 4.21* The restricted brownfield site for the hospital re-development required the adoption of space-saving strategies. Translated into the food service system, this required all preparation and detailed large scale catering to be reduced to a minimum. This fulfilled one of the early planning principles which was to reduce on-site industrial processes (catering was considered to be such a process). Hence the initial plan to have a cook-freeze system. There was also a fundamental need to establish the same type of system for patients in the new hospital phase 1 building and for those remaining in the existing South Block building of hospital 1.
1972-1976	Sketch Design (Operations 5-7)	*Refer Appendix 4, figure 4.22* The food service function was considered essential so had to be available as soon as the new phase 1 building opened. The need for centralisation to maximise economy in terms of catering staff labour and plant required the food service in the new phase 1 building to provide for patient and staff needs.
1978-1979	***Feasibility*** (R) (Operations 8-10)	*Refer Appendix 4, figure 4.23* Conflict and uncertainty regarding ventilation and natural light was caused by the considerable amount of internal planning in the phase 1 catering department.
1979-1984	***Sketch Design*** (R) (Operations 11-16)	There was an interruption in planning because of a re-organisation of teaching hospitals. The main impact was the acquisition of another hospital (referred to as Hospital 4) for which food services had to be provided.

Project A		
Time Frame	**Stage of Work**	**Environmental Impact**
1985-1986	Detail Design (Operations 17-43)	*Refer Appendix 4, figures 4.24 to 4.30* Whilst it was more economical to provide for patients and staff remaining in the South Block building of Hospital 1 from the new phase 1 kitchen, there were several problematic aspects to this, leading to conflict and uncertainty: • whilst the phase 1 food service system was developing based on a conventional production method for service to patients in the phase 1 building, a cook-chill system was considered to be more economical; • a conventional, heated trolley service from phase 1, providing food to the South Block of Hospital 1, could not operate because of the distances involved and the requirements of food legislation in this regard; • patients in the South Block of Hospital 1 would, therefore, be served by a different type of system than those in the new phase 1 building: this went against one of the key principles of having all patients on the same type of service; • the system duality, i.e. operation of a cook-chill and conventional service created complexities in terms of the planning of the food service system, particularly the need to keep these different types of operation as separate as possible within the phase 1 kitchen; • concerns and reservations regarding the implementation of a cook-chill system created conflict within the Hospital Planning Committee. On one hand, there was concern from catering users that: a large scale cook-chill operation could cause management problems related to stock turnover/control and quality of product; and that the DHSS was not really in favour of large scale cook-chill operations. However, a conflicting view expressed by construction professionals was that a total cook-chill operation would yield higher savings in energy and staff costs. The impending removal of Crown Immunity, placing even stricter controls on food hygiene, exacerbated fears about the adoption of cook-chill technology;
1986-1987	Tender (Operations 44-47)	*Refer Appendix 4, figures 4.31 and 4.32* Lack of a catering manager in post hindered planning progress. A contracting-out exercise being conducted for catering services increased the uncertainty regarding what type of system should be developed. Negotiations with another local Health Authority regarding the possibility of a substantial part of the cooking being done off-site, through a collaborative cook-chill service, compounded the uncertainty and complexity in the planning process. Pressure of time was becoming critical as the contractor was due to start on site with a no-variations contract (the phase 1 building was being designed to provide a conventional service). The earlier strategy of keeping catering areas well below Building Note standard appeared to cause a backlash as catering consultants considered the planned space for the phase 1 kitchen to be inadequate for either a cook chill or a conventional service. A complete re-draw of the phase 1 kitchen was recommended to ensure raw and cooked foods could be properly separated. Concerns regarding the possibilities of a cook-chill service were again exacerbated by the London Food Commission's Report "The Big Chill" which drew attention to the problems of this type of catering operation.

Project A		
Time Frame	**Stage of Work**	**Environmental Impact**
1987-1990	Construction (Operations 48-64)	*Refer Appendix 4, figures 4.33 to 4.35* Publication of new DHSS cook-chill guidelines. Impact of food hygiene regulations on cook-chill food distribution led to the decision to provide chilled food in bulk for regeneration and service at ward level in phase 1.
1990-1991	Commissioning (Operations 65-67)	*Refer Appendix 4, figures 4.36 and 4.37*

Table 5.8(b) Data Indicating the Timing and Impact of the Project Environment for Project B

Project B		
Time Frame	**Stage of Work**	**Environmental Impact**
1989	Inception (Operations 1-2)	*Refer Appendix 4, figures 4.38 and 4.39* Factors impacting on the inability of the existing food service system to cope with the first phase of re-development and the requirements of phase 2 were: • long distance of existing kitchen to new phase 1 wards and difficult topography. The type of tug purchased to pull the food trolleys could not cope with the site so the plated meals service operating for phase 1 patients was very poor; • providing a similar plated meals service to phase 2 patients was not a viable option since the problems inherent in the phase 1 food service system would be repeated. However, the phase 2 catering service had been planned before phase 1 had been commissioned and had proceeded on the basis of a plated meals service, similar to phase 1. Despite the known problems of operating a plated meals service on the site, hospital management regarded the alternative bulk trolley distribution method as old fashioned and undesirable. There was conflict between the image that hospital management wished to convey and what was practical, given all the site constraints; • the existing kitchens were old, badly designed and inadequately equipped and these problems were exacerbated by the removal of Crown Immunity which would result in the enforcement of tighter controls regarding hospital food hygiene; • the planning priority of regional management was in providing accommodation more directly related to patient care rather than "hotel" aspects. This, coupled with the fact that regional management was particularly cost conscious meant that there was no challenge when the Catering Manager advised that the existing kitchens could cope until phase 3 (when the new kitchens were planned in the overall re-development); • the closure of a nearby hospital kitchen added a further workload to the old existing kitchen, which was already stretched to its limit;

Project B		
Time Frame	**Stage of Work**	**Environmental Impact**
1989	Feasibility (Operations 3-8)	*Refer Appendix 4, figures 4.40 to 4.44* Problems identified above were brought to a head by a visit from the local Environmental Health Officer, which forced a review on the strategy for the provision of catering services. Timing was now uncertain, since it had previously been anticipated that no replacement kitchens would be required until the third and final phase of planning. The need for replacement catering facilities became a matter of urgency. A potential solution to the catering problems was to upgrade the existing old kitchens. This option was being pushed by the Health and Safety Executive. There was conflict regarding this possibility because: • of difficulties in gaining access to the old kitchen to carry out upgrading work; • the need for alternative catering arrangements whilst old kitchens were being upgraded; • the over-riding factor that upgrading was not really cost effective and provided a more cosmetic rather than fundamental solution (the Environmental Health Officer considered an increase in floor area to be essential to remedy the existing deficiencies).
1989-1990	Sketch Design (Operations 9-13)	*Refer Appendix 4, figures 4.45 and 4.46* There was uncertainty regarding the potential for any new facilities since most of the existing site had already been designated for other capital projects. The potential solution provided by a cook-chill type of service was short-lived as this was considered to be too politically sensitive. The introduction of a cook-chill service would have resulted in staff cuts; a situation that was to be avoided because of two other recent hospital kitchen closures. Investigation of temporary catering solutions, that would be put in place if upgrade of the old existing kitchens was implemented, led to the possibility of a system build kitchen option. Ultimately, this option proved to provide the best solution to the immediate and medium term catering problems. It was not a permanent solution as the local council had imposed restrictions on the period of time that the system build solution could remain.

Project B		
Time Frame	**Stage of Work**	**Environmental Impact**
1990	Detail Design (Operations 14-17)	*Refer Appendix 4, figures 4.47 to 4.50* Even when a final decision had been made regarding the solution for catering services, there was still uncertainty over the system build kitchen as it was very much an unknown quantity. Moreover, the financing of the system building kitchen was also uncertain because: • continuation of the catering scheme was dependent on the Health Authority's sale of health centre premises to a GP practice. The Regional Health Authority would only provide underwriting support if the sale had cast iron guarantees; • the Regional Health Authority would not release any money to bring forward construction of replacement facilities; • no money was included in the capital allocation for replacement of catering facilities before permanent replacement scheduled for phase 3; • the regional capital allocation from the Department of Health was under severe pressure, building costs were rising faster than capital allocation. The priority was to prevent delays to planned developments throughout the region. The complex site restrictions, and local council planning stipulations, had a major impact on the size of the system build kitchen, and hence internal relationships within the building.
1990	Tender (Operations 18-20)	*Refer Appendix 4, figure 4.51* After the design had been prepared and necessary funding arrangements secured, the only problematic aspect was the potential for conflict between the local Health Authority and the Regional Health Authority. The local Health Authority wished to go outside standing financial instructions and commence negotiated tendering with the system build kitchen company designers, rather than undertake a competitive tendering exercise which would have delayed the start of on-site works.
1990	Construction (Operations 21-26)	-
1990	Commissioning (Operations 27-33)	-

Table 5.8(c) Data Indicating the Timing and Impact of the Project Environment for Project C

Project C		
Time Frame	**Stage of Work**	**Environmental Impact**
1972	Inception (Operations 1-2)	*Refer Appendix 4, figure 4.1* Changing technology related to food service provision (i.e. cook-chill and cook-freeze methods of food procurement and trayed/plated meals) lead to changing aspirations about potential solutions to the catering component of hospital schemes.
1981	Feasibility (Operations 3-7)	*Refer Appendix 4, figures 4.2 to 4.5* No new kitchen facilities were anticipated until later phases of the re-development scheme (1995) since new staff dining accommodation had been provided along side an upgrade of the existing kitchens (10-15 year life expectancy) in 1975/1976. This meant that no money had been included in the re-development work for catering facilities until that time. Due to impending EEC regulations, which placed more demands on the arrangements and conditions under which food was prepared and delivered, the original planning concept of a centrally organised plated meals service was abandoned because of the physical distances involved and the fact that not all buildings would be linked by corridor. Therefore, a bulk service was chosen. At this stage, the dimensions of the ward pantries were agreed, however, when cook-chill food production methods re-surfaced on the agenda, these dimensions proved to be inadequate.
1984-1986	Sketch Design (Operations 8-13)	*Refer Appendix 4, figure 4.6 and 4.7* Further advances in catering technology, subsequent to initial policy decisions, coupled with hospital management's increasing emphasis on the importance of an enhanced catering services profile lead to further changes in planning: • development of a plated meals service (contradictory to concerns arising at the Detail Design stage. However, these were overcome to some extent as regeneration of cook-chill food would be much closer to the point of service); • development of a cook-chill procurement method, although the central kitchen was being planned so that it could ultimately adopt either a cook-chill or a conventional food production method; • the original 16m^2 ward servery areas were not adequate for a cook-chill production method and so were replaced by 60m^2 ward kitchens serving each 3x30 bed ward section. Planning of these areas proceeded on the expectation that cook-chill would be the preferred production method.

Project C		
Time Frame	**Stage of Work**	**Environmental Impact**
1986-1989	***Detail Design*** (R) (Operations 14-15)	*Refer Appendix 4, figure 4.8* Uncertainty surrounding the anticipated cook-chill production method was exacerbated by three significant external factors, as undernoted: • the impending removal of Crown Immunity; • public health concerns surrounding: Salmonella in eggs; Listeria in cook-chill foods; and the safety and effectiveness of microwave regeneration of cook-chill foods; • lack of clarity of DHSS guidelines relating to cook-chill food production processes.
1989-1990	***Feasibility*** (R) (Operations 16-20)	*Refer Appendix 4, figures 4.9 to 4.12* Existing kitchen facilities had been run down in anticipation of a region-wide cook-chill service from a centralised distribution point. However, this had never materialised and was no longer a viable option because of the problems identified at Detail Design stage. The run down state of the existing kitchens, combined with the changes in food hygiene legislation, brought about by the removal of Crown Immunity, lead to a crisis point in planning – a damning Environmental Health Officer's report on the existing catering facilities. This created further uncertainty surrounding planning for catering services. Clearly, the situation had to be resolved as quickly and effectively as possible. Upgrading the existing kitchens was an option but had many drawbacks, a primary disadvantage that retention of the existing kitchen sterilised a large part of the re-development site. As phase 1 had received higher cost allocations because it was based on a cook-chill service, and this idea was abandoned, it meant that there was funding to direct towards the provision of a more conventional type of service. Given the disadvantage of retaining the existing kitchens, the possibility of providing new kitchen facilities on the site was explored and ultimately provided the preferred solution.
1990	***Sketch Design*** (R) (Operations 21-23)	*Refer Appendix 4, figure 4.13* Complexities in planning the interior of the new catering department were brought about because of earlier decisions to use a mixed delivery service to patients. A plated meals service was to be used for patients in the new ward accommodation and a bulk trolley service was to be used for patients remaining in old accommodation. Internal planning of the new catering department had to be thought out very carefully so that when food production was in operation, bulk trolleys and food containers (which would have to travel outside) could be kept totally separate from the plates meals area and equipment.
1990-1991	***Detail Design*** (R) (Operations 24-28)	*Refer Appendix 4, figure 4.14 and 4.15* At this stage of the project, problems arose relating to project costings. In particular, a substantial savings exercise had to be undertaken prior to Final Cost Limit submission in order to bring projected costs within allowances. Despite this, the SHHD requested the Health Board to re-examine the initial option appraisal for the new catering department because of an excess of costs over the Departmental Cost Allowance. The savings exercise undertaken prior to FCL, limited the potential for any further savings. Thus, the Design Team could offer no more savings in Departmental Costs, to the level of the excess, without serious loss of function to the new catering department.
1991	***Tender*** (R) (Operations 29-30)	-

Project C		
Time Frame	**Stage of Work**	**Environmental Impact**
1991-1992	Construction (Operations 31-36)	*Refer Appendix 4, figure 4.16 to 4.19* The need for the rigorous savings exercise undertaken at Detail Design stage resulted in the decision to replace part of the tiled kitchen finish with a novel painted plaster wall finish. Although this finishing technique had been employed in finishing other areas of hospitals, it was untested in catering areas, particularly heavy duty areas such as the pot wash. As the new phase 1A catering department was being built, a problem which had emerged with the function of the phase 1 finishing kitchen windows resulted in the adoption of a sealed window design for the new catering department. This later proved to be problematic when a difficulty with the kitchen ventilation system emerged when the new catering department was operational. Uncertainty, leading to delay in decision making regarding the operation of a mixed bulk and plated meals service forced management to make a snap decision over service equipment needs.
1992-1993	Commissioning (Operation 37)	-

Several significant factors related to food services planning, prominent in the 1980s, had a major impact on the project outcomes. These are as undernoted:

(1) Cook-chill/freeze concepts in large scale catering were relatively new ideas. On the face of it, these systems appeared to be an effective solution to past hospital catering services difficulties. However, these food service systems were in the early stages of development and little was known about their inherent strengths and weaknesses. Moreover, DHSS building guidance on catering did not allude to these types of systems and in the mid 1980s the DHSS was not in favour of large scale units based on these new technologies. The lack of clear guidance, from the DHSS and Environmental Health Departments, on the technical aspects of cook-chill/freeze systems made planning difficult. Without knowing precisely the full effects of these types of systems, users could not make fully informed decisions;

(2) The 1980s was a period of constantly changing food legislation. Food hygiene law required incessant interpretation and there was a pressing requirement to plan for the future and take into account forthcoming changes in legislation/practice. In particular, there were increased requirements relating to food temperature control, influenced by the phasing out of Crown Immunity in 1991. This was brought about, in part, by evidence collected from the Institute of Environmental Health Officers and the British Pest Control Association (1985), which showed that low standards of food hygiene and pest control were to be found throughout the health service, and by public outcry over a Salmonella outbreak at Stanley Royd Hospital that killed 19 patients, (Kapila and Buttery 1986). The removal of Crown Immunity resulted in all hospitals coming under the aegis of the same strict food hygiene laws that governed other food serving premises, essentially it removed the protection that had prevented the prosecution of health authorities for breaches of the Food Act, 1984 and the Food Hygiene Regulations of 1970;

(3) The Salmonella and Listeria food scares in the late 1980s, coupled with the controversy surrounding the safety of microwave regeneration of chilled food, also impacted on decisions to opt for cook-chill/freeze or traditional production systems.

These food services specific environmental pressures impacted on all three projects, most significantly during the latter half of the 1980s. For retrospective project A, these environmental pressures impacted from the point when the detail design stage was repeated through to project completion. Although they did not result in a complete abortion of work for the food services sub-component of phase 1, the pressures did result in several policy changes and a considerable degree of uncertainty regarding the final solution for the food services sub-system.

For the longitudinal project and retrospective project B, planning for catering services was not initially considered to be a priority in the overall re-development schemes for these hospitals. In both cases, it was expected that existing kitchens would maintain food service provision until later phases of development when new facilities would be built. Although, some elements of the food service systems were being considered, most significantly the design and function of ward level kitchens, and general policy on type of operation, no provision had been made for replacement of central kitchens until a later date. For the longitudinal project, food services planning was at a more advanced level than for retrospective project B. Thus, when the environmental pressures impacted from the mid 1980s a certain amount of progress was aborted for the longitudinal project. This involved repetition of feasibility, sketch design and detail design stages. For retrospective project B, a replacement kitchen was not envisaged until phase 3 of the re-development and so less detailed planning, in relation to food services provision had been undertaken. For both of these case studies, the effect of the environmental pressures was to pull forward the replacement of existing inadequate kitchens on these schemes.

Since replacement of the central kitchens was still relatively distant in terms of re-development of project B, the effect of environmental pressures was actually to initiate a construction project in order to provide new kitchen facilities. This was a different situation from the longitudinal project where a new catering department was provided through negotiated tender with the phase 1 contractor to expedite progress - the new catering department being considered as an adjunct to the first phase. It was agreed that because of the similarity in construction detailing of the new catering department building works, the basis of negotiation would be rates contained in the Bills of Quantities for phase 1. However, the dissimilarity with the phase 1 nominated sub-contractors' works for mechanical, electrical and kitchen equipment installations meant that these elements of the works were subject to competitive tender. Negotiations proceeded with the phase 1 contractor to extend the existing phase 1 contract to reduce the pre-contract timescale, thereby allowing the new catering department to be completed at the earliest possible date. There was pressure to resolve the food services problem and commence building the phase 1A catering department as soon as possible since the money allocated for this had to be spent within a certain timescale and any delay would have had a detrimental knock-on effect for phase 2 of the re-development. Competitive tendering would have increased the tendering period by three months, moreover the phase 1 contractor was able to start work on site immediately. For retrospective project A, the final solution for the phase 1 kitchen was only resolved through a post-contract works package.

Thus, for all of the case studies, at least part of the solution could only be resolved through, what could be described as, a project within a project. For project B, this resulted in an independent construction procurement project separate from any other organisational structure involved in re-developing the existing hospital. For the longitudinal project, this manifested itself as an extension to the phase 1 contract. For retrospective project A, this was achieved through a post-contract works package.

Sections 5.4.2.1 (Environmental Pressure Leading to Timing Uncertainties) and 5.4.2.2 (Environmental Pressure Leading to Policy Uncertainties) bring together the findings of analysis of the environmental impact on development of the functional deficiencies. In particular, the two main effects of the project contexts' environments, in causing uncertainty over the *timing* and uncertainty over the *nature* of various aspects of food service system functioning are explored more fully.

5.4.2.1 *Environmental Pressure Leading to Timing Uncertainties*

In all three projects there was never any doubt that some form of food service provision was necessary. However, for the longitudinal project and retrospective project B, the exact timing for the introduction of food services was prone to change. For the longitudinal project, early planning assumptions, which later proved to be untenable, had a major impact on the development of food services and led to a crisis point in planning. The assumptions were based on: in-patient food services developing around a cook-chill/freeze method of food production with a tray meal method of food distribution; and that an early decision on the exact nature of in-patient food services was not necessary since the existing hospital kitchens had been upgraded in 1975/76 and it was envisaged that this upgrade would have a lifespan of 10-15 years. Thus, the conventional bulk distribution system, from the existing kitchen, would serve the needs of the first phase of re-development until the new cook-chill/freeze kitchen was operational. It was on this basis that no re-development of the kitchen was included in the design brief, as at that time it was anticipated that most of the new hospital would be operational by the mid 1980s and any re-development of the kitchen would, therefore, have come beyond this. However, progress was not made as expected and, at the end of the 1980s, this posed a serious problem since the existing kitchen had outlived its upgraded life (it was in fact, environmentally unsound, in terms of food safety/hygiene regulations) before any of the new accommodation was complete.

A similar early scenario existed for retrospective project B. During the early planning stages of the new hospital, catering was discussed and it was decided that new kitchen and dining facilities would be provided in the third and final phase of the scheme, planned for opening in the mid 1990s. At the time it was considered to be more important to provide accommodation "more directly related to patient care", and management was advised that the existing kitchens could cope until phase 3 was built. This decision was taken despite the fact that the existing catering department was sited at a point remote from the planned new development and the kitchen was old, badly designed, and inadequately equipped. The Catering Manager at that time envisaged that the re-development would have no impact on catering, and the Regional Health Authority, which was particularly cost-conscious, decided to take the Catering Manager's advice which was to do nothing. Despite this inertia, a kitchen upgrade and extension was completed in 1981/1982. In September 1983 a washing-up area and new food trolleys had been obtained in readiness for the pending phase 1 opening. By 1988, despite the upgrade in the early 1980s and continuing improvements, the existing hospital kitchens were unable to provide quality meals, choice menus and food served at the correct temperature. Changing legislation was compounding these problems and exerting increasing pressure on catering establishments to enforce tighter controls of food service temperatures. Even before the opening of phase 2, it was clear that the existing catering system was inadequate and unable to cope with phase 1 requirements, let alone the catering requirements for later phases of the re-development scheme.

At these crucial points speedy solutions to the hospitals' catering problems were necessary to avoid disruption to the rest of the hospitals' re-development. Interestingly, both projects had reached an impasse as a result of a similar chain of events and the options available to both were essentially the same:

(1) Upgrade existing kitchen facilities to improve the existing service;

(2) Buying-in of commercially prepared cook-chill foods for regeneration in upgraded existing kitchen or in existing ward level pantries/kitchens;

(3) Bring forward the procurement of a new permanent catering department;

(4) Provide new temporary catering facilities.

Two very different solutions emerged. For the longitudinal project, the solution was the development of a permanent, stand-alone catering department, procured as an adjunct to the first phase of development and physically linked to it. For retrospective project B, a system built kitchen, providing a conventional service to patients, with a staff restaurant facility, was the preferred option. This was a stand-alone department, built as a separate contract from other phases of the re-development scheme, and not physically linked to the rest of the hospital. The new catering department was also only a temporary solution with a limited life span of 20 years, although the planning department of the district council had imposed a maximum five-year retention period for the building.

There are possibly two factors, which help to explain how two, essentially similar, problems led to two very different solutions. Firstly, were financial considerations. At both projects no money was actually available to fund the building of a new catering department. In both cases, the central kitchen was not envisaged until much later stages in the re-development schemes, therefore, no money had been allocated for replacement catering services. For project C, the funding solution was provided when the local Health Board secured an advance from the SHHD for part of the funding allocated to a later phase of re-development. For project B, however, the Regional Health Board was not able to provide any funding. Finance was provided solely from the sale of a local health centre. For project B, therefore, there was a much more limited financial resource from which to provide a new catering department. The second factor related to early planning decisions that been made regarding the phasing and space allocations of different parts of the re-development schemes. Both projects B and C constituted hospital re-development projects on constricted brownfield sites. For project C, early on in the project, space had been identified that could potentially be used for replacement catering facilities, although in the early stages it was not envisaged that a large traditional catering operation would be required because of plans for hospital meals being provided by a region-wide cook-chill centre. Therefore, although space was limited on the brownfield site, there was the potential for new build of catering facilities. At project B, however, it was always anticipated that the catering component of the hospital would be provided in the later phase 3 of the re-development scheme. No space had been identified, outwith the plans for phase 3, for replacement catering facilities. Therefore, although both brownfield project sites were limited in terms of space and scope for new build, the constraints were much more acute at project B. The size of the catering facilities at project B were thus quite limited. These two factors, therefore, had a major impact on what could actually be achieved for both projects. The factors were more limiting for project B and resulted in the development of temporary catering facilities. The most important consequence of the outcome for project B, was the local council's stipulation that the department would have a life-span of no longer than five years.

For retrospective project A, the timing of introduction of food services was known from the commencement of re-development; it was clear that at the start of planning the phase 1 building was going to house the major element of the catering sub-system. This policy decision did not change throughout the lengthy project history. Additionally, it was always envisaged that some element of catering would be located in the South Block building of Hospital 1, to provide food for the patients remaining in existing ward accommodation on that part of the site: the distance between the proposed location of the phase 1 building and the old Hospital 1 building excluded any form of food transportation between the two sites.

5.4.2.2 *Environmental Pressure Leading to Policy Uncertainties*

As well as uncertainties relating to the *timing* of the introduction of food services, the project organisational structures of the longitudinal project and retrospective project A, also had to manage fundamental uncertainties over the *nature* of the system that would provide the best solution for the clients' requirements. This was not a particularly significant factor for retrospective project B. Although by 1989 several options had emerged that were capable of fulfilling the client's needs, once a choice had been made to provide a conventional service there was little deviation from this.

The situation was very different for the other two projects. For the longitudinal project, progress was hindered because of uncertainty surrounding food services planning at a regional level. Although the planning strategy, initially, had proceeded based on a region-wide cook-chill policy, regional management was not fully committed to this and had been unable to make a decisive statement on catering policy strategy. A catering strategy review had commenced when it had become increasingly clear among regional management that the profile of catering services needed to be promoted and enhanced and that catering had to be regarded as integral and complementary to other aspects of health care. Moreover, central government reforms, intended to introduce an element of competition between NHS units, were considered to be a potentially important factor impacting on catering and other "hotel services". It was thought that such services would be central in determining the perceived quality of the hospital.

Adoption of a cook-chill system had many perceived benefits: promising reduced costs, better food quality and better ward service. It gave economy of scale in production and removed the conventional peaks of activity in the kitchen at meal times allowing a more economical use of staff throughout the day and nine to five working hours. It also allowed meal times to be adjusted to suit individual wards. Time could be released to allow managers more time to plan, organise and supervise the production process. However, the operational difficulties of a cook-chill system were considerable. The DHSS guidelines were weak in areas and it was almost impossible to adhere to them for some foods. There was little margin for error and expert supervision was required to avoid temperature fluctuations due to equipment failure or human error. Tight temperature control was required throughout the cooking, storage and distribution processes. The initial costs for buildings and equipment were high, however, there were also hidden costs such as the requirement for stringent hygiene and quality control procedures; strict adherence to delivery times; and staff redundancy costs. Moreover, there was a lack of accurate information on the operating costs of cook-chill. Cook-chill was by no means universally accepted as the safest method of food production and storage. The proposed cook-chill system was criticised by Environmental Health Officers because of the crucial temperature controls required throughout the system and the short five day time period during which food could be stored in the chilled state. It would have been impossible to operate a cook-chill service in dilapidated buildings with antiquated equipment such as existed in the hospital at that time. The introduction of a cook-chill system would have almost guaranteed new equipment in a new building. With the removal of Crown Immunity at the end of the 1980s there was increasing acknowledgement that health catering premises would come under much greater scrutiny from environmental health departments and that the risk of hospital kitchen closure was a real possibility.

The uncertainties surrounding the new cook-chill/freeze catering technologies, with their accompanying stringent hygiene regulations, did little to alleviate the fears and doubts of regional managers. At the end of the 1980s there were several public health scares relating to microbial contamination of foodstuffs. These included Salmonella in eggs and Listeria in soft cheeses and cook-chill food items. Coupled with the latter was a second public concern related to the effectiveness of regeneration of cook-chill meals in microwave ovens. This considerable uncertainty lead to the abandonment of the anticipated cook-chill policy and abortion of much of the planning work that had already been achieved.

Environmental pressure relating to uncertainty over cook-chill technology led to delays in decision making regarding which type of production system to opt for. These delays were compounded by: management structure changes and the inability of decision makers to take responsibility and commit to a decision. The decision was originally vested in the Hospital General Manager but it was passed to the Hospital Divisional Management Team. Had this group been unable to make a decision, responsibility would have passed to the Unit Management Team.

The most contentious area of debate, which arose during the latter stages of food service planning, was that surrounding the method for meal distribution. Once it was resolved to operate food service from a new kitchen, based on a conventional system of meal preparation, there was conflict as to the type of service to run. The Catering Strategy Review Group had advocated a plated meals system. Nursing staff were split in their opinions regarding the advantages and disadvantages of such a system; catering management, however, preferred the traditional bulk system. The Catering Manager favoured operation of the new kitchen on a bulk service but was prepared to run the kitchen any way hospital management desired so long as sufficient funding was allocated. The kitchen staff dreaded the introduction of a plated meals system.

Management at Board level was pushing for a plated meals service. Their preference was driven by the notion that this type of service was more in keeping with public expectations of a modern hospital food service system. They were, however, unable to appreciate fully the inherent complexities of such a system from an operational perspective. One of the motivators to opt for plated meals was the potential savings that could be accrued because it was considered to be a more cost effective service. It was only at a late stage (construction of the phase 1A kitchen) that questions started to be asked about revenue implications, and the real ramifications of a plated meals system transpired. Although savings could accrue on a plated meals system through commodities, it was only at this stage that it was acknowledged that a plated meals system would be far more costly in terms of labour than an equivalent bulk system. Eventually it was resolved that a mixed bulk and plated meal distribution system would operate. This decision had a major impact on the design and operation of food services in terms of kitchen design, distribution system and ward level service. These important repercussions were not fully appreciated and translated into the design solution as evidenced by some of the post-occupancy problems. For example, it meant that bulk trolleys travelling externally would have to be kept separate from those trolleys remaining within internal transportation routes. These constraints had a significant impact on workflow and kitchen layout. Moreover, it was recognised that the proportion of bulk to plated meal distribution would vary according to commissioning of various later development phases of the hospital and the decanting of patients into new parts of the building.

For retrospective project A, throughout food services planning there was considerable uncertainty surrounding the nature of the system that would operate in the new phase 1 building, re-developed hospital 4 and Hospital 1 South Block buildings. Although the nature of the system would not have a major impact on location of the catering production unit within the phase 1 hospital, it did have important consequences with regard to the integration of design and operational factors concerning the relationships between the food production unit, food distribution system and ward service points. Conflict, related to the type of service that was to be provided, was exacerbated by changes in catering user group representation and other key project personnel. A number of other pressures, as detailed in section 5.4 (Environmental Assessment), were also key factors in creating an environment of uncertainty in relation to cook-freeze/chill production methods: uncertainties over new cook-chill/freeze catering technologies; changing food legislation; and the abolition of Crown Immunity; and food scares involving microbial contamination.

As a result of these environmental pressures there were several policy changes and it was not until May 1990, when construction was completed on the phase 1 building, that the Unit Management Team had made a firm decision regarding the system required for food service provision. As it was left so late, the changes that were necessary to effect the type of service that was finally chosen, had to be worked into a post-contract package. Food service system design and construction, for patients' service from the phase 1 kitchen, had progressed on a mixed conventional and cook/chill basis, throughout the majority of the project procurement process, but the final decision was for a cook-chill system. The changes necessary to effect this solution were considered, by those involved in planning and design, to be relatively straightforward to achieve. The extra space required for storage in the cook-chill system was offset against a decrease in the spatial requirements for some preparation and cold storage areas. Uncertainty regarding the type of central food production unit also impacted on the type of distribution system that would operate - i.e. bulk or plated. These considerations affected both the central kitchen and satellite ward kitchens. A plated meals service would have required a special chilled plating area in the central kitchen. For either type of distribution system there were implications for domestic staff. At the time the final decision was made for a bulk, cook-chill service it was considered that existing provision in the phase 1 ward kitchens was adequate. However, this conclusion proved to be erroneous as the phase 1 ward kitchens were too small to accommodate the food regeneration trolley.

5.4.3 Summary of Impact of Environmental Pressures

Environmental pressures impacted on progress and ultimately outcomes, on all three projects. All were affected by several food service specific environmental pressures. In addition, retrospective project A was also affected by other factors impinging indirectly on the project procurement process, through the client body. The food service specific environmental pressures led to uncertainty over the *timing* of food services planning and design : this was apparent at the longitudinal project and retrospective project B. During the early planning years re-development of replacement catering services appeared to be a low priority but as planning progressed, the need to provide improved food services became increasingly important, until at critical periods the lack of new facilities was jeopardising later phases of the hospitals' re-development schemes.

These pressures also led to policy uncertainties regarding the *nature* of the system that would operate. This was observed for the longitudinal project and retrospective project A. For both these, policy uncertainties were with regard to the type of production (cook-chill/freeze or conventional) and food distribution (plated or bulk) methods. For the longitudinal project, although the catering system was initially designed with a certain degree of duality (i.e. catering design progressed on the basis of a cook-chill solution but was supposed to be flexible enough to accommodate a more conventional operation) the switch to a conventional system was by no means a simple task. The final solution adopted for project context C was for the development of a permanent catering department physically linked to phase 1 of the hospital re-development and providing a conventional production method but utilising a mixed bulk and plated meals distribution system. The final solution attempted to provide a facility that would be flexible enough to accommodate the expected changes in catering that would be commensurate with the commissioning of later phases of the hospital, in terms of the proportion of patients being served by plated or bulk meal distribution, and to leave the potential for a review of cook-chill catering.

For retrospective project A, the final outcome was at odds with the original planning principles established in the 1960s. One of these original planning principles sought to minimise the extent of "industrial processes" on site. At the time, meal production was considered to be an industrial process. The original catering strategy, therefore, required production methods that would minimise food preparation/manipulation/modification activities (refer to Escueta's classification system in Chapter 2, (section 2.5.4.3.1 Development of User-Focused Questionnaires). Cook-chill/freeze production methods, specifically those that relied on purchase of ready-prepared meals, would have met this original planning principle because such methods would not have required the extent of prime cooking equipment used by a conventional production method.

Although uniformity of service for patients had been achieved, the patients in the phase 1 and Hospital 1 South Block buildings all received food procured by a cook-chill system, phase 1 kitchen functioning was compromised because of the operation of a conventional service for staff. Although the cook-chill system did require a limited number of items of prime cooking equipment to prepare foods that were not suitable for the cook-chill process, the volume of these, and hence industrial processes, exceeded those originally planned for because of the operation of a conventional service for staff food provision. The original planning principles, which required "industrial processes" to be minimised, were not met. As the decision had been taken to buy in ready prepared cook-chill food this should have reduced the need for prime cooking equipment even further. With this type of cook-chill system, the greatest requirement in the phase 1 kitchen would have been for storage space for chilled foods. In effect, in the phase 1 kitchen two types of production system operated: cook-chill (patients) and conventional (staff). This production mode duality was not economical as it would have been more cost-effective to procure both patient and staff food conventionally, particularly since the phase 1 kitchen had most of the prime cooking equipment requirements for a full conventional service anyway. The staff economies that a cook-chill/freeze system would have brought could not be realised so the catering staff complement could not be scaled down. Moreover, the operation of two different modes of food production created an additional degree of complexity since the two different production processes had to separated, as far as was possible.

Environmental pressures forced abortion and repetition of stages of the procurement process for all projects except for retrospective project B. The greatest degree of this abortion and repetition occurred during the project procurement process for the longitudinal project. The environmental impact was also greatest for this project as it was affected by *both* timing and policy uncertainties. The post-occupancy evaluation data, as shown in table 5.7 identified a greater number of operational/design mis-matches at the longitudinal project (10 mis-matches for this project compared to four and three for projects A and B respectively). Moreover, there was also a greater number of other types of outcome deficiencies identified through the post-occupancy evaluation, and as shown in tables 5.2 to 5.5, for the longitudinal project C than for the other two projects. These findings suggested a causal link between environmental pressure and project outcome deficiencies; project C showing the greatest number of deficiencies and exhibiting the greatest environmental impact.

5.5 Analysis of Functional Outcome Deficiencies

5.5.1 Determining the Cause and Effect of Operational/Design Mis-matches

The different problems identified by post-occupancy user evaluation resulting from mis-matches among users and fixed and unfixed elements of the food service systems are investigated further in this section. Fixed elements include the building envelope and fixed items of equipment. Unfixed elements include moveable items of equipment. Problems identified by one group of users were often related to, or associated with, problems identified by other user groups i.e. problems with one component of system functioning were related to others; and different problems within a project could be attributed to similar causes or origins, particularly with regard to the impact of environmental pressure causing policy and timing uncertainties.

Several factors, as undernoted, hindered attempts to correlate the project outcome deficiencies to specific points during the project procurement process:

(1) The complex inter-relationships between problems;

(2) The multiple aetiology of many of the problems;

(3) The repetition of stages of work during the project procurement process;

(4) The incremental nature of the project procurement process with each stage building upon the last so that as the project progresses the final solution to the client's initial demand becomes defined in increasing detail.

Therefore, there was a potentially large number of periods during the projects which could collectively result in courses of action that produced the observed functional problems. It was possible for part of the solution to be incorrect at the beginning of a project. During the building procurement process, corrective action could be taken to re-direct any errors. However, subsequent planning might not identify errors and could perpetuate mistakes right through to practical completion and commissioning. It is only in these latter stages when the building is put into operation, and users start to interface with the design, that operational planning and building design mis-matches become apparent.

If it is accepted that the process of reaching a solution to fulfil the client's needs is an evolutionary, incremental process dependent on a continual re-checking and re-validation of design and operational elements interacting to produce a functional system then the project procurement process through which the solution is resolved must allow for this continual checking process to occur. Hence, when environmental pressures impact on a project and force the client to adjust some element of the solution then there must be capacity within the project procurement process to ensure that changes in the proposed design and operational elements are re-tested to ensure compatibility with each other. One of the key functions of the project procurement process, therefore, is to ensure that as the solution evolves it is constantly re-tested and re-validated. This means that throughout a project, from broad strategic planning to detailed planning, there must be synergy between design and operational factors. For sub-systems that comprise buildings this must be effective within and between identifiable individual components. In terms of food services, critical relationships between users, fixed and unfixed structures must be maintained *within*: the production unit, distribution system and ward service points; and *between* these three components. When these relationships are not maintained, and there is deviation between design and operation, then functional problems manifest themselves in the final functional solution.

For each of the projects there were clear examples where design and operational mis-matches resulted in project outcome deficiencies, as identified by the user groups involved in food services operation. The origin of each of these problems was traced back through the project's procurement process to determine what deficiencies allowed these to occur. Moreover, the project procurement process subsequent to these points of origin were also examined to determine why no corrective action was taken to rectify the original divergence in design and operational planning. The outcome deficiencies could be categorised as undernoted:

(1) Environmental deficiencies - excessive condensation and heat because of ventilation problems;

(2) Spatial deficiencies - lack of space; under-utilised or misused space; problematic relationships between spaces/equipment impacting on workflow and activities;

(3) Finishing and equipment deficiencies.

The interplay between design decisions, operational decisions and the project environment, for each of the outcome deficiencies identified and discussed in section 5.5.2, are depicted by a series of figures accompanying the discursive text.

5.5.2 Operational/Design Mis-matches Related to the Working Environment : Excessive Condensation and Heat

5.5.2.1 *Longitudinal Project : Mis-Match Between Kitchen Function and Ventilation (refer figure 5.1)*

Discussion of kitchen function with the Catering Manager revealed a mis-match between kitchen function and ventilation for the phase 1 finishing kitchen.

As the phase 1 finishing kitchen for the longitudinal project had originally been designed for regeneration of cook-chill food only, there had been no requirement to install a substantial amount of prime (heat and steam producing) cooking equipment. In fact, only two fryers and three regeneration ovens were planned for. However, when the cook-chill idea was abandoned and the kitchen was re-developed for a more conventional service, there was pressure from catering staff to upgrade the kitchen to a unit that was more than simply a finishing kitchen, where it would be possible to produce cook-to-order meals. During the procurement process the impact that this policy change had on the design specifications of the finishing kitchen was not fully translated. In particular, the ventilation system could not cope with the heat and steam generated by the additional items of prime cooking equipment and as a result temperature and humidity became unbearable. The most obvious and simplest solution was to open the windows in the kitchen but there was no fly/bird screen fitted : opening windows in such circumstances would have been in breach of food hygiene regulations. However, keeping the windows closed led to an unsatisfactory working environment and contravened food hygiene and building regulations. As a consequence, until fly/bird screens were fitted (this was considered to be the most cost-effective solution) large amounts of food could not be cooked in the phase 1 finishing kitchen. All food was actually prepared in the new phase 1A kitchen and transported to the servery in the dining room adjacent to the phase 1 finishing kitchen.

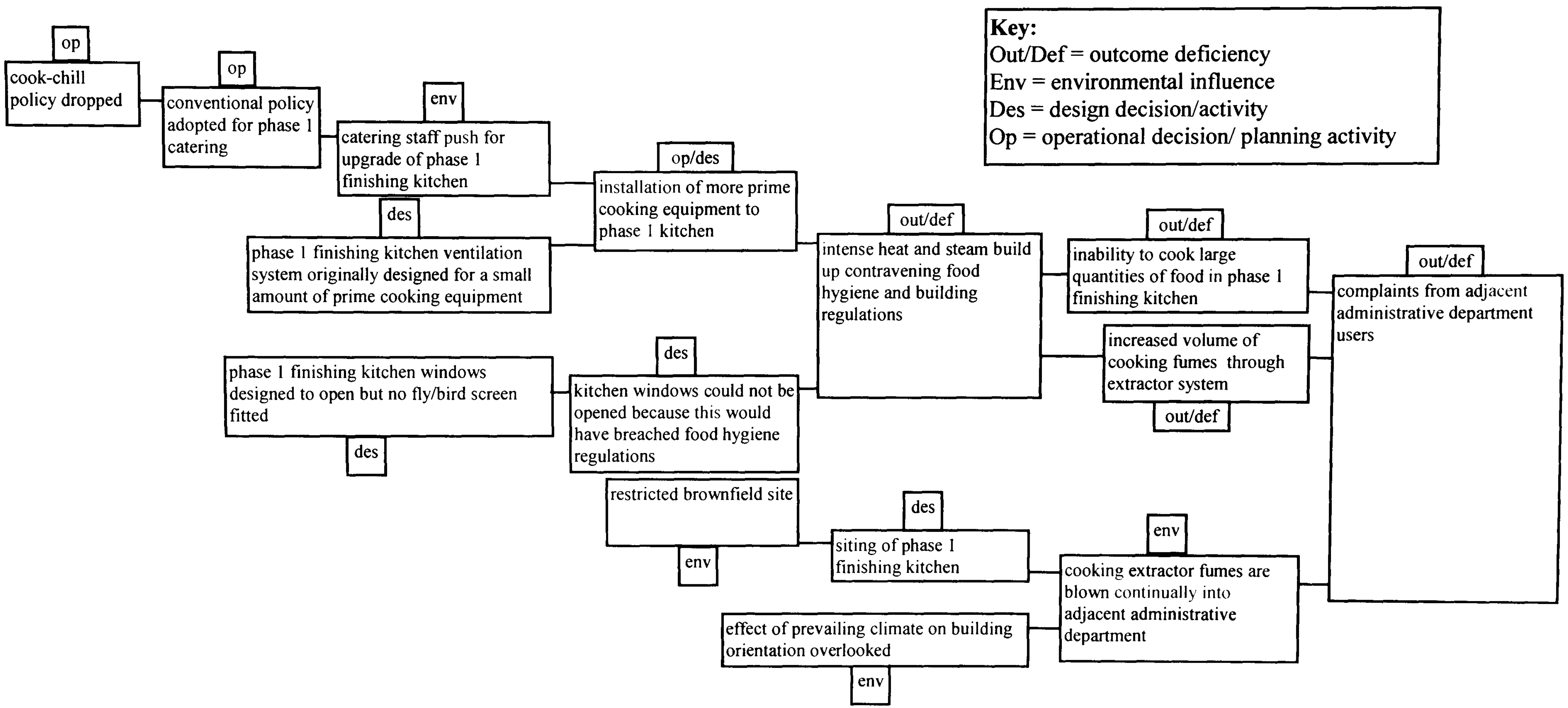
The fact that no fly/bird screens had been fitted was not the real problem. Installing them was simply a quick-fix solution to a rather more fundamental deficiency involving a mis-match between the volume of prime cooking equipment and the capacity of the ventilation system. Ultimately, the lack of fly/bird screens was determined, by the client, to be the architect's fault, however, there was no information in the client project files to indicate on what evidence base this decision was reached. The precise cause of the operational design mis-match between the prime cooking equipment and ventilation system was not entirely clear. What was evident, was that due to the many uncertainties relating to the nature of catering services the phase 1 finishing kitchen had been developed with a dual modality, in that it was planned to be able to accommodate either a conventional or cook-chill system, whichever was eventually resolved as the preferred option. At operation number 16 [Operations are related jobs or work packages that define a particular project] (refer to Appendix 5, LRC, table 5.5) there was an investigation of the feasibility of cook-chill alternatives and this included a review of the phase 1 food service areas (ward kitchens/pantries), at that time undergoing construction/commissioning, to ensure that they would be compatible with the potential operation of food services from a new catering department. Although the Mechanical and Electrical Engineers and Commissioning Engineer were consulted, the critical relationship between the volume of prime cooking equipment and ventilation requirements was not elucidated. Clearly, the duality of the phase 1 finishing kitchen was not such that it could accommodate the changes required for a more conventional type of service without significant modification to the ventilation system. As this mis-match was not identified at that point, and was not later identified through subsequent building procurement activities, the error was perpetuated through to commissioning and operation. It was only when the phase 1 finishing kitchen prime cooking equipment was in full use that this particular deficiency became apparent.

5.5.2.2 ***Longitudinal Project : Cooking Extractor Fumes Cause Problems in Adjacent Buildings (refer figure 5.1)***

Discussion of kitchen function with the Catering Manager highlighted the problem of cooking extractor fumes for staff in adjacent buildings.

Associated with the ventilation problem detailed above, unpleasant extracted cooking fumes from the phase 1 finishing kitchen irritated nearby building users. In this case, two contributing factors could be identified. First, the change in use of the finishing kitchen by installation and utilisation of an increased volume of prime cooking equipment led to a greater output of extracted cooking fumes than had been anticipated. This, coupled with the failure of the design team to recognise the effect of the prevailing climate and building orientation on the distribution of cooking extract fumes on the congested site, led to user dissatisfaction when these cooking fumes were blown into an adjacent administrative department. It is possible that this problem might never have emerged had the phase 1 kitchen remained as a simple finishing kitchen producing a lower volume of kitchen extract fumes. No evidence was identified in the client's project files to suggest that potentially problematic cooking odours were ever anticipated or accounted for.

Figure 5.1 Longitudinal Project C
Mis-match Between Kitchen Function and Ventilation - Phase 1 Finishing Kitchen
Cooking Extractor Fumes Cause Problems in Adjacent Administrative Department - Phase 1 Finishing Kitchen



Given the fact that: site constraints limited the location and positioning of new buildings and physical relationships/distances between departments; and there was a strong awareness among project contributors of the inherent problems of siting the new phase 1A catering department so close to other parts of the development, it is surprising that the impact of cooking extract fumes from the phase 1 kitchen was overlooked. Although the fumes might have been substantially reduced, and hence less troublesome, had the cook-chill policy remained, or the ventilation system been re-specified with the capacity to cope with more heat and steam producing equipment than was originally planned, the design team should have accounted for the effect of the cooking extract fumes on nearby buildings. Clearly, the important relationship between the close proximity of the phase 1 kitchen to adjacent hospital buildings was never made explicit and never identified as an issue during planning. This proved to be a major oversight, particularly when coupled with the change in decision regarding production method, from cook-chill to conventional. At the time when the feasibility of cook-chill alternatives was being investigated, there was an opportunity to identify any problems that might be created by such a major policy change. At Operation 16 (Refer Appendix 5, LRC table 5.5), when the feasibility of alternatives was being investigated, there was input from construction professionals (the Project Architect, Commissioning Engineer and Mechanical and Electrical Engineers) and the client (catering specialist). Even with interaction between these key parties there was still a failure to identify the mis-match between the addition of extra items of prime cooking equipment and the effect on kitchen extract system.

5.5.2.3 *Longitudinal Project : Excessive Condensation in Cold Weather (refer figure 5.2)*

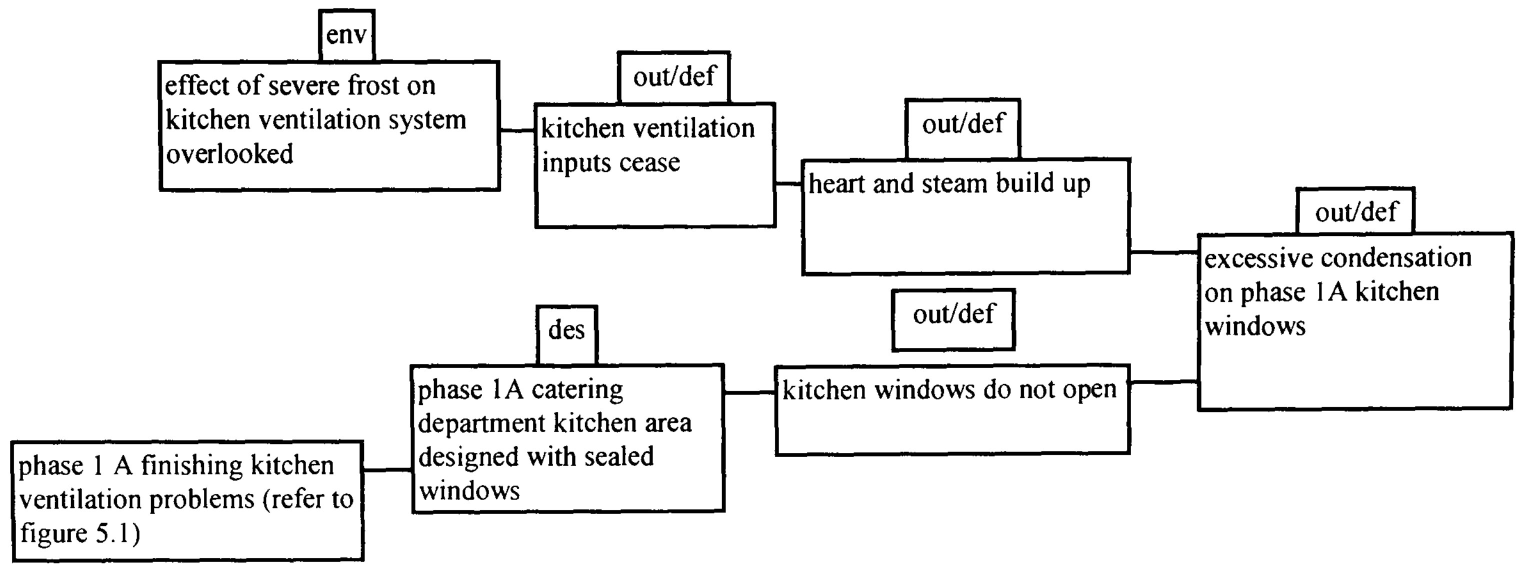
The phase 1 finishing kitchen ventilation problems that the design team encountered had an impact on the ventilation solution that was adopted for the new phase 1A catering department. Eleven members of catering staff commented on problems with cooking odours and two staff also expressed dissatisfaction with kitchen ventilation. Through discussions with the Catering Manager, concerns regarding kitchen ventilation were elicited.

The phase 1A kitchen suspended ceiling was the single most expensive item (costing approximately £100,000) and contained the ventilation extract and input systems. The preference for a suspended ceiling had undoubtedly been influenced by problems experienced with the high ceiling in the existing kitchen which had created an environmental health hazard. In the new catering department, with a severe frost the kitchen inputs ceased and the temperature in the kitchen began to increase. Condensation formed on the windows but the sealed window design would not allow the windows to be opened. The sealed window solution had been chosen because of the problems experienced in the phase 1 finishing kitchen when users had contravened food hygiene legislation by opening windows that had no fly/bird screen fitted. As with the cooking fumes problem, the effect of climate should have been anticipated. The outcome of this design unawareness, and adoption of an inappropriate solution based on previous experience, meant that an immediate response to the impact of climate on ventilation could not be offset by simply opening a few windows. The effect of severe frost on the function of the ventilation system was a factor that should have been accounted for. The sealed window design was, in part, chosen as a result of the previous problem caused by the lack of fly/bird screens for the phase 1 finishing kitchen. Additionally, the wiremesh screens were considered to be unsightly and to be avoided for the new phase 1A catering department. Although the architect made the final decision on this, there was strong support from catering user representatives who were consulted (refer Appendix 5, LRC table 5.9 Operation 33). Unlike phase 1, no quick-fix solution was possible so this resulted in necessary modifications to the ventilation system.

5.5.2.4 *Retrospective Project A : Excessive Heat and Poor Ventilation (refer figure 5.3)*

At retrospective project A, staff expressed dissatisfaction with regard to excessive heat and poor ventilation in the new phase 1 kitchen. Three members of the catering staff regarded kitchen temperature as being too hot. Likewise, three members of staff indicated that kitchen ventilation was bad. Like the longitudinal project, there had been considerable uncertainty regarding the type of system that would operate. Although the original cook-freeze/chill method of production had initially only been a short lived planning activity since food services had developed largely around a conventional method of production for the phase 1 kitchen, some allowance for cook-freeze/chill was always envisaged. Early in 1985, when considerable environmental pressure resulted in a re-emergence of a potential cook-chill strategy, the Mechanical and Electrical Consulting Engineers warned that a change from conventional to a cook-chill based system would have fundamental effects on the engineering services for the phase 1 kitchen : a significant amount of detailed design work had already been undertaken. The Mechanical and Electrical Engineers were involved in initial exploratory activities relating to the potential change to a cook-chill system (refer Appendix 5 LRC, Table 5.16 Operations 17 and18) and throughout the detail design stage.

Figure 5.2 Longitudinal Project C
Excessive Condensation in Cold Weather - Phase 1A Kitchen

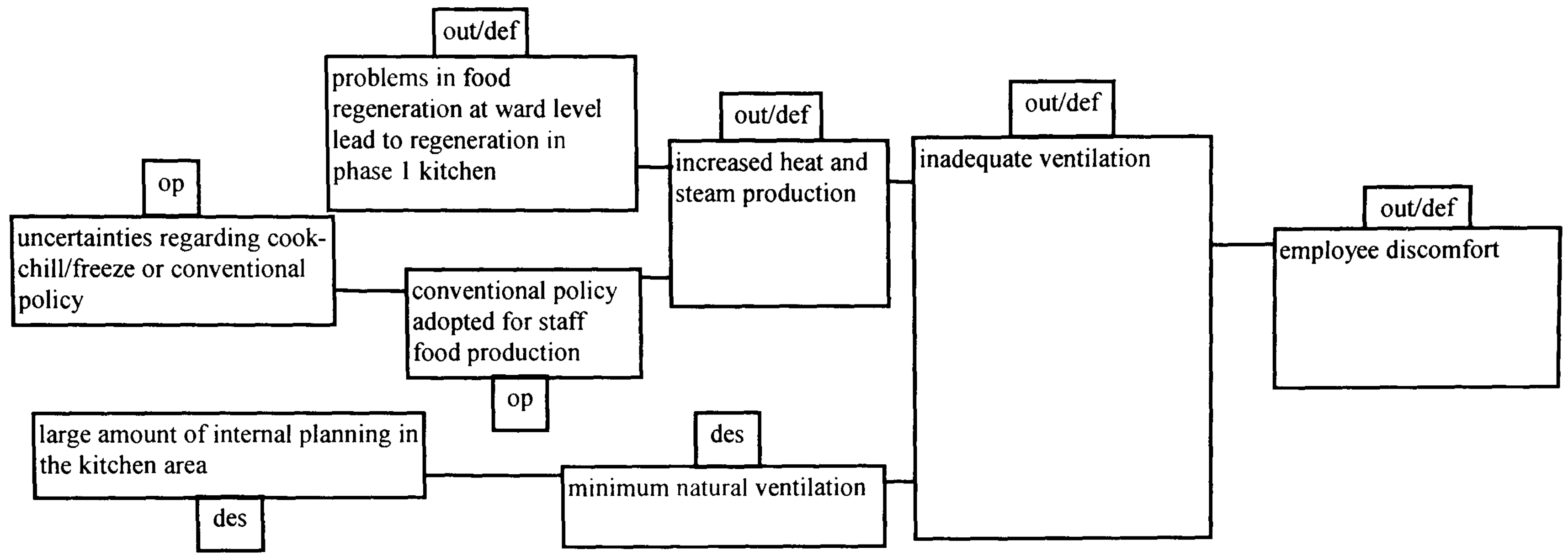


Operation 39 (Refer Appendix 5 LRC, table 5.18) was particularly crucial when, approximately one year after warnings by the Mechanical and Electrical Engineers, the Group Catering Advisor voiced further concerns with regard to lack of natural ventilation. This was considered to be problematic as, if the air conditioning system failed, there was no back up and there was a large degree of internal planning within the catering department, i.e. there were many internal rooms that did not have windows so the potential for natural ventilation was minimal. The Group Catering Advisor was particularly concerned that there might be statutory environmental health regulations pertaining to this. The architect investigated this potential problem but the concerns did not appear to be justified. However, extracts from the IHVE guide appeared to conflict with information provided by the architects. The Project Management Consultants were asked to intervene in this conflict and resolved that there was no problem. Despite these detailed considerations, in the final solution the building users were dissatisfied with excessive heat and poor ventilation in the kitchen. Like the longitudinal project there was a certain degree of duality in the phase 1 kitchen in that planning changes between conventional and cook-chill procurement had resulted in a design apparently capable of functioning in either modality, albeit with modification. Despite this, there was a number of periods when ventilation system concerns emerged; policy changes continued throughout the project which confounded attempts to match ventilation requirements to system functioning. The decision to provide staff meals conventionally, and the problems of food regeneration at ward level, leading to regeneration within the kitchen, added to the pressure on the ventilation system. The worst fears of the Group Catering Advisor were realised approximately 12 months after the kitchen became operational when the ventilation system failed and the build up of heat and humidity created a totally unacceptable kitchen environment, in terms of health and safety for both food production and employee comfort.

5.5.2.5 <u>*Retrospective Project B : Excessive Heat and Condensation (refer figure 5.4)*</u>

Criticisms relating to excessive heat and condensation in the new kitchen, caused by poor ventilation, persisted despite the fact that this problem had been addressed by the system build kitchen company during the defects liability period. All nine respondents from the catering staff indicated that kitchen temperature was too hot, in particular, one member of staff commented that the pan wash area was too hot. There was a similar response regarding kitchen ventilation. Only one of the nine respondents considered this aspect to be satisfactory, the other eight respondents considered ventilation to be bad. Concerns of catering staff were reflected by the Catering Manager who considered there to be inadequate control over the wall mounted electric heaters in the new catering department.

Figure 5.3 Longitudinal Project C
Excessive Heat and Poor Ventilation - Phase 1 Kitchen



In addition, the Catering Manager was also critical of poor ventilation causing heat retention and condensation in some areas (refer Appendix 7 Broad Brush Appraisal of Retrospective Project B).

Poor ventilation, leading to condensation and excessive heat retention was particularly problematic in the pot wash and servery areas. Excessive steam build up when the pot wash was in use had led to buckling of ceiling cover trims and the excessive condensation was causing unsafe and unhygienic floors and walls. The Health Authority was concerned that the creeping of this moisture through the cladding joints would cause deterioration of the building's roof structure. Poor ventilation was compounded in the servery area because the overhead fans that had been installed were ineffective, and so noisy they drowned out normal speech; at serving times when maximum ventilation was required the fans could not be used. The problem of the faulty fans was easily rectified and they were replaced by the system build kitchen company before the end of the defects liability period. As with the longitudinal project, there was an obvious mis-match between the volume of heat and steam being produced and the ventilation system capacity. Unlike the longitudinal project, however, there were no complicating environmental factors relating to production unit policy changes.

As soon as the system build kitchen emerged as the preferred option there was never any doubt that the kitchen would run conventionally - thus the requirement for a significant proportion of prime cooking equipment should have been known from a very early stage. At Operation 14 (refer Appendix 5, LRC table 5.26) the preferred system build option was worked up in detail. The plans were constantly reviewed and developed iteratively between the client and system build company (refer to Operation 16, Appendix 5, LRC table 5.26). Electrical loading, drainage, ventilation and other such service aspects were considered simultaneously until specifications were agreed upon for each. The system build kitchen company undertook this work with contribution from a variety of client side individuals. As the building procurement process progressed through a design and build process, the system build kitchen company was responsible for planning, design, construction, installation, services and commissioning. Although electrical and building sub-contractors were brought in for some of the works, the system build company itself installed the mechanical services. Lack of adequate ventilation to prevent the problem of condensation build up was deemed, by the Health Authority, to be a matter of design and that since the system build kitchen company was responsible for design and construction then this was a legitimate defect requiring attention. The system build kitchen company believed condensation build up to be caused by a lack of intake air rather than a lack of

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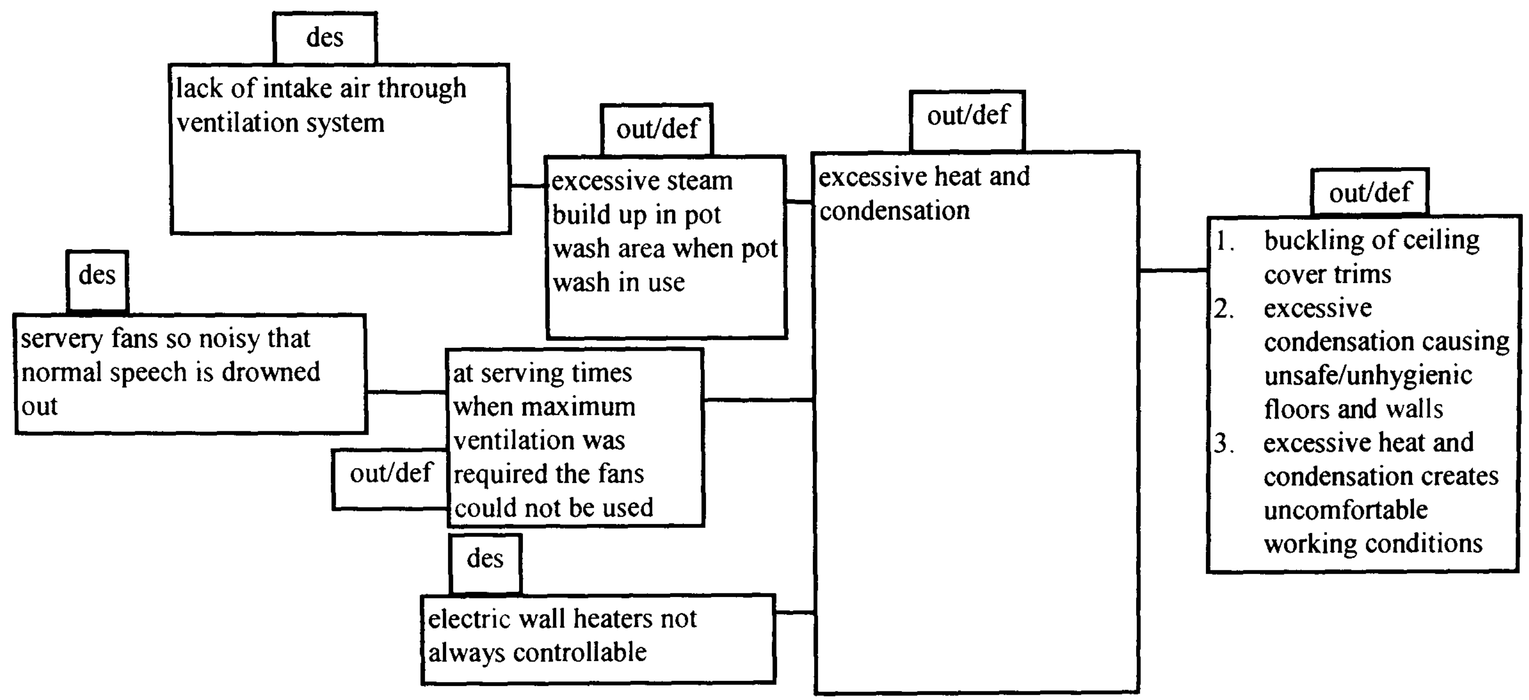
Figure 5.4 Retrospective Project B
Excessive Heat and Condensation - New Catering Department



In all three case studies, the ventilation deficiencies (excessive heat and condensation) were related to inadequate decision making regarding application of ventilation technology to catering facilities. The nature of the problems could be considered to be outwith the purely architectural domain since knowledge of kitchen function, and its relationship to ventilation requirements, was necessary in order to develop a more appropriate/effective solution. Ventilation requirements were not considered as an integral part of the design solution thus the crucial relationship between ventilation design and kitchen function was not adequately explored and addressed.

5.5.3 ***Operational/Design Mis-matches Related to Spatial Deficiencies : Lack of Space, Under-utilised or Misused Space, Relationship of Space/Equipment to Workflow and Activities***

A common area of dissatisfaction across the projects was due to spatial deficiencies in central kitchens and ward level kitchens. The deficiencies that occurred on the projects were due to the constant policy changes affecting the functional relationships within and between the production unit (cook-chill/freeze or conventional) and the food distribution/service components (plated/trayed meals or bulk). In the longitudinal project and retrospective project B, problems were mainly confined to the production unit. For retrospective project A, the inability of the project procurement process to relate policy changes to design and operational specifications led to problems in service of food at ward level as well as user dissatisfaction with the main kitchen in phase 1.

5.5.3.1 ***Retrospective Project B : Space Inadequacies and Rigidity of Work Activities (refer figure 5.5)***

Eight of the nine catering staff respondents indicated that space in the new kitchen was inadequate, only one respondent perceived it to be satisfactory. Although seven of the nine respondents from the catering staff indicated that relationships between spaces, equipment and different work areas hampered their work, only four indicated that the shape and layout had a negative effect on workflow. One respondent indicated that there was no effect and the remaining four of the nine respondents indicated that there was a positive effect. There was a similar split in opinion between those catering staff who though that equipment location made its operation difficult (five) and those who indicated that equipment could be operated adequately (four). With regard to the positioning of doors, windows and cupboards, there was again divided opinion among those staff that perceived such aspects to be conveniently positioned (four) and those staff who considered such aspects to be inconveniently located (five). With regard to space, the Catering Manager considered this to be sufficient but tight and required good management. In terms of work activities and the layout of the department, the Catering

Manager indicated that this provided for a good linear work flow that was safe and hygienic (refer Appendix 7 Broad Brush Appraisal of Retrospective Project B). Thus, although there appeared to be general satisfaction from the point of view of catering management, the catering users were dissatisfied with some aspects of spatial arrangement. Portering staff were also dissatisfied with the internal layout of the catering department – some difficulties were experienced in manoeuvring the food trolleys.

Retrospective project B's spatial problems related to difficulties in locating the new catering facility in such a position on the existing hospital site that future developments would remain unaffected. This was not a simple task, since much of the space on the site had been designated for new build projects. The location for the new department was complex: on one side was a main road; on another was a private dwelling; and on the remaining two sides were an oxygen store and hospital car parking space. The size of the catering department was limited as it had to be built so that it: was not too close to the dwelling and oxygen store; would not cause obstruction to the main road and dwelling beyond that; and would have a minimum impact on loss of car-parking space. On the client side, the District Health Authority Catering Services Manager played a key role in liaising with catering staff and the system build company in developing an internal open-plan design for the kitchen based on a conventional service. Although the system build company had previous experience of procuring kitchen facilities for a health service client, and had experience of building a kitchen to the same floorspace, the system build catering department project was very much an unknown quantity for the client.

As the size of the department was limited by site constraints some compromises inevitably had to be made in internal planning. The client's requirements and the system design were not wholly compatible as what the client had formatted as a draft plan would not fit with the system units. The structure would have extended too far if the catering department had been built to the dimensions originally requested. The whole department also had to be rotated 45 degrees from its original position. The combination of restricted site and modular unit required space allocations to be considered very carefully and this led to complexities in the interior.

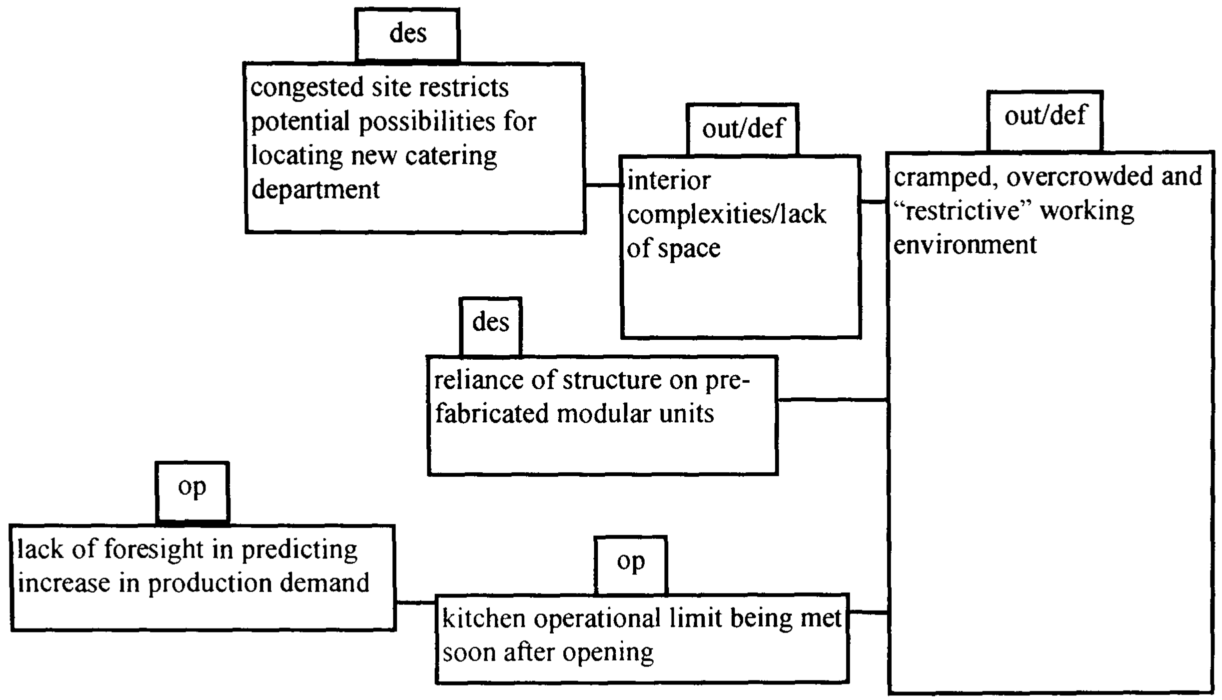
Quite lengthy considerations were involved in detailing the functional attributes of the catering department. Access and egress for: delivery vehicles; food distribution equipment and staff; and restaurant customers, had to be considered and provided for at different locations around the premises. In terms of collection and return of food/equipment by portering staff, access had to be restricted from the main body of the kitchen. The building had to provide all the requirements for a self-contained catering department with a good linear work-flow for a total of 50 staff. The internal environment had to meet all the necessary legislative requirements. Operational consideration had to be given to the range of prime cooking equipment to facilitate provision of a multi-choice menu but avoid equipment standing idle and occupying valuable space. Production area space was at a premium - at peak periods staff had to be able to work safely. Mobile equipment was required allowing flexibility in production techniques. Careful consideration was also given to cleaning requirements. It was essential to minimise the impact of equipment maintenance and engineering repair work since food services operated continually. A service gantry was provided at the back of equipment to facilitate this. These detailed design considerations were worked up in a very short time period. The detailed design work was undertaken by the system build kitchen company and at crucial steps in the process there was a broad range of client side specialists involved, this included catering users specialists and those involved in managing other aspects of the service such as transportation and distribution and ward level service (refer Appendix 5, LRC table 5.26, Operations 14 and 16).

Although these space restrictions were acknowledged and understood from the start, and users were involved in the kitchen design, catering users were critical of the cramped working conditions and the fact that the department was not adequate for the workload. The central cooking area was criticised for being too overcrowded and catering and portering staff were particularly critical of the food trolley area which would have benefited from enlargement to facilitate trolley movement. Staff commented that because of the lack of space in the department, working practices had changed requiring staff to adopt a "cleaner" working manner. In most kitchens there is enough space to create a certain degree of untidiness without affecting work or safety in the kitchen. However, in this kitchen the users were constantly tidying up or "working clean" because there was not enough flexibility in the department to allow for the working routines that they had previously been accustomed to.

At retrospective project B there was an interesting anomaly: the success of the new catering department (in terms of addressing the problems associated with the old food service system) led to such an increased production demand that the new kitchen, having been in use for only a short time, was already reaching its operational limit. The spatial restrictions users had identified within the central production unit of the food service system could, in part, be attributable to the extra demand arising from the success of the greatly improved service. At the beginning of 1990 the Catering Manager did recognise that the restaurant area, as planned, would be unlikely to accommodate the increase in the number of customers expected to use the catering department facilities when phase 2 of the development was operational. However, a bigger department could not be provided because of site and financial constraints. Given the size of the restaurant, the seating capacity had to be limited to 58, as opposed to 80 which was originally requested, in order to conform to fire safety regulations. Although the temporary physical nature of the new catering department was expected to have a life span of approximately 20 years, its operational life span could be severely curtailed because of these increased production demands. If demand continued to grow, the facilities might exceed their functional capacity. The worst case scenario would be for the food service system to be in a similar critical position to that which existed at the end of the 1980s. This was a possibility since, at the time the temporary solution was defined as the most likely solution, the Regional Health Authority was indicating that the permanent catering sub-component of phase 3 might no longer be a priority with a new facility, albeit temporary, that could have a maximum 20 year lifespan. The implication being that the implementation of the catering sub-phase of phase 3 could be held back if the District Health Authority was to maximise its usage of the temporary system build solution beyond the anticipated five year period, thus allowing the opportunity to bring forward one of the other phases.

Despite these difficulties, the problems at this project were less severe than those at the longitudinal project and retrospective project A. The main reason for this is that once the decision to provide a conventional service had been taken there was never any change to this. The only area that was further debated was the type of distribution/service system: the final solution was for plated meals. This particular aspect of the system was the most contentious. Essentially, the decision required was whether to opt for a plated meals or bulk distribution method of transport. The decision was not straightforward, as although it was known from past experience that bulk distribution had been more successful at keeping meals hot than an insulated tray method (refer Appendix 3, section 3.3.1 Pre-Stage 1 [1]-{2} Inception and 3.3.2 Stage 1 [1]-{2} Inception), the bulk system was considered to be old fashioned. Although the apparently inferior (in relation to maintenance on meal temperature) plated meals distribution method was finally selected, the problem over plated meals losing heat was resolved by the purchase of heated food trolleys. This, therefore, assisted in maintaining food temperature during delivery.

Figure 5.5 Retrospective Project B
Space Inadequacies and Rigidity of Work Activities - New Catering Department



5.5.3.2 *Longitudinal Project : Obsolescence of Central Dish Washer and Plated Meals Equipment and Inappropriate Use of Trayed Meal Preparation Area (refer figure 5.6)*

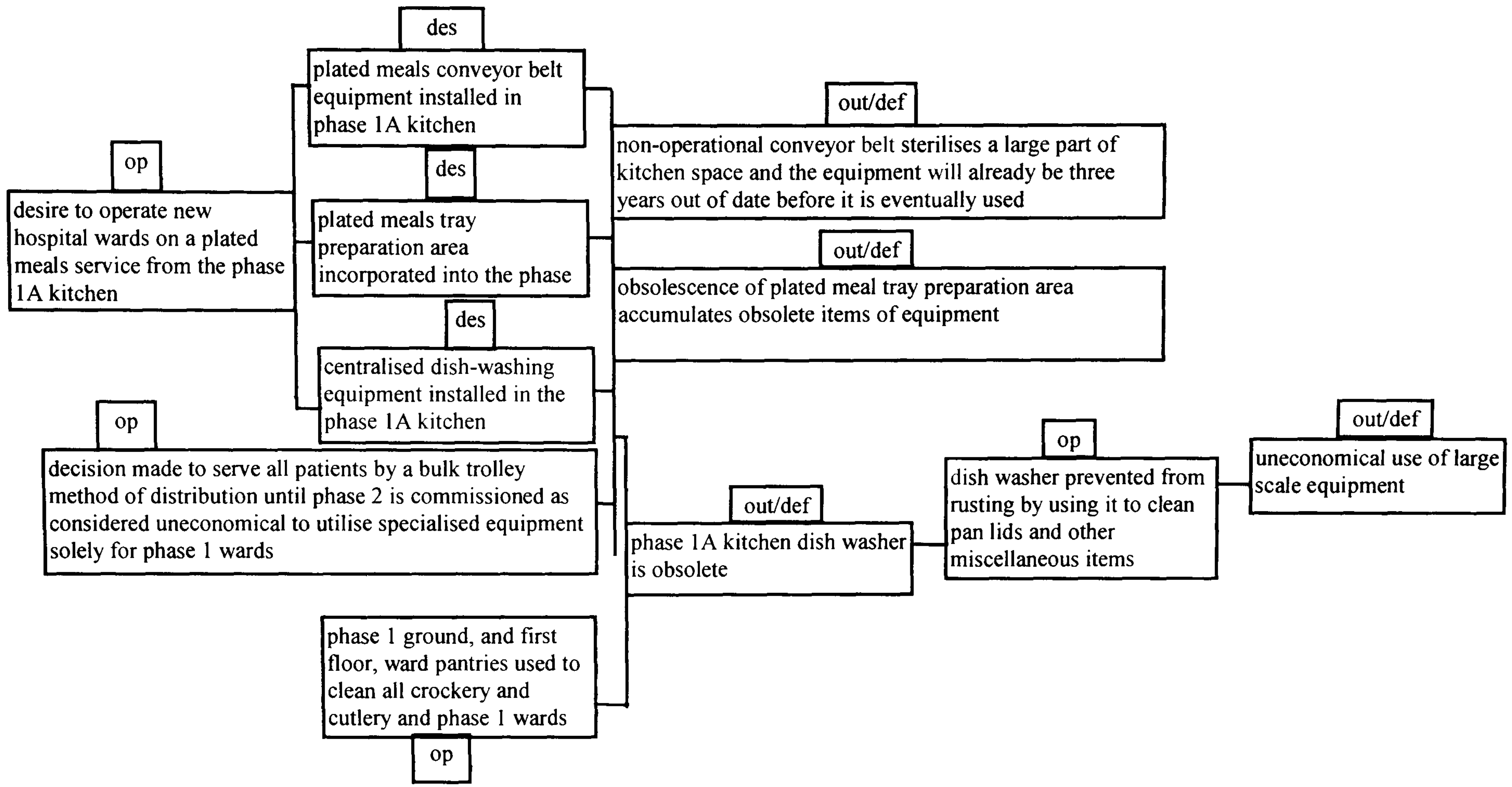
Several aspects of the new phase 1A catering department were identified by the Catering Manager as being problematic. These related to certain items of equipment and certain areas within the department, which had not yet come into operation. For the longitudinal project and retrospective project A, there were several policy changes affecting both the type of production system and food distribution/service system. For the longitudinal project, the worst effects of these constant policy changes were seen in the new phase 1A catering department where several major items of equipment and kitchen areas were not being used or were being misused. Meal plating equipment, purchased for the expected plated meals service, was taking up space in the kitchen but was not actually in operation. This equipment was fixed so a considerable proportion of kitchen space was sterilised. The associated trayed meal preparation area was not being used for the purpose that it was designed for; it was being used to store an assortment of equipment not used in other parts of the kitchen. This meal plating equipment was eventually to be used for a plated meals service which was due to come into effect when the bulk of the new hospital accommodation was in use. In the best possible scenario this would be in 1995, when phase 2 was scheduled to open, by which time the equipment would already be three years old, having been idle for this time. Approximately £100,000 worth of equipment for the plated meals service was actually tied up in the kitchen but not being used. Although it was envisaged that the phase 1 wards would be on a plated meals service once the new phase 1A catering department was operational, this was not realised so the plated meals equipment was essentially redundant. This situation had arisen because it had been decided that all patients would be served by a bulk trolley method of distribution until phase 2 had been commissioned as it was considered uneconomical to utilise the specialised plated meal equipment solely for patients in the phase 1 wards.

The central dish washer was designed to clean all the items used for a plated meals service but was largely redundant. Catering staff used the phase 1A dish washer for cleaning pan lids and other miscellaneous items to ensure that it did not rust but this was a very uneconomical activity. Planning for a central dish-washer appeared to be somewhat anomalous since there had been a clear policy not to over-centralise dish-washing facilities. This decision had led to the incorporation of a $16m^2$ servery/pantry for each 30 bed ward section in phase 1. This meant that the two phase 1 ward block pantries dealt with all the dish washing for the phase 1 wards and day hospital so the phase 1A catering department dish washer was not an essential purchase for food service system functioning : whatever method of service distribution was chosen, there was adequate provision at ward level for dish-washing. Since there was excess capacity within the system, in terms of dish washing, it was inevitable that one component (either in the central kitchen or ward serveries/pantries) would be under-utilised. This over-capacity was actually acknowledged at a design team meeting in June 1990.

Although the new phase 1A catering department had been designed to operate a bulk and a plated meals service there was considerable debate as to whether both systems would operate, and if they did, what proportion of patients would be served by bulk and what proportion by plated meals. Although debate indicated that the plated meals service was not cost effective for the number of patients it was intended to serve, and the complexities of running both service modalities from the same kitchen were considerable (in terms of workflow and separation of bulk and plated meals - the Unit Catering Manager indicated that it looked physically impossible to separate the two systems) the client still purchased equipment for both a bulk and plated meals service. There was a great deal of pressure to make a decision which opted for the more modern plated meals service which was being advocated by the Catering Review Group, however, it was probably not the most practical. After the equipment had been bought all the patients were served by the bulk method anyway which made the plated meal equipment and preparation areas largely redundant, at least in the short term until later phases were commissioned.

There were several opportunities during planning when the impact of policy changes on the design of the new phase 1A catering department could have been made more explicit, in particular refer to Operations 17 and 18 of table 5.5 Appendix 5, Operations 21, 22 and 23 of table 5.6 Appendix 5 and Operations 24, 25 and 27 of table 5.7 Appendix 5. At these particular points in procurement, a range of catering user specialists was involved, from Unit Catering Manager to CSA Catering Advisers. Despite this considerable expertise, ultimately, obsolescence of central dish washer and plated meals equipment and inappropriate use of trayed meal preparation area could not be avoided because of: considerations of economy (not economical to operate plated meals service just for phase 1 wards); and a fundamental over-capacity of dish-washing facility in the catering system.

Figure 5.6 Longitudinal Project C
Obsolescence of Central Dish Washer - Phase 1A Catering Department
Obsolescence of Plated Meals Equipment - Phase 1A Catering Department
Inappropriate Use of Trayed Meal Preparation Area - Phase 1A Catering Department

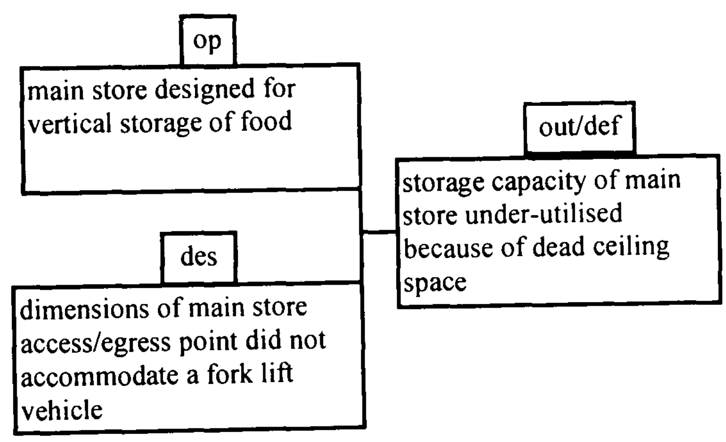


5.5.3.3 ***Longitudinal Project : Inappropriate Design of Main Kitchen Store (refer figure 5.7)***

For the longitudinal project there were several other outcome deficiencies, in terms of user interaction with facilities, which were highlighted by the Catering Manager.

The main kitchen store had a high roof space and was designed for vertical storage of food using a fork-lift vehicle. However, as the entrance dimensions of the store could not actually accommodate such a vehicle, food could not be stored above a certain height and consequently there was a considerable proportion of dead space in the main store.

**Figure 5.7 Longitudinal Project C
Inappropriate Design of Main Kitchen Store - Phase 1A Kitchen**



5.5.3.4 ***Longitudinal Project : Refuse Room and Bin Dimensions Mis-match (refer figure, 5.8)***

Another important aspect was the close proximity of the new kitchen complex to the rest of the development which demanded that sensitive areas such as refuse disposal had to be designed in such a way as to minimise environmental impact. The client's aspiration to reduce the volume of paper and cardboard waste, was to be provided by installing a compactor in the refuse room. This design solution was aimed at minimising the environmental impact of unsightly bins of rubbish sitting outside the catering department. However, a mis-match between the refuse room door dimensions and refuse bin dimensions would not allow the latter to pass in and out of the former. The bins could not be brought into the refuse room to be filled with compacted rubbish and had to be left outside; a situation which the client had wanted to avoid.

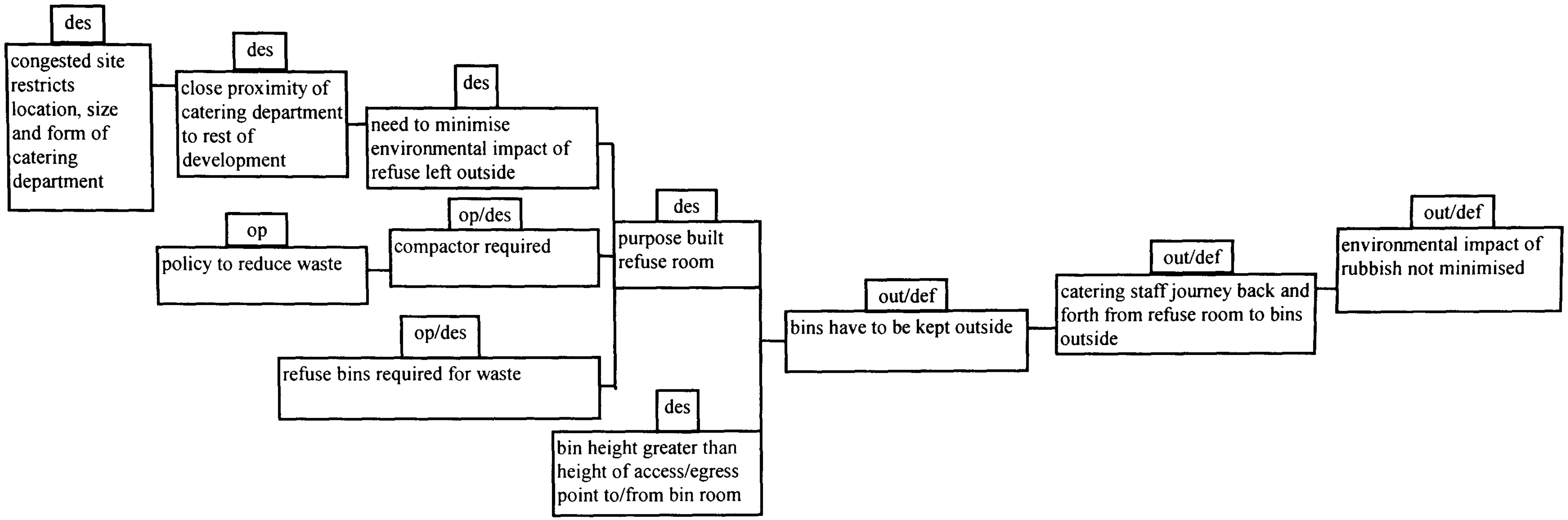
In this case, and that detailed in section 5.5.3.3 (Longitudinal Project : Inappropriate Design of Main Kitchen Store) above, clearly no specialist knowledge was required to determine doorway dimensions in relation to access and egress of unfixed items of equipment, yet in both cases the mis-match between design and operation was not identified until the building was complete. None of the project contributors, either those with specialist design knowledge or those with specialist knowledge of kitchen function identified these relatively simple dimensional errors.

As with the problems identified in section 5.5.3.2 (Longitudinal Project : Obsolescence of Central Dish Washer and Plated Meals Equipment and Inappropriate Use of Trayed Meal Preparation Area), there were opportunities for those involved in the development of these aspects to determine whether the solutions being proposed were appropriate. This occurred at Operations 17 and 25 (refer Appendix 5, LRC tables 5.5 and 5.7, respectively) when the draft kitchen accommodation schedules were being developed and revised. These tasks involved the Project Manager, Project Architect/Design Team with specialist knowledge provided by client catering user representatives and catering specialists from the CSA. Despite the involvement of specialist users with construction industry professionals in solving these aspects of the new kitchen design there were deficiencies. These problems might have been related to another deficiency (refer section 5.5.3.5 Longitudinal Project : Awkward Positioning of Daily Store), the positioning of the daily stores, since at the same time this element of function was being resolved so were the function of the main store and bin room. Difficulties in resolving this aspect of the solution were, in part, due to disagreement between the client catering user specialist and the CSA catering specialists. It could be argued that this conflict impacted on other aspects of function of the new phase 1A catering department.

5.5.3.5 *Longitudinal Project : Awkward Positioning of Daily Store (refer figure 5.9)*

A further spatial arrangement, which proved to be problematic and resulted in user dissatisfaction, was awkward positioning of the daily store, which was located outside the main body of the kitchen on a link corridor. This particular problematic aspect was commented on by the Catering Manager and also catering staff, who stated that the daily stores were too far away from working areas. Users were of the opinion that the daily store should have been kept within the main body of the kitchen: this could have been achieved by moving the store entrance within the kitchen area instead of in the link corridor. This spatial arrangement caused dissatisfaction among catering staff who commented that the daily stores were too far away from working areas.

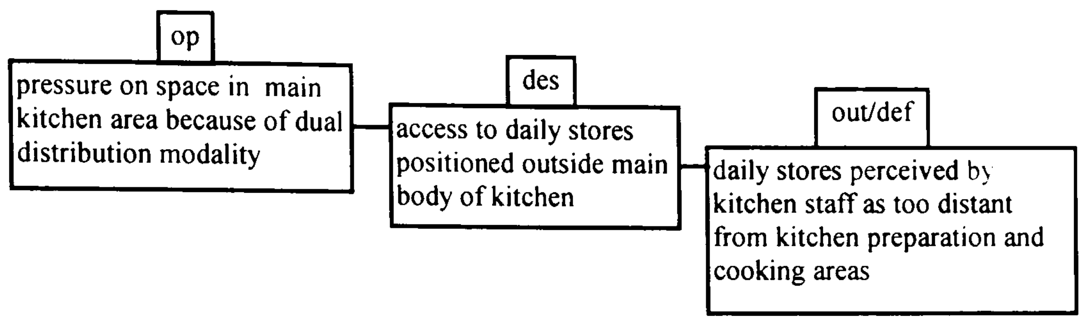
Figure 5.8 Longitudinal Project C
Refuse Room and Bin Dimensions Mis-match - Phase 1A Kitchen



The inconvenience was exacerbated as the daily store was visited by catering staff at frequent intervals. In this instance, the siting of the daily store did not match user expectations and experience.

In June 1990 there was a series of meetings in which the detailed design of the new phase 1A kitchen was discussed (refer Appendix 5, LRC table 5.5 Operation 17, table 5.6 Operation 21). Issues relating to storage were considered in-depth. The Mental Health Services Catering Manager did not consider the daily store to be a necessary component of the kitchen as the different preparation areas had adequate storage for one to two days supplies and the main store was not located too distant from these. Therefore, it was anticipated that food would be ordered from the main store directly into the storage areas in the individual preparation areas. This would allow better control for the storekeeper. However, in the final solution, the daily provisions store was retained with its entrance lying outwith the main body of the kitchen on the link corridor. This was perhaps more convenient for storekeeping control but not for the kitchen users. The ideas proposed by the Mental Health Services Catering Manager on store control had not been adopted in the way that was intended. Retention of the daily provisions store may not have been quite so problematic if the entrance had been within the main kitchen. According to guidance in the Health Building Note, related to catering services, the daily stores should be located conveniently in relation to the main cooking areas and pastry preparation areas. In terms of distance, this was certainly achieved and was only problematic because of siting of the entrance, which had to be moved into the link corridor because of the lack of space in the kitchen area. The fact that the Mental Health Services Catering Manager left his post during these crucial discussions was a complicating factor. Had he remained, then a satisfactory solution might have been resolved. The architect's drawings were based upon a brief drafted by the Mental Health Services Catering Manager, with associated work flow information. The drawings were also influenced by guidance in the Health Building Note for Catering Departments and the advice of the Common Services Agency catering advisors. These latter two were at odds with the Mental Health Services Catering Manager's ideas on modern kitchen design. Although there was doubt about the necessity of the daily provisions store, particularly as space was at a premium, it remained in the final detail design drawing and ultimately progressed to the built form.

Figure 5.9 Longitudinal Project C
Awkward Positioning of Daily Store - Phase 1A Kitchen



5.5.3.6 *Retrospective Project A : Inadequate Space and Rigidity of Work Activities in Central Kitchen and Inadequate Space in Phase 1 Ward Kitchens (refer figure 5.10)*

Two members of catering staff considered the phase 1 kitchen to be too small. One member of staff indicated, in particular, that there was inadequate space in the phase 1 kitchen for unloading food trolleys. Two of the four catering staff respondents were also critical of the positioning of windows and cupboards in the phase 1 kitchen. Two of the catering staff did not perceive the general shape and layout of the kitchen to affect the way they undertook their work. However, in response to another survey question, they indicated that the general design and layout of the phase 1 kitchen made work activities rigid.

Domestic staff in three of the seven phase 1 ward kitchens criticised lack of space in the ward kitchen areas. Additionally, one of the members of catering staff involved in food transportation and distribution was critical of the lack of space in one of the other ward kitchens, particularly in terms of manoeuvring the food trolley.

Throughout planning there was a persistent adherence to existing DHSS space guidelines for catering services, which did not actually allude to cook-chill/freeze systems, with the expectation that this would ensure DHSS approval and expedite planning. Since the size and location of the catering department in the new phase 1 development had been fixed at a very early stage, there was no scope to change this at a later date had it been determined that the kitchen size was inadequate. Despite a report in 1987 suggesting that kitchen space was insufficient, and should be enlarged to ensure adequate separation of raw and cooked foods, there was nothing that could be done to increase the size of the kitchen *per se*.

This spatial inadequacy could have been alleviated, to some extent, by reducing the number of processes to be undertaken within the kitchen to a minimum, hence buying-in of pre-prepared cook-chill food rather than on-site production; plating of food at ward level rather than by a centralised plated meals system in the phase 1 kitchen. These space saving benefits were offset by the fact that a conventional system still operated for staff food production. This impacted on both the design and operation of the kitchen since certain areas were designated for cook-chill because of the stringent temperature control required for this type of operation. Therefore, operation of the dual production modes resulted in particularly rigid working activities to ensure that there was no encroachment of the two different food procurement methods into each other.

Despite the fact that central kitchen facilities were developed within the same timescales as phase 1 ward level kitchen facilities, there were significant deficiencies in the functional relationships between these two components of the food service system. This situation was largely avoided for the other two case studies despite the fact that ward level kitchen facilities in the first phases of these two hospitals' re-development schemes were essentially finalised when the new central kitchen facilities evolved. The ward kitchens in phase 1 were not used as the location for meal service, except for one ward kitchen which was slightly larger than the others, although even here, service was problematic because of the cramped environment once the food trolley was inside the ward kitchen. This was due to the fact that ward kitchens were too small and inadequate for meal service at ward level.

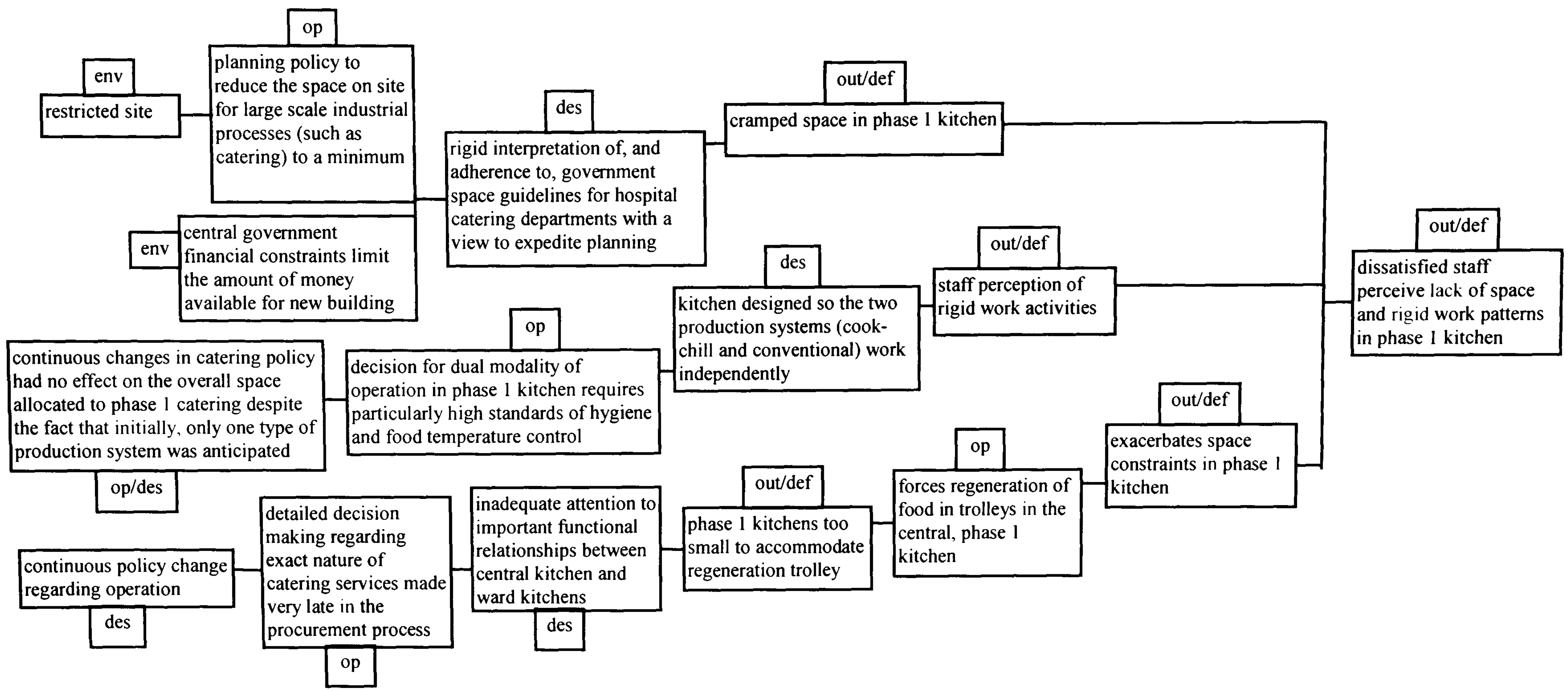
The inadequacies became apparent soon after patient food service commenced post commissioning. When the food service system first came into operation in phase 1, the cook-chill food was regenerated at ward level. Regulations regarding regeneration of cook-chill food demanded that regeneration occurred as close to the point of service as possible. On the ward, the ideal location for this activity was the ward kitchen. However, the ward kitchens were unable to accommodate the food regeneration trolley even though this element of functioning had been reviewed when it became certain that cook-chill would be the system of food service provision for patients: upon review it had not been considered necessary to alter the design of the ward kitchens. Since the ward kitchens in phase 1 were too small for meal regeneration an alternative location for regeneration had to be found. The patient day room within the phase 1 wards was used instead. However, this was not successful either because the smell of the food regenerating on the ward proved to be very unpopular with patients. The smell of food lingered in the day room; probably due to the soft furnishings, carpeted floor and the lack of adequate ventilation. A partial solution was reached by regenerating the cook-chill food in the trolley in the phase 1 kitchen. This had the advantage of allowing catering staff to closely monitor and control the regeneration process. One of the disadvantages was that the cook-chill food had to be transported for a time without a heat source but since the phase 1 kitchen and wards were not at distant locations, this time was minimal. Other factors also had to be taken into account in the switch from ward kitchen to central kitchen regeneration: these concerned the impact of such a change on central kitchen ventilation system and power and space requirements. Clearly, not all of these were adequately addressed, as discussed previously.

On arrival at the ward the trolleys were plugged in immediately to keep the food hot. Service to patients commenced immediately after that from the day room. This was not a wholly acceptable situation from a health and safety perspective because there was no designated area in the day room for food service. For example, there were no wash-hand basin facilities and no impervious floor coverings. The service of meals from the day/dining room created problems in the service of meals to patients who remained at their bed-side. Pushing meal service into the day/dining area from its original purpose built environment in the ward kitchen contributed to a poorly organised system of meal distribution at ward level. Patients remaining at their bedside for meal service perceived that their "access" to food was not equal to those patients taking meals in the day/dining room and subsequently felt neglected. Complaints that arose from this feeling of unequal access to food were exemplified by comments that showed how patients were forced to go to the day/dining area for their meals if they wanted any chance of receiving hot food. Operation 59 (refer Appendix 5, LRC table 5.21) was a crucial step in planning activity as it allowed overview of ward kitchen and day room facilities in light of the policy changes. The key user representatives (catering and domestic) were involved in this review activity including selection of the type and size of regeneration trolley.

5.5.3.7 ***Conclusions on Operational/Design Mis-matches Related to Spatial Deficiencies***

Retrospective project B was not affected to the same extent as the other two case studies by policy-changing environmental pressures. Outcome deficiencies for the longitudinal and retrospective project A were identified in central and ward kitchens and in two instances there was a clear link between the problems identified at these starting and finishing points of food service.

Figure 5.10 Retrospective Project A
Inadequate Space - Phase 1 Kitchen
Rigidity of Work Activities - Phase 1 Kitchen
Inadequate Space - Phase 1 Ward Kitchens



Problems associated with system duality emerged again, except in this case, as opposed to the ventilation problems, the kitchen at the longitudinal project and retrospective project A had actually been designed and equipped to function in a dual mode. At retrospective project A, dual function related to mixed cook-chill and conventional catering within the central kitchen. At the longitudinal project a mixed bulk and plated meal distribution system was developed for the phase 1A kitchen, however, only the bulk system was in operation at the time of post-occupancy evaluation.

As was the case with the ventilation difficulties, project outcome deficiencies related to spatial problems were largely due to design decisions that did not take full cognisance of the specific technology and activities that the building envelope was supposed to support. Catering specific technology appeared to be at the periphery of the design solution rather than an intrinsic component of it. These problems could also be considered to be outwith the purely architectural domain; for example, for three of the deficiencies identified for the longitudinal project (obsolete central dish washer and main store and bin room dimension mis-matches) no specialist design knowledge was actually necessary to appreciate over capacity of dish washing provision and simple dimensional mis-matches. It was clear that crucial relationships between catering-specific technological components and non catering specific components of the design were overlooked. Moreover, existing design guidance, specifically for hospital food services proved to hinder rather than facilitate achievement of a functionally effective design. The design guidance tended to focus on defined spaces and their space allowances according to expected "norms" related to the nature/size of hospital catering departments, i.e. the type of procurement method and number of meals produced. The guidance constrains creative design solutions because design teams tend to stick rigidly within the space norms without relating these to the specific form of functioning and organisational set-up required by the client. This approach is often adopted to expedite planning approval since designs which are close to the norm are considered more likely to gain central government approval.

5.5.4 Finishing and Equipment Deficiencies

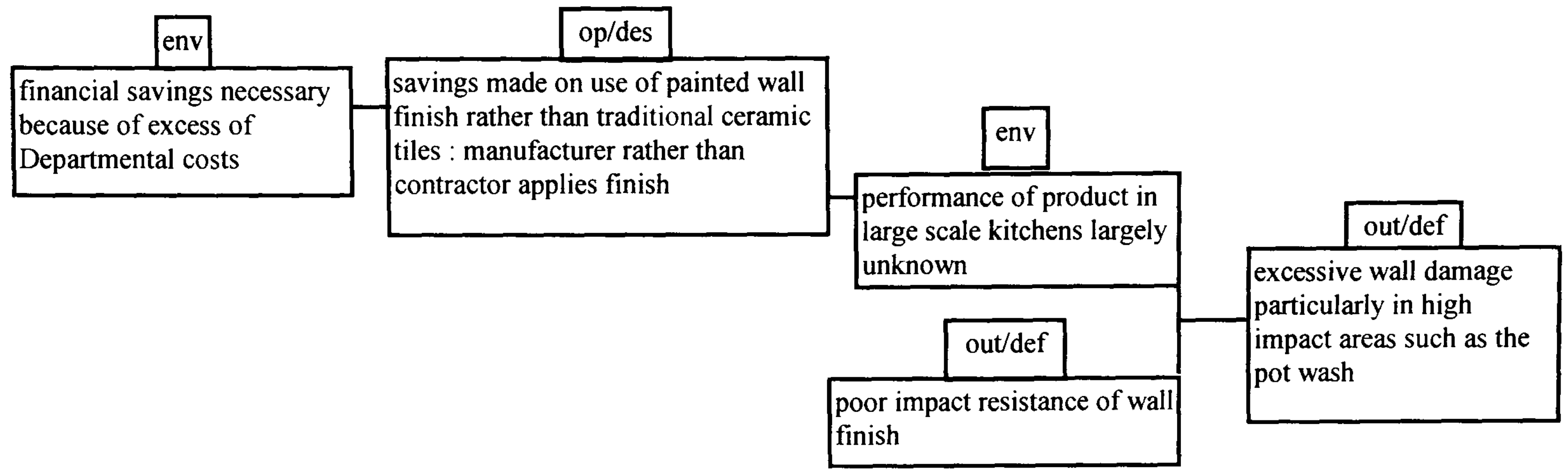
5.5.4.1 *Longitudinal Project : Inappropriate Wall Finish (refer figure 5.11)*

A painted wall finish was pursued as the preferred finish for the new catering department at the longitudinal project because of its seamlessness and anti-microbial properties. Additionally, this finish was attractive to the client because, although it cost the same as a more traditional ceramic tile finish, installation costs were cheaper as it was applied by the manufacturer rather than contractor. However, after only a few weeks of normal wear and tear the wall finish had started to peel. Its impact resistance was extremely poor and damage to exposed plaster beneath was quite deep in some places, particularly in high impact areas such as the pot wash. Although such deficiencies were obvious, only the Catering Manager referred specifically to the wall finish as being problematic. Although most of the kitchen staff surveyed were satisfied with food hygiene standards, two respondents did indicate that they found it difficult to achieve food hygiene standards. However, there was no indication as to why this point of view was put forward but it was perhaps related to problems with the wall finish crumbling in certain areas. The painted finish actually created an environmental health hazard. This is an instance, where a solution which had worked perfectly adequately in other circumstances (hospital operating theatres and animal houses), had failed to meet performance requirements in another unknown situation. The finish was recommended by the CSA Catering Advisor, as it was seen to be superseding ceramic tiles in hospital kitchens. This was a problem that could not necessarily have been anticipated by client or designer. However, the decision to use the, largely experimental, painted wall finish rather than a more traditional tile finish was strongly pursued because of the pressure to find savings to offset excess departmental costs (refer Appendix 4, figures 4.14 and 4.15 and Appendix 5, LRC table 5.9 Operation 35).

5.5.4.2 *Retrospective Project B : Inappropriate Food Trolleys (refer figure 5.12)*

The restriction on siting options for the new catering facility at retrospective project B, did not permit a physical link between it and the rest of the hospital development. The trolleys used for meal distribution were unsuitable for external transportation and porters commented on several problems they encountered in their use, mainly due to problems with wheels (collapsed wheels, wheels falling off, problems with wheel bearings). Although the Catering Manager was aware of the site difficulties relating to food trolley transportation, no difficulties regarding a fundamental problem with trolley design was acknowledged (refer Appendix 7). These problems were exacerbated by the site topography. Although there had been previous problems in meal distribution because of the steep, sloping site, a food trolley to cope with the site difficulties had not been identified.

Figure 5.11 Longitudinal Project C
Inappropriate Wall Finish - Phase 1A Kitchen

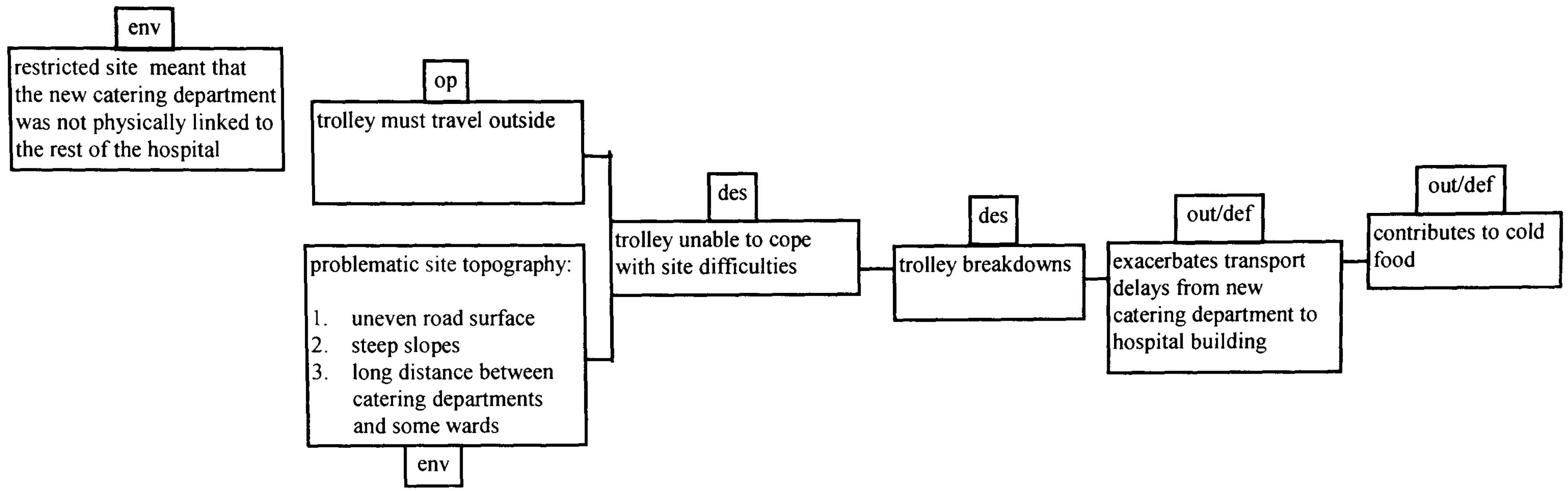


Due to problems in operating a plated meals service from the existing kitchen to the phase 1 wards, £50,000 had been allocated for a phase 2 post-works contract so a bulk rather than plated meals service could be provided (refer Appendix 3, section 3.3.2 Stage 1[1]-{2} Inception). The money was for the purchase of bulk food trolleys which performed consistently better (in terms of maintaining food temperature) than the plated meals service. However, when the temporary system build kitchen was identified as the best solution, the decision was to revert to a plated meals operation. The system build kitchen company had no involvement in this decision - it was made solely by the client. Lack of information in client project files did not allow a proper judgement to be made on whether the plated food trolleys that were bought were inadequate (simply a poor choice) or that because of the site problems no food trolley could have coped. The reversion to plated meals from a bulk service might have overlooked the distribution problems that were previously encountered although the same situation would apply as there was no physical link between the new catering facilities and the rest of the hospital - trolleys had to travel outside.

5.5.4.3 *Conclusions on Operational/Design Mis-matches Related to Finishing and Equipment Deficiencies*

The poor performance of the painted wall finish probably could not have been anticipated since it had appeared to be appropriate in other similar situations. The trolley problems should have been anticipated as there had been difficulties in the past, and since the new catering department was not linked to the rest of the hospital development, there should have been pre-testing of the solution, for example, gathering information on food trolley performance at hospitals with similar site difficulties. Again, specific decisions related to catering equipment technology appeared to be at the periphery of the design process. Although not within the purely architectural domain such decisions should have been taken within the context of the overall design solution. In both of these cases, had post-occupancy evaluation data been available for these solutions then more fully informed decisions could have been made. The painted wall finish was driven by the requirement to cut costs; the plated meals service was driven by what was considered "attractive" in terms of meal distribution/service. Thus, external pressures impacted on these outcome deficiencies: the solutions adopted were not due to carefully considered design compromises.

Figure 5.12 Retrospective Project C
Inappropriate Food Trolleys - Distribution System



5.6 Research Findings : Relationship to Theory and Literature

5.6.1 Assessment of Function as an Indicator of Project Performance

Quality, in relation to construction project performance, can be defined in different ways depending upon the viewpoint being taken. This research focused on the *functional* aspect of construction project performance, emphasising the requirement of buildings to provide settings that efficiently and effectively provide for complex user group activities. A review of the literature showed that the time and cost aspects of building performance were relatively well defined, documented and understood but the quality aspect was much more nebulous and elusive. Possible definitions of quality, as related to the construction industry were developed (refer to the seven definitions in Chapter 3, section 3.2.1 Quality as a Measure of Project Performance) and this showed that different aspects of performance, including function, could be described from a quality perspective. The validity of any definition of quality was essentially dependent on the viewpoint of the person making a quality judgement on a building and the point in the building's lifecycle when such a judgement was being made.

Generating a functional definition of quality was essential as the focus of the research was on the user perspective of complex, multi-user buildings, as exemplified by the hospital. The particular approach to function, adopted by the research, was based on that espoused by Preiser et al (1988). The functional approach was concerned with how well the building's design was integrated with the organisation it housed and the activities which the organisation had to perform inside the building; i.e. the ability of the building to provide a setting appropriate for the realisation of building users' needs and goals. This approach was key in underpinning the user-focused post-occupancy evaluations of the hospital project contexts. The survey instruments, developed to gauge user groups' perceptions of food service system function, were based on this fundamental premise - that buildings should support user activities. From this broad definition of function, survey instruments were developed that focused on issues pertinent to each of the main user groups involved in food service system functioning. A review of literature on hospital food service provision (refer to Chapter 3) highlighted the significance of this aspect of hospital care to patients. This, combined with associated literature on hospital food service evaluation facilitated development of the user focused questionnaires.

To facilitate this part of the methodological approach, the focus was in identifying only the problematic aspects of food service system functioning, i.e. in determining those aspects that users were dissatisfied with. For those groups involved in the provision of food service (catering, portering, nursing and domestic staff) the survey tool was designed to elicit information on aspects that were perceived by these groups to hinder their activities. Although not an ideal approach, as data was not sought on successful aspects of functioning, it avoided the need to make value judgements around how to distinguish between building successes and identifying one building, or an aspect of a building, as being "better" than another.

5.6.2 The Impact of Design Guidance

The potentially negative influence of health service capital planning guidance, as highlighted in Chapter 4, proved to be a factor in the development of several design/operational mis-matches. At project A, DHSS space guidelines on kitchen design were doggedly adhered to, not for any justified design purposes but with the expectation that this would secure DHSS approval and therefore expedite planning progress. As a further example, guidance on kitchen design was used by central government advisors at project C, in order to secure certain aspects of content (for example, the daily stores) that were not necessarily considered to be appropriate by others inputting into the design solution. In these instances, it can be seen that procedures were given the same, if not more, weight than the design problem and that guidance, when interpreted as instruction, can be an unhelpful influence when the development of novel solutions to problems are inhibited by it.

5.6.3 Client Involvement

Although an exploration of user participation was not the focus of the research, it was an important consideration. In previous research by Hughes (1989), the importance of client involvement in the construction project procurement process was highlighted. However, Hughes' analysis of client involvement was not particularly useful as measurement of this aspect of the project organisational structure was oversimplified by not differentiating between different contributing groups and individuals within the client organisation. In the current research, an attempt was made to identify and distinguish the contribution of different parts of the client organisation through the detail provided in the 3R charts. Depending on the aspect of food service system under consideration, input of different specialist parts of the client organisation was expected. So, for example, when issues relating to food transport were being considered, it would be expected to find some sort of input from within the client organisation showing expertise/knowledge in this aspect of system functioning, for example, the manager responsible for portering services. Where specialist input from a certain part of the client organisation was not found when expected, this would suggest the potential for problems if work was being undertaken and decisions being made without the necessary input of the all the relevant parts of the client organisation. The research did not, generally, find expertise to be lacking where it was expected. On all three projects, client involvement appeared to be good, the Catering Manager appeared to occupy a key role in the planning process with relevant input form other expected associated user groups (domestic, nursing and portering) as appropriate.

If client involvement appeared to be satisfactory, some explanation is required to explain how, even in seemingly straightforward situations, problems arose (for example the bin and bin room dimension mis-match at project C). The following are put forward as possible explanations:

(1) User "experts" can make errors in judgement which potentially, can have a major impact on the direction that a project /building solution may proceed in. For example, at project B, the Catering Manager's advice was that the existing hospital kitchens would cope until phase 3 of the hospital re-development was built. This advice was taken despite the fact that the existing catering department was sited at a point remote from the planned new development and the kitchen was old, badly designed and inadequately equipped. This was clearly an erroneous judgement, since even after an interim upgrading, the old kitchens could not even cope with the requirements of the first phase of the re-development scheme;

(2) Related to the above potential difficulty, is the fact that the construction procurement process is highly dependent on interaction and communication between a myriad different groups and individuals (primarily representing the client organisation or construction professionals). As the development of design solutions, for specialist areas, is dependent on "expert" advice then others contributing to work on the design may not necessarily feel they are in a position to be able to challenge questionable decisions. This is where the inherent complexity of the procurement process is problematic: it is beset with communication difficulties even when clients and construction professionals think they are speaking the same language. Different perceptions and conceptualisations between those in the client organisation and construction professionals were explored in Chapter 4 and potential damaging effects on communication highlighted. It would appear that despite the ostensibly good client involvement, the transactions occurring between client organisation and construction

professionals did not adequately bridge the gap between what the client expected (expressed mainly in text through the brief), what the design professionals thought they had provided (mainly through drawings, plans, and other architectural tools) and what was actually created (the final built form);

(3) Again, related to the above explanations is a third possibility and this relates to the discussions of client involvement and user participation in Chapter 4. Data in the 3R charts (refer Appendix 5) clearly showed client involvement although this was limited to participation of those with a management function/responsibility. There is a level beyond this, that of the actual user, which is crucial. Anecdotal evidence, from discussions with key project personnel, indicated that there was some degree of user involvement in decision making/planning. This issue was picked up through the user group surveys on food service system functioning and some users did indicate their input in decision-making (for example, catering staff at project B). No documented evidence could be found to support this or identify when and how users were involved in planning. The key point is that although client involvement was demonstrated on all three projects, this did not indicate the level of user participation and this could have been a key factor in optimising success and minimising the development of deficiencies. Underlying this is an assumption that those in management positions communicate with users regarding design and operational elements, and that those undertaking the day-to-day activities are really involved in, and have an impact on, decision-making. It is difficult to know whether managers represent the wider views of staff or simply their own views. Even if managers do involve users in decision-making, there is an assumption that this communication process is effective. Given the difficulties identified in Chapter 4, it is likely that communication between managers and users, even within a similar discipline, or work area, does not escape such problems as differences in perceptions, values and conceptualisations. If users are not effectively involved in the construction procurement process then the resulting outcomes might not meet user expectations and this could result in users having to bridge any gaps between design intent and the client organisation's operational requirements.

Shumaker and Pequegnat (1989) highlighted that users groups were disadvantaged regarding four major factors influencing participation in the design process:

(1) Their interest in, and knowledge of, the process;

(2) Their status within the community and their professional field;

(3) Their organisational strength;

(4) Their long term proximity to the planning and design process.

This reduced effective user participation. In support of this, Kernohan et al (1992) acknowledged that,

> ***"Building-users hold a wealth of experiential knowledge of buildings that is not being used to inform design and management processes."*** (Kernohan et al (1992)

In offering a solution, Kernohan et al (1992) propose a social negotiation mechanism for building design achieved through client/user and building provider (design professionals) dialogue,

> ***"One means for bringing users and providers together is to develop processes that enable users, designers and managers, in fact all those with interests in buildings, to benefit from the social negotiation of building quality. Rather than working in isolation from clients and users as proposers of finite solutions synthesised from expert and scientific knowledge, it seems more sensible for designers and managers to become involved in a process of negotiation with clients and users to develop building solutions acceptable to all."*** (Kernohan et al 1992)

This process may have the potential to bridge the gap (refer to (2) above) as illustrated by Zeisel's (1984) "user-needs-gap model" (refer to Chapter 4, section 4.3 Conceptual Differences and Differences in Specialism) and Cairn's (1996) more recent associated work on fulfilment of user needs (refer Chapter 1, section 1.1 Introduction).

5.6.4 The Influence of the Project Environment

Identifying the environmental factors impacting on the project contexts was important in understanding the functional deficiencies. The focus of the research, on the development of one specific building sub-system for a specific building type, showed how different solutions developed even though similar environmental pressures were being experienced (in particular, compare the contrasting food service solutions developed for project B and project C). The research recognised Walker's (1980) and Hughes' (1989) view, that the environment could act in two ways on the process of providing a project: indirectly, upon the client's normal organisational activities and directly, upon the process of building provision itself. It was the indirect environmental factors that had the most significant impact on planning food services (refer section 5.4.1 Data on the Effect of Environmental Pressure). These are summarised as: uncertainty surrounding technological changes in catering processes/methods; constantly changing food legislation, particularly the impending removal of Crown Immunity; and public health scares relating to microbial contamination of food. These environmental effects could be related to Hughes' (1989) "technological", "policy" and "social" environmental factors. A further constraint brought about by control of finances/budgets and the timing/phasing of food services development played a definitive part in determining the scope of the chosen solutions. As a response to policy uncertainties caused by environmental pressures, a common strategy (particularly projects A and C) was to develop dual modalities during planning. This approach allowed progress to be made as solutions were developed that appeared to be capable of adaptation to whatever sort of operational policy was finally chosen (for projects A and C there was uncertainty regarding: the type of food production method that should operate - cook-chill/freeze versus conventional; and the type of distribution system that should operate - bulk trolley or plated/trayed meals). Ultimately, this strategy proved to be erroneous as it was not a straightforward process to adapt the design and operational policy to the final solution as evidenced by the functional problems identified by the users.

5.6.5 Analytic Generalisation and Theoretical Framework

As identified in Chapter 2, (refer section 2.1.1 A Case Study Approach), the multiple-case study approach was dependent on the development of a theoretical framework for analysing the case studies and then generalising the findings thereof. For this particular investigation, multiple cases were selected from three hospital construction projects. The cases that were analysed, were all those building outcome deficiencies identified as functional deficiencies. At the outset of the investigation, it was envisaged that the functional deficiencies, elicited by user groups, could be explained by the theoretical constructs developed in Chapter 4 (refer section 4.6 Theoretical Constructs and the Complexities of the User/Building Interface). It was anticipated that the cases would provide literal replication, Yin (1994), i.e. that the deficiencies could all be explained by the theoretical constructs thereby supporting the theoretical framework and associated research hypothesis. The greater the number of literal replications, (or number of cases that can be explained by the proposed theoretical constructs) the more convincing the support for the theoretical propositions. In summary, the theoretical framework proposed that building function was dependent on the relationship and interaction between building users, whose everyday needs are represented by operational planning and fixed and unfixed elements, provided by building design. These relationships and interactions were seen to be important within and between different systems and component sub-systems of buildings. It was envisaged that user perception of functional problems would depend on the theoretical constructs of adaptability, tolerance and flexibility in the design solution. Within the hypothesis, this was expressed as "**a functionally successful building is dependent on the project procurement process maintaining integration between building design and operational planning, particularly at periods of increased environmental complexity**".

In considering the literature on food service provision and evaluation and classification of food service systems, it was clear that problems in aspects of functioning could have complex causes since such systems depended on interaction of different user groups in different parts of a building, with different equipment. Often, although this was not necessarily always the case, difficulties in aspects of system functioning would be identified by the ultimate user group - the patients.

Across the three case study construction project contexts, there were 17 distinct functional problems (case studies), identified by users, that were as a result of design/operational mis-match (or inadequate relationships between users, fixed and unfixed elements). Upon further inspection, it was possible to theme the problems (cases) according to the aspect of food service operation affected, that is: problems related to the work environment (five cases); types of spatial deficiency (ten cases); and problems relating to finishing and equipment (two cases). The common factor among the majority of these problems was an inability to relate adequately different aspects of food service system functioning to one another. These failures were essentially due to solutions that did not effectively incorporate the purely architectural aspects into the design. Catering technological elements and service aspects appeared to be most at risk. Although some of these problems related to catering specific areas and equipment they were associated with simple dimensioning errors (mis-matches between equipment size and the proportions of access/egress points). The most serious problems were those where a chain of problems interlinking the different components of system functioning (central production kitchen, distribution system and ward service location) resulted in a sort of cascade effect and had an ultimate negative impact on patients (for example the deficiency discussed in section 5.5.3.6 Retrospective Project A : Inadequate Space and Rigidity of Work Activities in Central Kitchen and Inadequate Space in Phase 1 Ward Kitchens).

The problems identified by the user groups typify those reported in the literature. For example, Smith (1984) reported on the ventilation problems at Bangor Hospital rendering the kitchen unworkable. Stone (1990) reported on the inadequacy of the central kitchen at the Best Buy Hospital in Bury St Edmonds. The design solution for the central kitchen was rooted in a policy that required the use of ready-prepared meals. As ready-prepared meals were never used, the kitchen could not cope with the extra work involved, which was not originally anticipated, in the preparation of raw and semi-processed foodstuffs.

With regard to the theoretical framework and propositions developed in Chapter 4 (refer section 4.6 Theoretical Constructs and the Complexities of the User/Building Interface), all 17 functional problems could be defined in terms of interaction between users, fixed and unfixed elements. Table 5.9 shows that of the five working environment problems, four (1, 2, 4, 5) could essentially be identified as fixed element - unfixed element problems. The ventilation systems could not cope with the volume of heat and steam produced from heat and steam-producing equipment (ovens, steamers, boiling pans, grills etc.). In these four cases, the problem was restricted within the food service system in the kitchen (central production unit) and only impacted on those users within the kitchen. In case 5, the cause of the mis-match was not clear. Unlike cases 1, 2, 4, where there was a clear impact from the project environment, there appeared to be no complicating external factors. In these three cases, the constant policy changes over cook chill/freeze options, as opposed to more traditional production methods did impact on planning. Ultimately, the prime cooking equipment changes brought about by these policy swings were not matched by a corresponding/complementary changes in ventilation system requirements. The relationship between production method (cook chill, cook freeze, traditional) and ventilation requirements, therefore, appeared to be critical, that is, there was low tolerance in this aspect of food service system functioning. Case 3 was slightly different in nature. Whereas the other four cases were due to fixed element – unfixed element relationship problems, case 5 was due to a fixed element problem in relation to climate. This was one aspect which was not identified in the theoretical framework developed in Chapter 4. The other distinguishing/notable feature of this case was that, although the problem was essentially located in the central production unit, it affected users in a different hospital sub-system (i.e. not part of the food service system - an adjacent administrative department).

Table 5.9 Explanation of Functional Problems Using Theoretical Constructs

WORKING ENVIRONMENT PROBLEMS	Component of System Functioning Affected	Type of Relationship Problem	Project Environment Factors Impacting on Outcomes
1. Mis-match between kitchen function and ventilation	Central production unit Project C	Fixed element (mechanical ventilation) Unfixed element (prime cooking equipment) Fixed element (windows) Users (kitchen staff)	Client organisation operational policy changes.
2. Cooking extractor fumes cause problems in adjacent buildings	Central production unit Adjacent administrative department Project C	Fixed element (mechanical ventilation) Unfixed element (prime cooking equipment) Fixed element (windows) Users (kitchen staff) Users (nearby administrative staff)	Client organisation operational policy changes.
3. Excessive condensation in cold weather	Central production unit Project C	Fixed element (mechanical ventilation) External climate (unpredicted factor) Fixed element (windows) Users (kitchen staff)	Experience of problems (1) and (2)
4. Excessive heat and poor ventilation	Central production unit Project A	Fixed element (mechanical ventilation) Unfixed element (heat and steam producing equipment) Unfixed element (food trolleys producing heat)	Client organisation operational policy changes. Impact of problem (15)
5. Excessive heat and condensation	Central production unit Project B	Fixed element (mechanical ventilation) Unfixed element (prime cooking equipment and other heat and steam producing equipment, e.g. dish washer)	None identified

SPATIAL PROBLEMS			
6. Space inadequacies and rigidity of work activities	Central production unit Project B	Fixed element (dimensions between spaces and equipment) Unfixed element (equipment) Users (catering staff)	Restricted re-development site Limited financial resources Timing implications imposed by more stringent food hygiene regulations
7. Obsolescence of central dish washer	Central production unit Project C	Fixed element (dishwashing equipment in central kitchen) Fixed element (dish washing equipment in ward kitchens) Users (domestic staff, kitchen staff)	Client organisation operational policy changes.
8. Obsolescence of plated meals equipment	Central production unit Project C	Unfixed element (plated meals equipment) Users (kitchen staff)	Client organisation operational policy changes.
9. Inappropriate use of trayed meal preparation area	Central production unit Project C	Fixed element (plated meals preparation area) Users (kitchen staff)	Client organisation operational policy changes.
10. Inappropriate design of main kitchen store	Central production unit Project C	Fixed element (main kitchen store doorway dimensions) Unfixed element (fork lift vehicle) Users (kitchen staff)	None identified
11. Refuse room and bin dimensions mis-match	Central production unit Project C	Fixed element (refuse room doorway dimensions) Unfixed element (refuse bin dimensions) Users (kitchen staff)	None identified.
12. Awkward positioning of daily store	Central production unit Project C	Fixed element (central cooking and preparation area) Fixed element (daily stores) Users (kitchen staff)	Conflict between catering user representative and specialist food service advisers.
13. Inadequate space	Central production unit Project A	Fixed element (dimensions between spaces and equipment) Unfixed element (equipment) Users (catering staff)	Client organisation operational policy changes.

SPATIAL PROBLEMS (continued)			
14. Rigidity of work activities	Central production unit Project A	Fixed element (dimensions between spaces and equipment) Unfixed element (equipment) Users (catering staff)	Client organisation operational policy changes.
15. Inadequate space	Ward service point Project A	Fixed element (dimensions of ward kitchen) Unfixed element (dimensions of food trolley) Users (domestic staff, catering staff, patients)	Client organisation operational policy changes.
FINISHING AND EQUIPMENT PROBLEMS			
16. Inappropriate wall finish	Central production unit Project C	Fixed element (wall) Fixed element (wall finish) Users (kitchen staff)	Financial pressures.
17. Inappropriate food trolleys	Transportation/distribution Project B	Fixed element (external transportation routes) Unfixed element (food trolleys) Users (portering staff)	None identified.

Comparison between the different strategies adopted for overcoming these problems was interesting. In case 1, there were potentially three ways of overcoming the mis-match between the ventilation system and output of prime cooking equipment. These were as undernoted:

(1) Adjust the mechanical ventilation system to increase extraction capability;

(2) Reduce the volume of prime cooking undertaken in the kitchen;

(3) Allow natural ventilation to augment/compensate for the deficiency in mechanical ventilation.

Clearly, the third strategy appeared to be the most straightforward since it required only minor user adaptation to ameliorate the problem. The second strategy would have involved a radical review of production methods and menu composition. The first strategy would have required a more permanent physical adjustment to the building solution. Although the third option was the preferred strategy to resolve the problem, the windows could not be opened (for hygiene reasons) as no fly/bird screens had been fitted. Reducing the output of prime cooking equipment may have overcome the user dissatisfaction identified with case 2, however, this was not a viable option. The final solution to case 1, to fit the fly/bird screens, thus allowing the windows to open, may have intensified the cooking extract problem experienced by users in the adjacent building Moreover, fitting of the fly/bird screens might also have added to aesthetic displeasure of the nearby building users - information from the client project files did indicate that they were perceived by the client as being "unsightly". The impact of case 1 and case 2 on case 3 was notable. The phase 1A kitchen was designed to have a sealed window design hence no need for wiremesh fly/bird screens. This might have been a successful design, had it not been for the fact that the ventilation system was affected by extreme cold weather - a climatic factor that went unforeseen until the ventilation system failed in a particularly cold spell. This unexpected effect, coupled with the sealed window design meant that overcoming this particular problem was dependent on a physical change to a fixed element. For case 4, there were similar strategies to case 1 for overcoming the ventilation problems. However, the ameliorating effect of opening windows in this particular instance was limited because of the large amount of internal planning of the phase 1 kitchen. This was borne out after commissioning when there was a complete failure of the mechanical ventilation system. For case 5, the solution adopted was to adjust the ventilation system itself (to increase the airflow through the department).

One interesting feature in the procurement process of projects A and B was the effect of planning for system duality. As the nature of the production method, for both projects, was open to considerable change, the planning teams adopted the approach of creating enough flexibility with the developing solutions to allow for development of whichever production mode was finally selected. Ultimately, this strategy was not entirely successful, as evidenced by the resultant problems in the kitchen working environment at these projects. In both projects, there were opportunities during the development process for solutions to be reviewed and amended. In conclusion, the theoretical propositions of the research explain the cause of these five functional problems (cases) - inability of the procurement process to explicitly identify and maintain the critical unfixed element – fixed element relationship between prime cooking equipment, mechanical ventilation system and natural ventilation system within the central production unit and within a procurement process affected by environmental pressure (constant policy changes).

The theory could also be expanded to explain other sorts of deficiencies, as categorised in tables 5.2 to 5.5. This is by virtue of the fact that such deficiencies involve problematic relationships between building design and operational planning. For example, table 5.2 shows that deep fat fryers were installed with cold water tap connections. This is indicative of an unfixed element - fixed element problem. Catering staff, who use such equipment on a daily basis, are aware that cold water is not effective in cleaning grease from equipment. However, this important relationship might not be so obvious to a non-user specialist. Thus, although the architect might have some expertise regarding services aspects, there may be a gap with regard to specialist items of equipment. In table 5.4, the poor organisation of meal service at ward level reflected more general problematic relationships between the split in responsibilities over different activities of different contributing user groups. Table 5.5 indicated a range of difficulties related to existing deficiencies, particularly concerning the transportation and distribution of food around awkward sites. Such deficiencies represent fixed element - unfixed element - user problems where food trolley (unfixed element) manoeuvring (users) was inhibited by the layout of communication routes (fixed elements), such as narrow corridors, inadequate lifts, non-automatic doors, sloping sites etc. In effect, many building outcome deficiencies could be classed as functional.

The two deficiencies related to finishing and equipment problems (cases 16 and 17) could also be explained through the theoretical propositions of the research. Case 16 was reflective of a fixed element - user problem, specifically the poor resistance of the painted wall finish particularly in the high impact areas of the kitchen. Like cases 1, 3, 4 and 5, the problem was confined to the central production unit of the food service sub-system. The extent to which users could have ameliorated, or compensated for this problem was probably quite limited. Kitchens, particularly areas such as the pot wash are prone to physical abuse simply because of the nature of the work that is undertaken there. A more permanent, satisfactory solution would have been brought about by using a more traditional finish (i.e. making a change to a fixed element), such as ceramic tiles, whose impact-resistant properties are known. However, the risk taken in using this innovative finish appeared to be reasonable at the time. As with the cases previously discussed, the project environment was a significant factor leading to the adoption of this largely untested wall finish (at least in hospital kitchens). The necessity to make financial savings to offset excess departmental costs was the primary reason for this choice. The case illustrates another critical relationship exhibiting low tolerance, i.e. the relationship between wall finish and high-impact user activities. Ultimately, the mis-match created was as a result of considerable environmental pressure related to project costs. Although tried and tested solutions might be effective, such an approach to design would stifle the evolution of novel solutions.

Case 17 was illustrative of an example of an unfixed element - fixed element problem arising in the transportation and distribution component of the food services sub-system. The unfixed element was the food trolleys and the fixed element the external hospital circulation system. As the catering department was not physically linked to the ward accommodation areas, food had to be transported outside. The site topography was especially problematic - steep slopes and uneven road surfaces, which created considerable wear and tear on the food trolleys - the wheels being most prone to damage. Again, in this instance, the effect of any user adaptability would be limited, e.g. avoiding potholes in the roads might have made some improvements. The other option would be for a change in food trolleys or alteration of existing ones so that they were more robust and less liable to damage. Adapting the unfixed element (food trolleys) would be a far less resource intensive and more cost-effective solution than alteration of the fixed element, i.e. construction of a physical link between catering department and the rest of the hospital, particularly given the distance between the catering department and the ward accommodation. This problem probably would be reduced in future with the provision of more permanent replacement catering department facilities in a later phase of the hospital re-development scheme.

Cases 6-15 are illustrative of a variety of "spatial" problems, for example: lack of space; under-utilised or mis-used space; poor relationship between space and equipment to workflow and user activities. Like the majority of the other cases, these were related specifically to the central production unit of the projects' food service sub-systems. However, for case 15, the particular deficiency was identified at the ward service point but was closely related to the problem identified by case 13. Of all the cases examined, this proved to be the most complex.

In analysing the other cases, certain similarities between some of the other types of problems (i.e. working environment and finishing/equipment) emerged. These are also discussed relative to the theoretical propositions in Chapter 4. At the longitudinal project, there were three cases (10, 11 and 12) illustrative of relationship problems between user activities and spaces. For case 12, the problem was due to user perception of ease of access to the daily stores. Users had to exit the main kitchen area to get to the daily stores, which were located on a link corridor. This created feelings of inconvenience among the kitchen staff. As the journey to the daily stores was made frequently by users, this exacerbated dissatisfaction. In this instance, there could be said to be low tolerance in the relationship between the positioning of the daily stores relative to the main cooking and preparation areas of the kitchen. The main environmental factor contributing to this unsatisfactory spatial arrangement was conflict between the catering user representatives and central government catering advisers. The way in which hospital kitchen design guidance was used and interpreted was also a factor (refer to section 5.5.3.3 Longitudinal Project : Inappropriate Design of Main Kitchen Store).

Other critical relationships that were not adequately resolved were illustrated by cases 10 and 11. In case 10, like case 12, the problem was confined to the kitchen. A mis-match in simple dimensioning (between a piece of anticipated equipment - fork lift vehicle - and doorway dimensions) meant that users could not store food in the main kitchen stores in the way that was intended, as the equipment would not fit through the doorway. This example was illustrative of a user (kitchen staff) - fixed element (kitchen stores doorway dimensions)-unfixed element relationship (fork lift vehicle).

For case 11, which is considered in further detail in Chapter 6 (section 6.4 Towards a Conceptual Framework for Developing an Approach for Improved Building Function), although the problem originated in the catering department, there was the potential to impact on users in other parts of the hospital. A similar dimensioning mis-match to that in case 10 meant that:

(1) Refuse bins had to be kept outside, rather than inside the bin room;

(2) Users were forced to make repeated journeys from inside the bin room to the bins outside with compacted rubbish;

(3) Other hospital users, or passers-by, might be dissatisfied with the bins of rubbish sitting outside the department.

In order to make the solution work, users were forced to adapt their behaviour to ameliorate the dimensioning error. Thus, for this case, there was also a critical relationship between users (kitchen staff) - fixed element (bin room doorway dimensions) - unfixed elements (bins), which was not properly resolved during procurement. In terms of the negative impact of the project environment, unlike case 12, there did not appear to be any extraneous factor impacting on the development of these two aspects of the food service system.

Cases 7, 8 and 9, from longitudinal project C also shared similarities. The linking feature between these two cases was the obsolescence, or inappropriate use, of certain areas and associated equipment within the central production unit. With regard to cases 8 and 9, reasons of economy led to a decision to operate only a bulk method of meal transportation and distribution, at least until later phases of new ward accommodation were commissioned. This meant that the flexibility/duality built into the system (i.e. design for plated meals and bulk distribution) led to under-use/non-use of the equipment areas in the kitchen designed for plated meals distribution/service. Hence, the obsolescence of the plated meals equipment and inappropriate use of the trayed meal preparation area (used much as a spare room in a house - for storing items not currently being used). In this case, the relationship between operational policy (user activities) and associated areas and equipment (fixed and unfixed elements) were mis-matched. However, it would be expected that these particular deficiencies would disappear when (and if) the decision was made to start operating a plated meal distribution service for a proportion of the hospital's patients. These two cases illustrate the complexities, which are inherent in building systems that comprise interlinking components. In these cases, type of service/distribution method linked to the operation of parts of the central production unit. Like case 16, the impact of financial pressures from the project environment had a considerable bearing on these outcomes, and also policy changes related to type of distribution/service method.

Case 7 was similar to case 8 and 9 in that it was an example of a case of obsolescent equipment. Although the deficiency itself was isolated in the catering department, it related to another component of the food service system - the ward service areas (ward kitchen/pantry). As phase 1 ward accommodation already had dish washing capacity, over-capacity in the system was created by providing central dish washing facilities in the new phase 1A catering department. Thus, in this particular case, critical relationships between the user activity of dish washing and the location of such facilities were not adequately matched, in particular the operational relationship between the main kitchen (central production unit) and ward service areas. Like cases 8 and 9, it would be expected that this over-capacity would be reduced if replacement ward accommodation, in later phases of the hospital re-development, were constructed without dishwashing capacity - this would be picked up by the central facilities in the phase 1A catering department.

For cases 6, 13 and 14, deficiencies related to user perceptions of, and dissatisfaction with space, per se, and the associated impact on perceptions of the rigidity of work activities. For project B, financial constraints, and constraints related to development on an already congested site, limited the size of the central production unit. The site limitations and modular unit design led to complexities in the interior. Here, the form that user adaptability took was to change working practices. Thus, overall workflow within the department was dependent on user interaction across a variety of spaces within the kitchen and associated fixed and unfixed elements of equipment.

A similar general lack of space was also identified at project A, refer to case 13. The environmental pressure leading to this was largely because of a constantly changing production method policy. In addition, the way in which design guidance was used was not helpful. As a result of the final decision, for a mixed cook chill (patients) and conventional (staff) production operation within the phase 1 kitchen, very rigid working practices had to be enforced to keep these two different production modes separate. Hence the deficiency identified by case 14. Dimensioning problems similar to those illustrated by cases 10 and 11 also affected the intended use of the ward kitchens at project A. The food distribution trolleys were too large to fit comfortably in the ward kitchens so re-heating of the cook-chill food switched to the day/dining room of the ward. However, this was unsuccessful and reheating was undertaken in the phase 1 kitchen. This was also problematic and had an impact on kitchen ventilation (this was clearly an exacerbating factor for case 4). Thus, for project A, cases 4, 13, 14 and 15 were somewhat interconnected.

These four cases from project A show the complex nature of interactions and relationships between users, fixed and unfixed elements which might be confined to a particular component of a sub-system, for example the central production unit of a food service system, but are likely to encroach on other components, for example ward service points. Beyond that, problems in a particular sub-system may impact on another, totally separate sub-system, for example the kitchen extracts annoying administrative staff in an adjacent building. For any building deficiency, it is possible to tease out these critical relationships and identify the crucial relationships between fixed elements, between users or between unfixed elements, or between these three elements. These relationships may be confined to a particular component of a building sub-system (intra) or between different sub-components (inter). At a higher level of interaction, there may be critical relationships between different sub-systems. This is illustrated in figure 5.13.

Figure 5.13 Relationships at the Building/User Interface

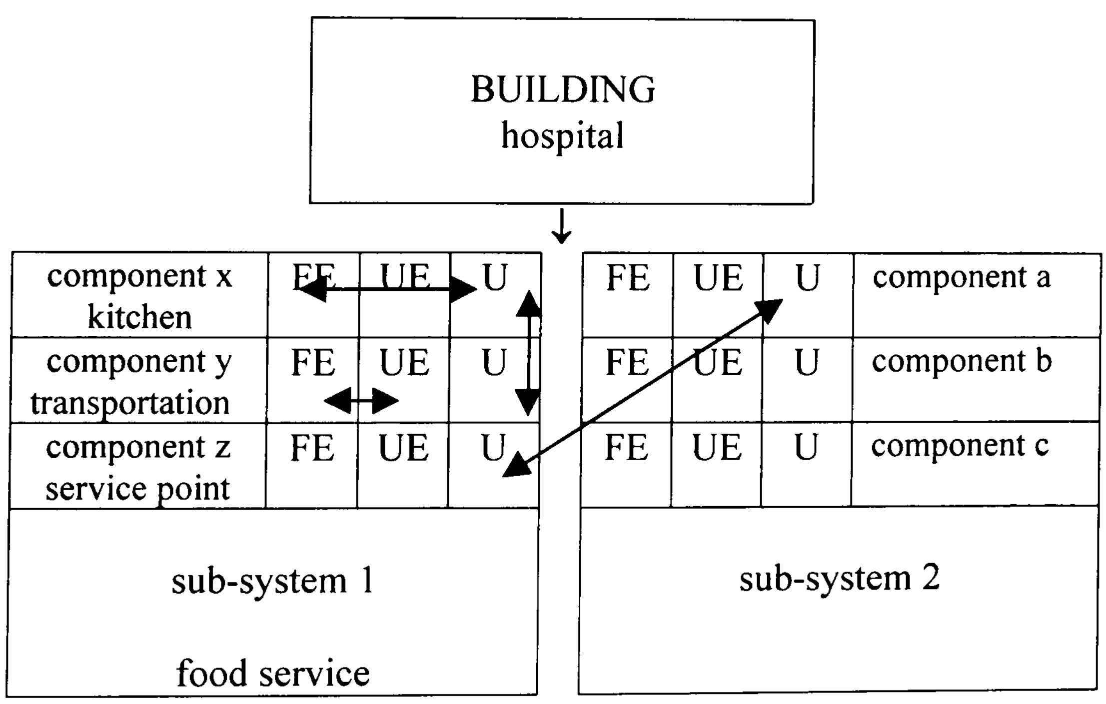


Figure 5.13 illustrates how buildings can be envisaged as a series of interlinking sub-systems with component parts. Buildings can be divided into sub-systems, for example the food service system is a sub-system of a hospital building. Sub-systems can be sub-divided into their component parts, for example, the food service sub-system is largely recognised as comprising a central production unit (i.e. the kitchen), a transportation/distribution system and ward/service points (ward kitchens/pantries or

day/dining rooms). Different sub-systems will be associated with different component parts. Each component will be associated with certain user groups (U), unfixed elements (UE) and fixed elements (FE). The function of any building, or building sub-system, depends on a complex set of interactions between users, fixed elements and unfixed elements. These interactions may involve the components of other building sub-systems. Interactions can be identified at a very detailed level, for example at the level of a specific workspace or at a much broader level. In complex, multi-user buildings, the functional complexity of a building is considerable and could be envisaged as an intricate three-dimensional network where links, or interactions may be numerous, extending across the users, fixed and unfixed elements of different sub-system components. These interactions are represented in figure 5.13 by the double-headed arrows.

It is suggested that the theoretical constructs should be applicable to the investigation of all construction project functional outcome deficiencies. Regardless of building type, all buildings can be described in terms of their built form (design) [i.e. fixed and unfixed elements] and the functions or operations which must be carried out within them by building occupants [i.e. user group activities dictated by the client organisation's operational policies]. Therefore, using the proposed constructs of fixed element, unfixed element and user group interaction, it should be possible to analyse relationships between: the people that occupy buildings; the building's structure/spatial arrangements; and equipment used in/around the building. The theoretical constructs are not confined to a particular sub-system of a specific building type but encompass all built structures where there is a building/user interface. Although the research focused on a specific building sub-system, the analytic generalisations from the case study approach are applicable to the wider construction industry. This wider generalisation can be demonstrated by applying the theoretical constructs to other reported cases of outcome deficiencies. For example, one of Hughes' (1989) case study projects was a construction project for a county branch library. Among the deficiencies that were reported were:

(1) Poor design in terms of layout and wasted space;

(2) Inaccessibility to lower shelves;

(3) Noise and lack of privacy for quiet reading.

Using the proposed theoretical constructs, these problems demonstrate a variety of user fixed element and unfixed element problems. For example, inaccessibility to lower shelves shows some degree of oversight, or a lack of understanding, regarding user interaction with book shelving. Clearly, the users were not able to fully ameliorate the gap between design and intended function, hence raising of this problem. Although this appeared to be a rather obvious user group and unfixed element relationship/requirement it was an area of the design solution where there was low tolerance.

Another example is provided by Walker and Hughes' (1984) analysis of a project providing a high-rise warehouse, services block and packing line extension for a pharmaceutical manufacturer. One of the project deficiencies, identified during construction, concerned the poor quality of the warehouse floor. This facility used forklift vehicles for stacking pallets. The trucks had an unusually high reach and a smooth, level floor finish was essential to their smooth operation. The uneven floor finish made the trucks rock and as a consequence the trucks could not operate as quickly as anticipated and did not achieve the expected number of pallet stackings per hour. This problem demonstrates a critical relationship between a fixed element (the floor finish) and an unfixed element (the forklift vehicles). The low tolerance between these aspects of the solution required this problem to be rectified by ensuring an even floor finish. Although the problem was partly due to the truck masts being slightly out of plumb, even when these were adjusted the negative impact of the uneven floor finish still had to be resolved.

The theoretical constructs provide a means for explaining construction project functional outcome deficiencies and potentially offer a framework for minimising the occurrence of these in future procurement processes. This is explored more fully in Chapter 6.

5.7 References

British Pest Control Association (1985) Hospitals Can Damage Your Health.

Cairns, G. M. (1996) "User Input to Design: Confirming the User-Needs Gap Model." Environments by Design, Vol 1, No 2.

Committee Of Public Accounts (1977) "Ninth Report, Session 1976-1977." HMSO; London. Committee of Public Accounts (1984) "Sixteenth Report, Session 1983-1984. Manpower Control, Accountability and other Matters Related to the National Health Service." HMSO; London.

Hughes, W. P. (1989) "Organisational Analysis of Building Projects." PhD Thesis, Department of Surveying, Liverpool Polytechnic.

Kapila, M and Buttery, R (1986) "Lessons from the Outbreak of Food Poisoning at Stanley Royd Hospital. British Medical Journal **293**: 321.

Kernohan, D., Gray, J., Daish, J. and Joiner, D. (1992) User Participation in Building Design and Management. Butterworth Architecture; Oxford.

Preiser, W. F. E., Rabinowitz, H. Z. and White, E. T. (1988) "Post-Occupancy Evaluation." Van Nostrand Reinhold; New York.

Shumaker, S. A. and Pequegnat, W. (1989) "Hospital Design, Health Providers and the Delivery of Effective Health Care", in Zube, E. H. and Moore, G. T. (eds) Advances in Environment, Behaviour and Design. Plenum Press; New York.

Smith, J. (1984) "Hospital Building in the N.H.S." British Medical Journal, 289 : 1599-1602.

Stone, P. (1990) "British Hospitals and Health Care Buildings : Designs and Appraisals." Architectural Press; London.

The Report of a Committee of Inquiry into an Outbreak of Food Poisoning at Stanley Royd Hospital. (1986), HMSO.

Walker, A. (1980) "A Model for The Design of Project Management Structures for Building Clients." PhD Thesis, Department of Surveying, Liverpool Polytechnic.

Walker, A. and Hughes, W. P. (1984) "Private Industrial Project Management : A Systems Based Case Study". Construction Management and Economics, **2** : 93-110.

Yin, R. K. (1994) Case Study Research : Design and Methods. Second edition. Sage Publications, Inc; London.

Zeisel, J. (1984) "Inquiry by Design: Tools for Environment-Behaviour Research." Cambridge University Press; Cambridge.

CHAPTER 6
Conclusions and Recommendations for Further Work

6.1 Introduction

This final chapter of the thesis presents the main conclusions from the research findings, drawn from the analysis of data from the case studies, as detailed in chapter 5. The findings are considered in relation to the research hypothesis. In the final part of the chapter, the concepts discussed in the thesis, and the research findings, are used to synthesise a framework for developing an approach to achieving more successful building function, through more effective building design and operational planning integration throughout the project procurement process. This is postulated as a mechanism for achieving feedforward that will allow improvement in processes, and ultimately lead to improvement in buildings themselves.

6.2 Summary of Findings

There are seven main conclusions arising from the research, as undernoted:

(1) Data from the user-focused post-occupancy evaluations identified six categories of outcome deficiency; the problems were grouped according to their cause (refer to section 2.9): (1) poor workmanship; (2) incorrect translation of specifications; (3) lack of time; (4) existing deficiencies; (5) poor system administration; (6) design/operation mis-matches between building users and fixed and unfixed elements of the design solution. Only functional outcome deficiencies from category six were analysed in detail.

(2) Of the 17 design/operational mis-match outcome deficiencies that were identified: 15 related to the central production unit (central kitchen or catering department); and one each related to the distribution system and the satellite kitchen at ward level. Of these 17 problems, five related to deficiencies in the working environment attributable to unsatisfactory temperature and ventilation. Ten of the deficiencies related to spatial problems: lack of space; under-utilised or mis-used space; and poor relationship of space and equipment to workflow and activities. Two of the deficiencies were due to finishing and equipment problems.

(3) Design team interaction with the user did not guarantee a totally successful solution even when the quality of communication appeared to be good (note that during a design team meeting for the longitudinal case study the architect had commented positively on the brief provided by the food service representative).

(4) The use of specialist design guidance (in this case related to food services) was seen to have a negative impact. The usefulness of the guidance was limited in its application to the development of new catering technologies such as cook-chill and cook-freeze as there was a lack of information on these particular aspects. Moreover, often there was persistent adherence to guidance with the expectation that this would expedite the approval process. Thus, the way in which design guidance was used, or chosen to be interpreted, restricted the development of novel food service solutions to complex client requirements.

(5) Outcome deficiencies manifested despite the fact that there were re-validation or check points within the project procurement process; i.e. opportunities for the solution to be reviewed, re-tested or re-examined to ensure that it still met client requirements. Constant policy changes led to considerable uncertainty about the nature of the final solution that would be adopted.

(6) The development of dual modalities during planning, as a response to policy uncertainties, caused by environmental pressures, ultimately had a negative impact on the development of the final design solution.

(7) On further consideration of the observed project outcome deficiencies, it was apparent that the majority were due to problems that had arisen because design team members and user specialists had been unable to relate different aspects of system functioning, to one another, adequately. In particular, there appeared to be an inability to incorporate effectively the catering technological and associated service aspects into the design solution; i.e. the elements that were not purely architectural. Some of these functional relationship problems were relatively simple and did not require significant design or user expertise. These are exemplified by mis-matches between room access/egress dimensions and dimensions of equipment that was supposed to move in and out of these rooms. Similar mis-matches between fixed elements and unfixed design elements were identified at the other case studies. Mis-matches emerged where user interaction with fixed/unfixed design elements was problematic. The most problematic deficiencies emerged when different components of the food service system (central production kitchen, distribution system and ward service locations) were not effectively integrated.

6.3 Relationship of Findings to Research Hypothesis

As detailed in chapter 1, the research hypothesis stated that,

A functionally successful building is dependent on the project procurement process maintaining integration between building design and operational planning, particularly at periods of increased environmental complexity.

With regard to testing the research hypothesis, as stated above, there are essentially two key findings:

(1) The common factor among all 17 functional outcome deficiencies was a lack of integration between the purely architectural aspects and the catering specific aspects of the design solution. Inability of the procurement process to relate one to the other meant that function could not be adequately explored and addressed and, thus, an effective solution evolved. The resulting functional outcome deficiencies were, therefore, not due to carefully thought out design compromises, but emerged because of inadequacies in the project procurement process which failed to identify and maintain critical relationships between users, fixed and unfixed elements comprising the functional solution.

(2) Environmental complexity leading to changes in the timing of introduction of food services planning and changes in the nature of the food services policy, had a major impact on the development of project outcome deficiencies. Specifically, procurement processes were unable to relate environmental pressures to the design solution through their impact on the relationships between users, fixed and unfixed elements.

As stated in the development of the methodology (refer chapter 2, section 2.1.1 A Case Study Approach), the case study approach is not open to statistical reduction of results and Popper's (1969) view on the growth and progress of scientific knowledge applies. On that basis, the weight of evidence is *support for* the research hypothesis.

6.4 Towards a Conceptual Framework for Developing an Approach for Improved Building Function

It is through the construction procurement process that a solution to the client's problem is evolved and defined in terms of the relationship between user group activities (operational planning) and physical settings (building design - incorporating the fixed elements that are the province of the architect and the unfixed elements on which the users are expert). This process must create a physical setting which is appropriate to the performance requirements of the client organisation to fulfil immediate, and usually longer term, needs. The client organisation provides the information relating to the activities and specialist equipment which the built solution must contain (operational planning) and the architect supplies the information which will determine what spatial arrangements will facilitate the execution of these activities (building design). Each level of planning must be clearly described by the architect in spatial terms and by the client in terms of the activities and equipment associated with these spaces. This means that the solution, in terms of both the physical building design and the operational policy, become more clearly defined in increasing detail. Defining the building solution in design and operational terms will, in itself, not secure adequate functioning. Critical relationships must be identified and defined as a shared activity by design professionals and users. Successful functioning is dependent on this activity - it is the key to maintaining integration between building design and operational planning and allows for a better understanding between designers and users. This activity is particularly important in harmonising the purely architectural aspects of the solution with other essential features or components, often of a specialist technological nature and usually within the expertise of another member of the design team; for example, mechanical services and specialist items of equipment.

Building design and operational planning activities cannot be considered as discrete work stages occurring within a linear planning process. They must be considered as evolving concepts that are liable to change as the project environment changes and must be integrated throughout the whole of the procurement process. In chapter 4 (refer section 4.6 Theoretical Constructs and the User/Building Interface), a useful way of conceptualising the complexities of user group/building interface interactions and relationships in complex, multi-user facilities was proposed. An integrating mechanism for building design and operational planning activities is suggested by the research. This would be through visualising: operational planning, as those aspects that relate to user group activities and specialist items of equipment; and building design, as those aspects incorporating the fixed elements of the design. These fixed elements relate to those aspects of the physical structure within the domain of the architect. Understanding the complex interaction and relationships between operational planning and building design is crucial to building function.

Different sub-systems develop at their own pace and when the design is finalised in order that tendering may proceed this does not necessarily mean that all sub-systems of the building have been defined, identified and resolved to the same extent. As far as finalising the design is concerned this is somewhat of a misnomer since after the design stage, detailed design work often still continues for some sub-systems. This was certainly the situation for retrospective case study A as a post-works package had to be assembled to cope with the changes that were being made even when the catering department was being built.

In practice, client policy decisions are not always made before the design is "finalised". Thus, during the latter stages of building procurement the client may still be making major decisions relating to operational policy and building design and this will impact on the building/user interface. Thus, at the beginning of the procurement process client and architect are concerned with macro decisions and, later on, detail decisions. Critical points between each stage of work imply that the building/user interface is defined to such an extent that progress can be made on the next stage of the process. However, at any time during the procurement process the solution to the client's problem will be described and defined to differing degrees of certainty depending on which level of the building/user interface is being scrutinised. This is due to the fact that the environment is constantly constraining the solution directly, through the project procurement process structure, and indirectly, through the client organisation. For example, the nature of the ward design and activities to be carried out in the ward may be fixed with a large degree of certainty at an early stage in the project. However, design and operational information relating to another aspect of the development, such as surgical provision, may be less concrete. In effect, the degree of clarity, which can be placed on any portion of the solution, will depend on the client organisation's ability to envisage performance requirements in the long, medium and short term for the client organisation. The building procurement process can be sub-divided into common stages because at certain crucial stages progress towards the achievement of objectives must be seen to be made. Financial and other resources can only be released when sufficient information is known regarding the solution and this must be expressed in both design and operational terms. The existence of design as a singly identifiable work stage is, therefore, somewhat artificial. When the tendering process commences this merely indicates that the solution has been defined with enough certainty to allow construction to commence.

In large, complex multi-user buildings it is inevitable that different sub-systems will develop and progress at different rates. Environmental factors will be moulding the client organisation and project procurement process continually and different sub-systems will be affected by differing external pressures. The building solution, consisting of its individual sub-systems, emerges as a whole from the building procurement process although, at any moment during the project's history, the individual sub-systems will be at different stages of design and operational solution resolution.

The dynamic nature of the construction procurement process, therefore, requires an approach which allows solutions to be tested and re-tested at different stages of the process, as a response to information coming in from the environment which will impact directly or indirectly on the project. Critical relationships, made explicit at the start of the project and refined in increasing detail as the solution is clarified, should form the basis against which any new information can be tested. The impact of new information on these critical relationships must be assessed in order that synergy between design and operation is maintained.

Drawing together the key ideas in the thesis, and the main findings of the research, an approach, focusing on process, is put forward as a means through which to achieve improved building function.

Chapter 1 of the thesis identified the need to relate procurement processes to products, in order to determine the cause of building performance deficiencies in terms of function. The research has developed and tested a methodology for this purpose. However, to generate a continuous quality control cycle in the construction industry, thereby continually improving products, it is the procurement processes that evolve these products which must become more effective and must be seen to change. It is only such a continual feedforward mechanism that focuses on procurement processes, which will ultimately lead to sustained improvement in building function with repetition of successes and avoidance of failures.

Central to this approach is an acceptance of the crucial importance of building function as a construction industry performance indicator, and that function is achieved through integration of design and operational planning throughout the procurement process. Moreover, the impact of the environment on the final product, either directly through the procurement process, or indirectly through the client body, is a factor that must be taken cognisance of if successful functioning is to be achieved. Figures 6.1(a) and (b) illustrate this approach in diagram form. It is based on the following concepts and ideas explored earlier in the thesis:

(1) Relationship and interaction between building users and fixed and unfixed elements within and between different sub-systems and component sub-systems of complex multi-user buildings (refer to section 4.6.1 Relationship and Interaction Between Users, Fixed and Unfixed Elements);

(2) The associated concepts of adaptability, tolerance and flexibility in the context of (1) above (refer to sections 4.6.2 User Adaptation to Inadequate Design Solutions and 4.6.3 Tolerance and Flexibility);

(3) The effect of environmental pressure on the project procurement process (refer to section 5.4 Environmental Assessment).

Figure 6.1(a) illustrates a conceptual framework for the construction procurement process showing how deviations arise. Figures 6.1(b) and 6.2 show how deviations can be managed, adopting an approach, which requires critical relationships to be determined and made explicit.

The building procurement process is the mechanism through which a solution is evolved to meet the problem of producing a new building. There are two parts to the process which must be integrated in order to achieve successful building function: design and operational planning. The design part of the process relates to physical aspects comprising fixed elements (essentially the elements which are in the domain of the architect) and unfixed elements (essentially the elements that are in the domain of the users, for example specialist equipment). Knowledge of the physical environment is the domain of the design professionals. Operational planning comprises those tasks which relate to determining the user activities that must be supported by the new building and consolidating these in an operational policy. This aspect of the process is the domain of the client body.

Effective dialogue must occur between the design specialists and client/user specialists, as design and operational planning must be integrated throughout the whole of the building procurement process. Environmental pressures impact directly and indirectly on the procurement process - this generates more information which must be accounted for in terms of its impact on the solution. Often environmental pressure will result in a deviation in either operational planning or design activities, or both. Deviations, as indicated by the boxed "D" symbols in figure 6.1, must be evaluated by re-testing and re-validating the solution. Within this approach, re-testing is against pre-identified and prioritised critical relationships between fixed elements, unfixed elements and users. Failure to maintain the design and operational aspects within the parameters for successful function, i.e. the extent of tolerance and degree of flexibility required, will result is aspects of building function that will not perform as intended. The degree of deviation, and the extent of tolerance demanded by the critical relationships will impact on the severity of any outcome deficiencies that emerge. Deficiencies might be corrected by a simple change in user activities and working practices. However, more serious problems might require a change in user activities and/or the fixed and unfixed elements of the solution. Clearly, changes that incur a requirement to alter the physical environment, will bear a greater financial cost. The procurement process, therefore, must allow for corrective action to be taken. An example of how corrective action should be taken is illustrated in figure 6.2.

Figure 6.1(a) Conceptual Framework of the Construction Procurement Process Showing how Deviations Arise

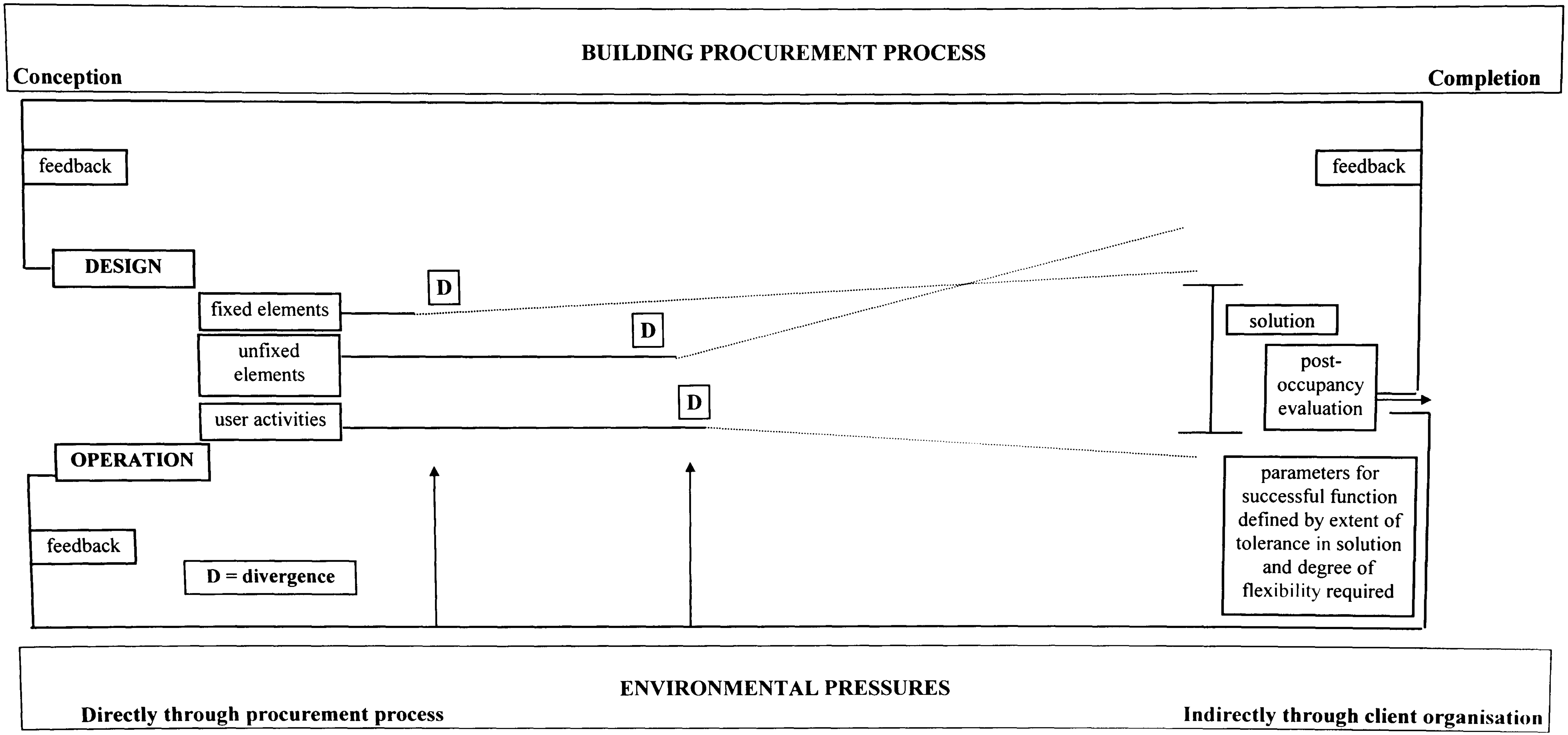
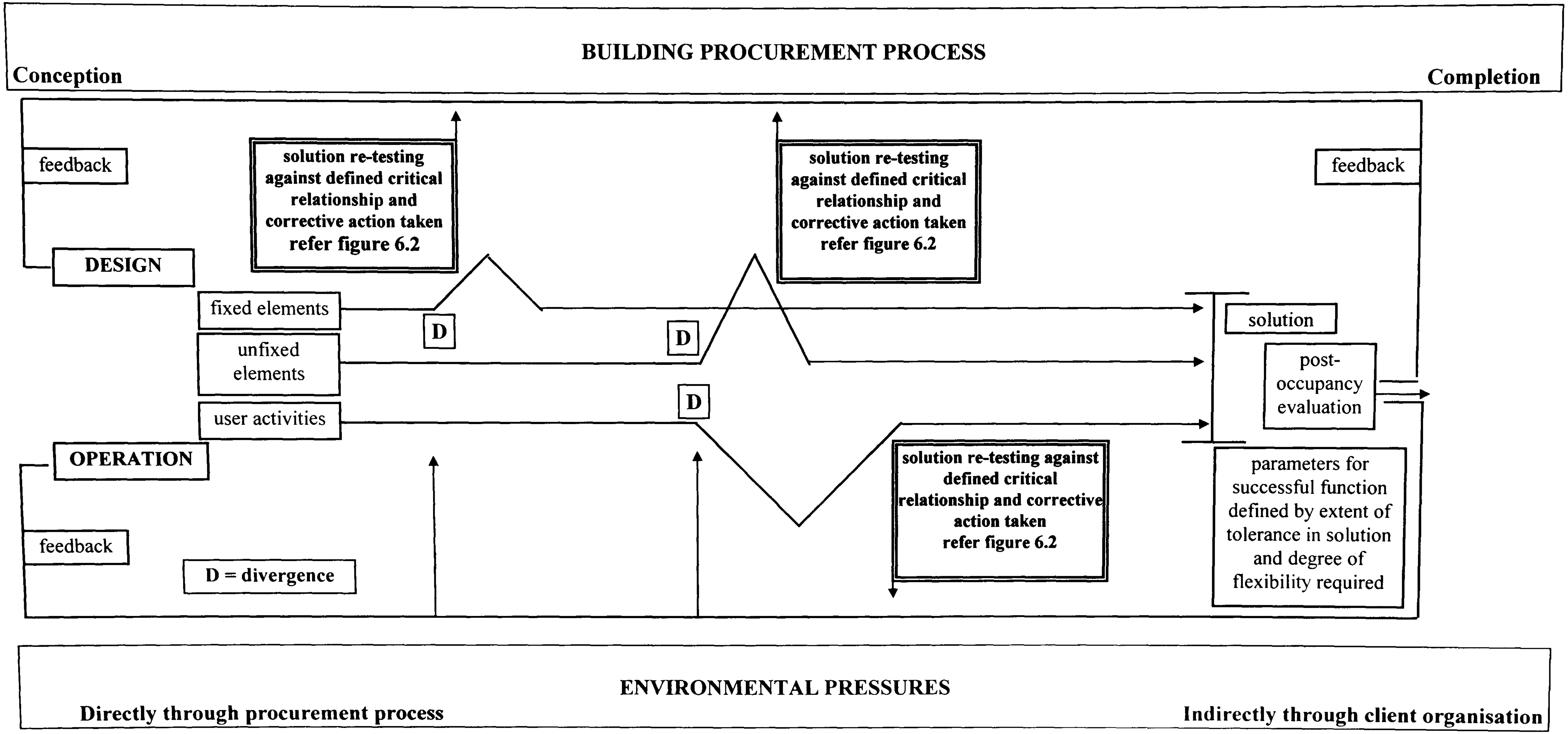


Figure 6.1(b) Conceptual Framework of the Construction Procurement Process Showing Resolution of Deviations



The research proposes that three elements (fixed elements, unfixed elements and user groups) interact to produce a functional building solution.

Details surrounding the fixed elements are largely driven by the design participants. User group interactions are largely driven by the client's operational policy. Unfixed elements tend to be within the expertise of the client, particularly as some items of equipment might relate to specialist technologies (for example catering). In order for any building solution to work, there has to be interaction between these three elements. People usually work in defined spaces with certain equipment and so physical environments must be created which allow people to perform activities efficiently and effectively. In order to procure the most appropriate physical facilities, design specialists and clients must share a common understanding about the problem to be solved and must understand the interactions between fixed elements, unfixed elements and user groups. This means that where compromises have to be made, all parties appreciate the potential impact on the final building solution. This can be achieved by an approach which requires a focus on the interaction between fixed elements, unfixed elements and user groups. As explained previously, some aspects of the building solution may exhibit low tolerance so any errors in identifying and defining these could be costly. Although some aspects of a solution may appear to be straightforward this might lead to them being overlooked, for example, simple dimensional relationships between items of equipment and the rooms/spaces that must accommodate them. Therefore, it is essential that relationships between fixed elements, unfixed elements and user groups are made explicit, and that any relationships which are critical, i.e., where there is low tolerance, are highlighted. These interactions should form the basis upon which the solution is developed and on which any potential deviations in planning can be assessed. This information must be generated from the very broad level of design right down to the detailed level. In order to achieve this, it is useful to envisage a building as a whole, comprised of different components or sub-systems, such sub-components are distinguished by the goals or activities that they are geared towards.

In essence, what is required is a process or mechanism that integrates the knowledge and experience of building users (user activity or operational planning experts) with the knowledge and experience of construction professionals (the experts on building design), Kernohan et al (1992) describe a process of *"social negotiation"* as being the key to this. This concept is better understood through the following,

> ***"Because our intentions and expectations are continually being modified with changing social experience over time, we seldom, if ever, encounter spaces or facilities that are perfectly matched for us. The world is full of imperfect buildings***

occupied by imperfect social organisations. Our use of space calls for continuous negotiation between the intentions of the individual and social group. The idea that quality is negotiable has important implications for the relation between users and providers. One means for bringing users and providers together is to develop processes that enable users, designers and managers, in fact all those with interests in buildings, to benefit from the social negotiation of building quality. Rather than working in isolation from clients and users as proposers of finite solutions synthesised from expert and scientific knowledge, it seems more sensible for designers and managers to become involved in a process of negotiation with clients and users to develop building solutions acceptable to all." (Kernohan et al 1992)

For example, the food services sub-system of a hospital is dependent on interaction between users and fixed elements and unfixed elements related to: the central production unit (central kitchen); the transportation and distribution system; and the ward areas. At the very broad level of planning, the way in which the food service sub-system relates to other components of the hospital should be determined. For example, are there any essential interactions between the catering department and other parts of the hospital which would require close physical proximity, or are there physical relationships with other departments that must be avoided? At a more detailed level of planning, there should be careful consideration of the links between the different components of the food service sub-system. For example, food must be delivered to patients on the wards and the nature of the transportation and distribution system will have an impact on how food is delivered. Focusing on these types of interactions will allow the design team to formulate a data set of relationships between users and fixed and unfixed elements and will allow for identification of critical relationships. This is particularly important when the project environment is volatile and environmental pressures have a potentially major impact on the procurement process.

For instance, when new technologies are being used, and there is uncertainty relating to their adoption, then it is essential to work within some kind of framework, identifying key interactions between new specialist equipment, the building that houses it, and the people that use/operate it. The solution to the client organisation's problem is unique, dictated to a certain extent by the environmental pressures impacting on the client organisation at the time of construction procurement. Hence, the need for a framework that will allow re-testing and re-validation of the solution.

As an example, figure 6.2 demonstrates how this approach could have been applied to the procurement process for the longitudinal project, in order to avoid the problem of the mis-match between refuse bin and refuse bin room doorway dimensions.

Figure 6.2 Solution Re-testing and Avoidance of Operational/Design Mis-Match

Constraining environmental influence:

Brownfield site limits options for siting a new catering department which results in the close proximity of the department to existing buildings.

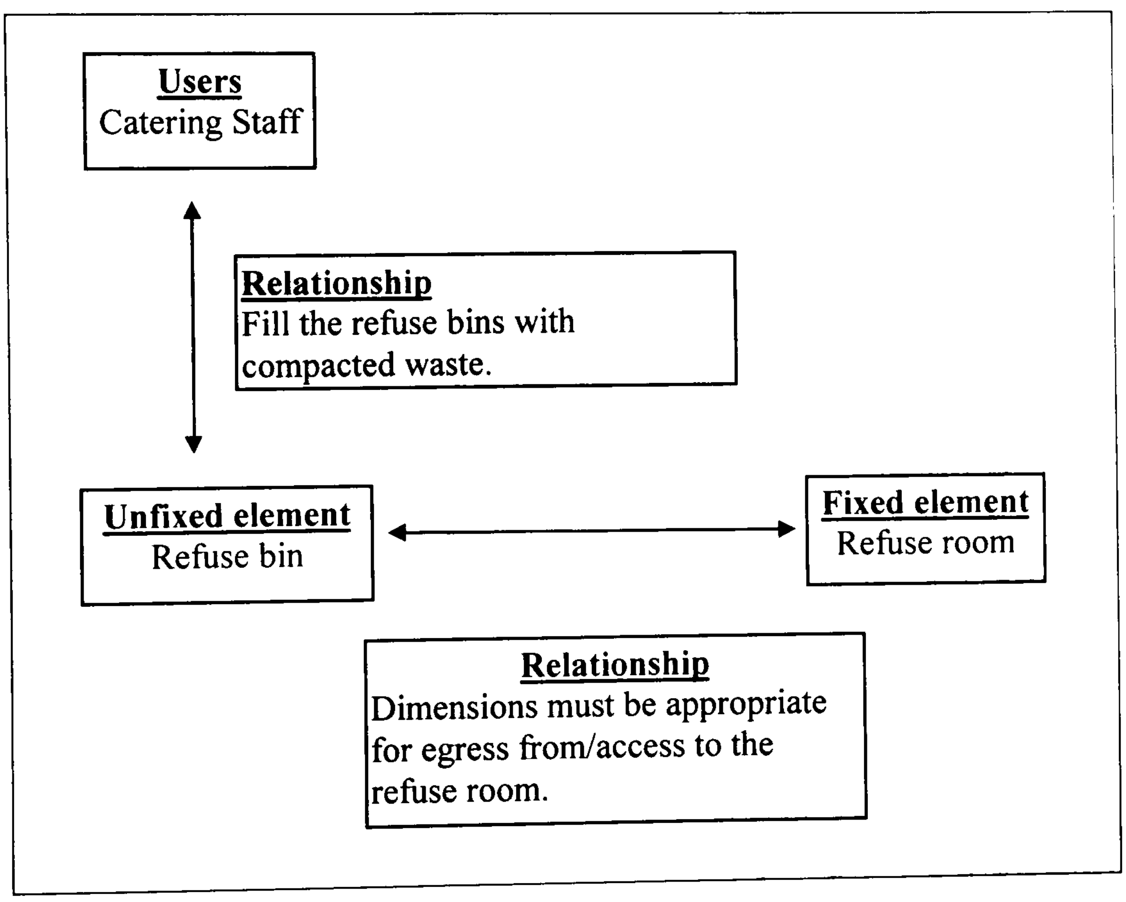
⇓

Policy decision:

Refuse disposal has to be designed in such a way as to minimise its environmental impact on the site. As part of this strategy, a compactor is to be installed in the refuse room to reduce the volume of cardboard and paper waste. This will assist in minimising the environmental impact of unsightly bins of rubbish sitting outside the catering department.

⇓

Functional Relationships



In the example, two key relationships are identified:

(1) Users/unfixed elements

The catering staff fill the refuse bins with compacted waste and these bins will remain in the refuse room until uplifting.

(2) Users/fixed elements/unfixed elements

The catering staff take the refuse bins out of the refuse room ready for uplifting.

As the critical dimensional relationship between the size of the refuse room doorway and size of the refuse bin was overlooked, the bins had to remain outside. Thus, the client organisation could not achieve the objective minimising the impact of unsightly bins of rubbish left outside the catering department. Moreover, this operational/design mis-match necessitated a certain degree of user adaptation since instead of making one journey outside, with a refuse bin full of compacted rubbish, the catering staff were forced to journey back and forth with compacted rubbish to fill the refuse bins sitting outside. Through this relatively straightforward example, the principles of the approach are demonstrated and can be applied to more complex situations.

It is suggested that the benefits of developing this conceptual framework into a problem solving approach that can be applied to the construction project procurement process are that:

(1) It can be applied across different levels of planning, from a broad strategic level, for example, how different building sub-systems should relate to each other, to a very detailed level, for instance, the design of specialised workstations;

(2) Contributing individuals are better able to see where their expertise and knowledge fits into the solution, and have a better understanding of how this relates to the expert input of others. This should provide a mechanism which should go some way towards bridging the communication gap between clients and users and design professionals as there is a common understanding of the objective that participants are working towards;

(3) When environmental pressures impact on the procurement process, there is a clearly specified data set of critical relationships against which potential changes in decisions can be tested. Thus, when compromises have to be made, there is a better understanding of the potential problems that these changes may create. In addition, the data set can be used to work out the most effective method for overcoming potential problems. If a part of the solution could not be designed as intended, then the users could be fully briefed regarding the adaptations that they might have to make in order to make the solution work as effectively as possible.

6.5 Recommendations for Further Work

Post-occupancy evaluation is a crucial aspect of the construction procurement process. Once the building has been commissioned and users have occupied the building, then a functional assessment of the solution must be undertaken, most importantly from the users' perspective. It is essential that future post-occupancy evaluations attempt to relate successes and deficiencies in the building, to the processes that evolved the building. The thesis has provided a methodological technique for this type of post-occupancy evaluation.

The technique should be applied to a range of building types and sub-systems to verify its general applicability.

In the context of the case study analyses, the research has revealed the need to identify critical relationships between user groups, fixed elements and unfixed elements. This provides the basis of a conceptual framework for developing a problem solving approach which can be applied to the construction procurement process. Repetition of the investigative technique, on similar building types or sub-systems, would further validate the conclusions of the research and allow the establishment of critical relationship data for specific building types. This could be developed as a form of guidance, which should be regularly updated as more post-occupancy evaluations are conducted. This guidance would be used to inform the process of design rather than the design itself, as it would highlight aspects of a building solution which require particularly careful consideration. Thus, instead of producing guidance that might be prescriptive, for example, all doorways should be 1m wide to accommodate food service trolleys, the guidance should focus on critical relationships. For instance, the dimensions of doorways must accommodate the dimensions of food service trolleys. These critical relationships should be identified, even for apparently straightforward situations, as simple relationships can be overlooked. They should also be identified for strategic level, complex relationships which will probably involve different departments or sub-systems.

Further work is required to take the conceptual framework forward so it can be applied to the construction procurement process as a problem solving tool. Specifically, a detailed methodology for solution re-testing against the defined critical relationships requires development and application to a range of live projects. This would confirm the general applicability of the approach, irrespective of building type.

6.6 References

Kernohan, D., Gray, J., Daish, J. and Joiner, D. (1992) User Participation in Building Design and Management. Butterworth Architecture; Oxford.

Popper, K. R. (1969) Conjectures and Refutations : The Growth of Scientific Knowledge. Third edition. Routledge and Kegan Paul; London.

APPENDIX 1

Project Histories for Longitudinal Project C and Retrospective Project A

APPENDIX 1
Project Histories for the Longitudinal Project C and Retrospective Project A

1.1 Longitudinal Project C

1.1.1 Project History

In 1973 a Professional Planning Committee submitted its proposals to the North Eastern Region Hospital Board for future development on an existing hospital site, of a new hospital containing 1800 beds and related ancillary accommodation. After the early proposal the Scottish Home and Health Department (SHHD) made a decision to restrict the development in size to approximately 600 new beds. The decision was probably affected by the changing attitudes to, and policies for, mental health care. In particular, the last 25 years have seen an enlightened and more liberal approach to the care of the mentally ill, with fewer patients receiving long term in-patient treatment. For those who do require admission, the length of such episodes is, on average, considerably reduced, with earlier discharge to the community and the possibility of re-admission if improvement is not maintained - the "revolving door" concept of modern psychiatric care. Undoubtedly, the SHHD envisaged that the increasing emphasis on community care and the importance of day hospital care would lead to a decrease in the number of psychiatric hospital beds required. This decision by central government did mean that the Hospital Board had to reassess its plans for the decommissioning of another of its mental health hospitals outwith the city.

Approval In Principle, to a re-development of the hospital, was secured some years before 1977 but continued planning and modification of the scheme demanded renewed approval from the SHHD in the 1980s. Approval In Principle for the 3 phases of the hospital development was granted by the SHHD in October, 1985. From November to December 1986 the Project Architect presented the first layout drawings of phase 1 accommodation to a multi-disciplinary group of "users" whose comments were then incorporated into revised layout drawings which were approved by the Project Team. In June 1987 the SHHD approved the first formal submission subsequent to Approval in Principle (The Pre-Design Cost Limit). A few months later at the beginning of October, the project received planning approval from the District Council, Planning and Building Control Committee. A short time later in November the Health Board and Design Team completed the second formal submission to the SHHD - the Final Cost Limit Statement. This certified that design had been completed within approved costs and allowed the preparation of contract drawings and documents to begin. A year later in September 1988 the contract for phase 1 had been awarded and phase 1 was completed in 1991. At the time this research was being conducted, phase 2 was being built.

1.2 Retrospective Project A

1.2.1 Project History

The project history is fairly long and complex with many changes occurring during the project duration. A scheme for redeveloping Hospital 1 was first proposed in the 1930s. In the 1960s a rather grand scheme was announced in the House of Commons for re-development of this Health Authority's hospitals along with several others. This scheme was abandoned and a more modest scheme for rebuilding the Authority's hospitals and it's associated Institutes on the site of Hospital 1, was proposed. The idea was to have one very large project and to undertake amalgamation in one go. In 1967, a Joint Planning Committee (JPC) was set up to commence planning in earnest. A year later this re-development proposal was accepted by the DHSS, and the hospital's associated teaching establishment, to the extent that provision was made for the scheme in the hospital building programme. From this time, until 1972, planning of the scheme progressed and was worked up in detail. During this time period the Design Team members were appointed, a system of user representation was worked out and various other changes in the planning organisation came into being, notably the establishment of a Project Steering Group (PSG). At the end of 1972 the DHSS gave formal stage A1 approval on behalf of the DHSS and the University Grants Committee (UGC) to a project building and engineering cost of £10,603,000 (covering both phase 1 and 2).

In April 1975, first stage (A5) approval was given to the scheme, which incorporated all main Hospital and Institute departments adjacent to one another in a single deep planned building. Shortly after, in April, the formal stage A2 (B4) submission consisting of the Development Control Plan and Budget Cost was forwarded to the DHSS, associated teaching establishment and the UGC.

The Town Planning Committee considered "Notice of Proposed Development" for the new hospital. The meeting was attended by the Project Steering Group and the design consultants. The Committee decided to raise no objections to the principle of the hospital development on the site, subject to certain provisos. At the end of March 1976, Capricode stage 3c First Part had been completed and the client instructed the Design Team to start work on Capricode stage 3c Second Part (Final Sketch Planning). However, a few months later in August, the DHSS informed the hospital Board of Governors that they could not fund even a first phase on the scale envisaged. The Board of Governors were asked to consider an alternative within the following constraints:-

(1) Relocation of all the clinical and academic activities associated with Hospital 3 and its Institute branch so that their current premises could be vacated:

(2) Costs were to be contained within £6m at May 1975 prices;

(3) The complex created by the new development and the existing buildings of Hospital 1 had to be autonomous, capable of functioning efficiently without any simultaneous or subsequent commitment to additional development.

Plans formulated to fulfil this brief endeavoured to achieve as much as possible of the original objectives of integration of existing services. Although the new layout as planned had some disadvantages with regard to the functional relationships of departments, there were some very important benefits. In contrast to the previous scheme, the "opening out" of the building meant that less air conditioning was required. In fact, little or none was involved except in the areas where it was clinically essential, such as operating theatres. This meant less expensive running costs. In addition, the environment, with much more daylight would be greatly improved, particularly for staff. The DHSS constraints did have a negative effect on planning. The planning group then had to ask themselves the question, "What can we buy for £6m?" In other words, the architects were in the position of trying to work out how many thousands of square metres this £6m figure would buy. On this basis, the design did not proceed in an illogical fashion but the constraints on costs meant that attitudes of individuals in "controlling a piece of the action" had to fall by the wayside. The functional content had been agreed previously and although re-planning was necessary, the planning principles remained essentially the same. Based on the above tenets, a new formal stage A1 submission was made to the DHSS in March 1978. A revised financial statement of the phase 1 submission was made and many reminders were given to the DHSS. Almost a year later in September 1979 UGC consideration of the formal submission had to be halted due to a misinterpretation between Institute and associated teaching establishment. The result was that until an expenditure limit set by the UGC was known, no further planning could take place.

At the end of January 1980 it was decided to discontinue planning. A far-reaching report on medical education finally produced a reason for the stopping of all further action by the DHSS. No planning was carried out between Project Steering Group Meetings 56-61

(28/1/80 - 15/12/82). At that time, approval of Stage 1 was being awaited, approval would have given a cost base and agreed the overall principles for the development. Planning was further delayed when there was a re-organisation of postgraduate teaching hospitals.

It was not until July 1981 that formal stage A1 approval was given to proceed to stage 2. During the lull in this planning period both the Mechanical and Electrical and Structural Engineering consultants were changed.

Clinical developments during the delayed planning years led to a revision of the hospital operational policy. The developments, particularly in cardiac diagnostic techniques, meant that it was not now possible to incorporate the original objective of functional integration within the cost limits laid down. It was considered that a more efficient service could be provided if all surgery were included on a single site in the new building with cardiology and associated facilities also united, preferably in the buildings of the adjacent Hospital 4 (if available) or a few minutes walk away in the existing Hospital 1 South Block.

The UGC had agreed to purchase a convent site from the DHSS on the condition that the medical Institute raised the capital money for the adaptation and extension of the building. This was £2.3m. A £1m donation was given to the Institute on the condition that the DHSS proceeded as planned with the associated hospital building. An urgent decision on re-planning was, therefore, essential.

The revised hospital operational policy document had to exclude all mention of Hospital 4, since at that time its availability was unknown. The revised document was then submitted to stage 2 of the planning procedure for DHSS approval. At the end of 1982 it was agreed that planning would recommence.

Planning to progress the project through stage 2 was further interrupted when a special working group was appointed by the DHSS to look into the overall proposals for re-development. In particular, the group was asked to advise on the acceptability of the whole operational policy for the management of cardiological and cardiac surgical patients as envisaged after construction of the phase 1 building. At that time, the operational policy proposed for the management of cardiological and cardiac surgical patients after the construction of phase 1, was for the invasive investigation of cardiac patients to remain in the old South Block of Hospital 1, physically separate from the new phase 1 development. The DHSS was extremely concerned as it considered that clinical and organisational disadvantages would have resulted from such a policy.

At the beginning of 1984 the special working group visited the Health Authority to assess the situation. The group recommended that the scheme should be allowed to proceed and that the transfer of Hospital 4 to the Health Authority would allow the close association of cardiology with cardiac surgery to be facilitated. Planning immediately re-started. The DHSS began re-consideration of stage 2 approval - Budget Cost Submission. The Project Manager was optimistic that DHSS approval of the Budget Cost would be forthcoming providing the UGC contribution was approved without delay. A phase 1 reconciliation statement was formulated reflecting the changes to the functional content since the stage 1 submission had been finalised. The Budget Cost Submission was sent to the DHSS in May 1984 and this was approved in July.

Capricode stage 3 planning commenced. At this stage there was a further reorganisation of the planning structure. In particular, a Hospital Planning Committee and Institute Planning Committee were established at the intermediate planning level. Serious planning got underway in 1984. At the end of this year the 3F Detailed Design stage was underway and the architects were beginning to form their working drawing team.

During 1985 there was a critical need to identify all possible savings to bring the cost within the stage 2 approval figure. Until a satisfactory reconciliation had been reached between the stage 2 approval and the cost plan, the working drawing stage could not proceed. Changes to the functional content, through progression of planning, were agreed to by the DHSS. In April 1985 there was a call for all information to be frozen on the Final Sketch Scheme, however, departmental operational policies, including catering, were still being changed and clarified. Outside project management consultants were also appointed in this year. In September, the content of the phase 1 building had virtually been settled. It was considered that any radical review of the scheme would seriously jeopardise its progress and the project management consultants requested the client to freeze the phase 1 design. The project management consultants and the Design Team had started to prepare a programme leading to a start on site.

At the beginning of 1986 the Health Authority prepared a submission to the DHSS to request additional funding. Throughout the year meetings took place with the DHSS to discuss major changes that had occurred since the Budget Cost was last revised in July 1985. A revised Budget Cost statement was submitted with supporting information to justify the increased costs that the DHSS was being asked to meet. Further amendments to the functional content were still required in order to allow for such things as the input of the Health And Safety Executive and to meet the needs of town planning requirements.

Concern was expressed that all the changes being made to the phase 1 functional content would not be looked upon favourably by the DHSS. There were concerns that the DHSS suspected a partly "fictional" functional content; i.e. that the planning team was unclear as to the nature of operations to be conducted within the re-development. As a result of this, DHSS approval to requests for additional funds could not be formally received prior to tender. Therefore, the Health Authority, decided to underwrite the funding commitment.

A preliminary works contract for site clearance of phase 1 was tendered for and contracted in the early part of the year. There was a substantial difference between tender and budget, which created difficulties, but work on site was completed in the latter half of the year. By mid 1986 Certificates of Readiness had been signed by the Design Team members and evidence of current professional insurances were being prepared. Joint venture tendering for the main contract had also commenced despite the fact that there were still problems in reconciling the Pre-Tender Estimate with the Budget Cost. In November, the DHSS gave formal approval to proceed to tender on the main contract but problems arose because of a discrepancy between the tenders and Pre-Tender Estimate. The lowest tender was considerably in excess of the Budget Cost and large savings had to be made to reduce the deficit. On condition that the endowment fund contributed towards this, the DHSS sought Treasury approval for the additional money to be spent. This had to be found from DHSS funds.

The Design Team produced information for the contractors to enable the savings proposed to be agreed and allowed for in the authorised contract sum. The Health Authority agreed to underwrite a considerable amount of the deficit from endowment funds and also asked the DHSS to take into account a possible higher than anticipated return from land sales. The DHSS contacted the Treasury.

At the beginning of 1987 the DHSS finally gave approval to proceed with construction, the contract having been offered to the lowest tenderer at £17,967,623. Work started on site on the 2nd of March. Planning continued after this date to provide for cardiology services following completion of phase 1. The Authority also had to plan for (what became known as the interim scheme) the complex series of service transfers and refurbishment of existing buildings that would be necessary upon the opening of phase 1.

Later in 1987, concern was expressed that there was an apparent departure from what was considered a desirable operational policy in having a close association between departments. At that time, the situation was that activities would be carried out in four separate buildings, the new Institute, Phase 1, the South Block of Hospital 1 and in Hospital 4 with the possibility of a phase 2 to follow. This situation had largely arisen from the DHSS' decision at the end of the 1970s not to proceed with one large building containing all functions. These concerns again halted planning, in this case the interim scheme (the refurbishment of existing buildings). The architects expressed their concern at more changes resulting from the client's need to re-assess its overall development policy.

This problem was finally resolved in 1989 when an Approval In Principle document was sent to the DHSS and Hospital 4 was bought by this Health Authority. This new AIP document revised the planning solution previously agreed in the mid 1980s, which was instigated by the special working group, and effectively it requested the purchase and refurbishment of Hospital 4 as an integral part of the interim scheme.

The construction of phase 1 suffered from various problems. A 26 week delay in the contract was caused by problems in the production of working drawings for the mechanical and electrical installations. In May 1988 the contractor gave notice of a delay due to the excessive number of variations and alterations received to individual service layouts. This formed the basis of a later claim.

In March 1989 the DHSS finally agreed to the increase in the approved contract sum for phase 1 but the problems encountered with the excess tender over budget estimate prompted the DHSS to undertake an investigation. In November the new Institute building was formally opened.

Meetings of the Commissioning Team commenced in the latter half of 1989 but the functional content of the phase 1 building was not finally settled until December that year. At the beginning of 1990 the hospital opened and Practical Completion of Works was on the 22nd of May. The first patients were admitted in November 1990.

APPENDIX 2

Outline of Current Food Service System Functioning for all Projects

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Outline of Current Food Service System Functioning for all Projects

2.1 Longitudinal Project C : Overview

The new catering department services both the new and old hospital buildings. Currently the catering department is physically linked to the first phase of the re-development but will also be linked to phase 2 when this is completed. The new catering department provides meals for all patients on the hospital site: this includes patients in all the wards, day hospitals; and patients eating in the visitors' and patients' dining restaurant in phase 1 of the building. The kitchen also provides food for all the staff on the site. The new department has been operational since October 1992. All meals are cooked conventionally from a variety of raw, semi-processed and processed foods. Prior to transportation, food is kept hot in the heated food trolleys, which are plugged in at kitchen level. All patient food trolleys are designed for bulk food delivery. Some wards receive certain meals in an insulated box. In the patients' and visitors' restaurant, once the food has been delivered it is transferred to a servery system from which the food is served. Porters are involved in meal transportation and distribution and return of dirty food trolleys to and from the new kitchen. At ward level the food trolleys are plugged in at the point of service to keep food hot. At ward level nursing and domestic staff, and often the patients, are involved in food service. In the new phase 1 wards dirty crockery and cutlery are washed up in the two large ward pantries on the first and ground floors. In the old hospital wards dirty crockery and cutlery are washed up at ward level in individual ward kitchens.

2.1.1 The Patient Meal System

2.1.1.1 *Menus*

At this hospital patients do not fill in menu cards. Instead, the nurse in charge on the ward completes a form indicating the number and type of meals required by patients on the ward. However, when the food trolley arrives on the ward the nurses give the patients a choice from the food trolley. With experience, and on wards where there is very little patient turnover, the nurse in charge will be able to identify popular and unpopular dishes and be able to complete the menu sheet accordingly. If the nurse has estimated correctly then all patients will receive what they want and there should be little wastage. However, in the worst case scenario, too much of an unpopular dish and too little of a popular dish may be ordered. This could result in considerable wastage and inadequate portions to go around all the patients. However, the patients' completion of individual menu cards would be a laborious and time consuming process and not all patients would be able to manage this task. At the time of service patients may have forgotten what was ordered, and even with the patient's menu card at hand to verify the order with the food on the plate, some patients will not be satisfied. The bulk delivery system with the patient's choice at ward level offers the best flexibility but allows for greater misjudgements in ordering.

2.1.1.2 *Meal Preparation*

All patient meals are prepared in the new kitchen (phase 1A) at the hospital. The menu sheets sent down by the nurses from the wards provide the catering department with information on the number of portions of different food items that have to be cooked. Special diets are prepared in the diet kitchen area of the new kitchen. As stated previously, a mixture of raw, semi-processed and processed foods are used to prepare patient meals. The food is cooked conventionally. Food is kept hot by a series of hot cupboards near the food trolley bay. Prior to distribution, the food trolleys are loaded with the correct food quantities for each ward; this is based on the information provided on the nurses' menu sheet. Some meals are transported in insulated plastic boxes. These are used for the day hospitals in the old part of the hospital and for wards where it is impossible to transport food vertically i.e. no lifts, so stairs must be used.

2.1.1.3 *Transportation and Distribution*

Generally, three or four porters are involved with food delivery at any one mealtime. At each mealtime there are three different "runs" which the porters must make in order to deliver food across the hospital site. On the first run the porters deliver food to all phase 1 wards, the phase 1 day hospital and the patients' and visitors' restaurant and staff restaurant. The food trolleys are manoeuvred manually. In general, these areas can expect to receive breakfast at 7.55am, lunch at 11.30am and supper at 4.40pm. Generally, porters work to a tight schedule allowing themselves fifteen minutes to deliver food to all the phase 1 sites. Once the porters have returned to the kitchen the second run begins. Five minutes are allocated to the portering staff in which time a tail lift truck is loaded with trolleys for nine wards on the old hospital site. Half an hour is allocated at lunchtime for porters to deliver the food to the wards on run one and return to the catering department for run three. At supper time porters have ten minutes to load the truck for run two and 15 minutes to deliver all the run two meals before returning to the department to get ready for run 3. Once the porters have completed their second run delivery the third "run" commences. At lunch, the porters have 15 minutes to load up the trolley and delivery to run three wards. This run commences at 12.25pm. At supper time, the porters have 10 minutes to load the truck and deliver to the run three wards, which begins at 5.20pm. On arrival at the ward, the food trolley is plugged in by the porters at the point of service so that the food is kept hot. At breakfast time the wards on the old hospital site are served in a different sequence. Actual food service times may vary from ward to ward and day to day depending on the needs of patients and nursing staff. One of the wards is a rehabilitation ward and so the patients tend to do most of their own cooking.

2.1.1.4 *Removal of Dirty Trolley and Dirty Crockery and Cutlery from the Ward*

At lunch time all dirty food trolleys have to be returned by 2.15pm and at supper time the food trolleys have to be returned to the kitchen by 6.30pm. The porters return all the dirty food trolleys to the new kitchen. In the phase 1 wards domestic assistants return dirty crockery and cutlery to the large ward pantries located on the ground and first floor. Three wards and the day hospital share the ground floor pantry and three wards share the first floor ward pantry. Domestic staff in the ward pantries clean dirty crockery and cutlery through a machine operated dish washer. In the old hospital, crockery and cutlery are stored in individual ward kitchens and are cleaned there by the domestic assistants who use a machine operated dish washer.

2.1.1.5 *Beverage Service*

The beverage service varies from ward to ward. In the phase 1 wards the domestic assistant working in the large ward pantry organises all the beverages for the wards allocated to that pantry. A domestic assistant will come from each ward to the relevant pantry and collect the beverage trolley for their ward. Once beverage service is finished the domestic will return with all the dirty crockery and cutlery and this will be cleaned by the domestic assistant in the ward pantry through a machine operated dishwasher. At ward level, the domestic assistant is responsible for patient beverage service but nurses and patients may become involved in this. In the old hospital wards the service varies from ward to ward. Generally, the domestic assistant is responsible for the service although in many wards patients have free access to the ward kitchens and make beverages at their own discretion. Nurses often supervise activities, which patients undertake in the ward kitchens and so they may become involved in this service. Patients are sometimes remunerated for helping in chores such as the beverage service and it may also form an important part of an individual's rehabilitation. The domestic assistant on the wards will clean dirty crockery and cutlery after beverage service through a machine operated dishwasher. Although most hospitals have a budget allocation which allows patients to have seven beverages per day it seems unlikely that there is enough control over the system in certain parts of the hospital to allow this to happen. In some cases patients are told to treat the ward as their home so restricting the amount of drinks they are allowed is an action which can be seen to contradict the "open-house" policy.

2.1.1.6 ***Ward Kitchens***

In the old part of the hospital each ward has its own ward kitchen. The domestic assistant is responsible for maintaining hygiene standards although it is a nursing responsibility to order the necessary provisions. Patients often come into ward kitchen to make beverages and snacks and to wash up crockery and cutlery. This will usually be supervised by a nurse or domestic assistant. Generally, the ward kitchens in the old part of the hospital are quite large and well equipped. Some of the ward kitchens have been recently refurbished. In general, these wards are equipped with: beverage making equipment; milk dispenser; waste disposal chutes for disposal of food waste; refrigerator; cooker; sink; storage space; microwave oven; dish washer and wash hand basin. In the new phase 1 wards all wards have small internal room ward kitchens which are of similar design and layout. Generally, these are equipped with: cooker; refrigerator; sink; wash hand basin; microwave oven and storage space. These ward kitchens are mainly used for making visitors tea and any beverages, which are required by patients outwith the main ward pantry operational hours. The domestic assistant is responsible for maintaining food hygiene standards here.

The phase 1 wards are linked closely to the two large phase 1 ward pantries which is where all main meal and beverage service takes place. In these two ward pantries it is the responsibility of the domestic assistant to order the necessary provisions for the wards under his/her charge. In the pantries, toast, sandwiches and beverages are prepared and a large dish washer is used to clean all the dirty crockery and cutlery from the wards. The pantries are equipped with: a grill; refrigerator; dishwasher; hand basin; and cooker. Some of this equipment does appear to be obsolete, probably due to the fact that these ward pantries were initially designed on the presumption that they would serve as regeneration kitchens for a cook-chill or cook-freeze type service. The day hospital on the ground floor is serviced by the large kitchen pantry on the ground floor. Food is provided for patients at lunch and afternoon tea time only. In the day hospital there are training kitchens which are set up like domestic kitchens. These are mainly used for therapeutic and rehabilitative purposes by Occupational Therapists. One of these kitchens has never been used and is being utilised as a storage area.

2.1.1.7 *Ward Level Dining Facilities*

Throughout all wards on the hospital site there are facilities at ward level for patients to come together in a communal dining environment. In each ward there is a clearly delineated dining area for patients. It is usually at some location in the dining area where food trolleys are plugged in to keep food hot and where food is served on to plates by the nurses and/or domestic staff. Depending on the ward, patients may also assist in food service.

2.2 Retrospective Project A : Overview

After construction and commissioning of phase 1, food services provision became split between two buildings. Phase 1 of the new development contains the main catering department, which provides meals for all patients in phase 1 and Hospital 4. The catering department also houses a dining room which provides meals for all staff from the phase 1, Hospital 4 and Hospital South Block sites and for visitors. On the ground floor of the phase 1 building there is also a coffee shop, which provides beverages and snacks for staff, patients and visitors. Various vending machines are located within the different buildings for patient, staff and visitor use.

The catering department in phase 1 has been operational since November 1990 providing meals for patients and staff. Approximately 600 meals are served each day from the phase 1 kitchen. Meals for the dining room are prepared conventionally in the phase 1 kitchen but patient meals are produced by a cook-chill system.

As far as the staff system is concerned a mixture of raw, semi-processed and fully processed foods are purchased. According to the state of the food, and the menu requirements, these foods are then prepared for cooking. After cooking the food is then kept hot on a servery system and then plated up to dining room customers according to demand.

In the phase 1 kitchen, patient meal provision operates on a very different system. Food is actually purchased from a commercial supplier of cook-chill foods in the chilled state. Meals are transported to the hospital kitchen from the commercial supplier and held in the chilled state in a chiller in the phase 1 kitchen until they are ready to be consumed. On the day of consumption the chilled food is loaded into regeneration trolleys where it is regenerated (re-heated) centrally in the main kitchen. Other patient menu items are prepared and cooked conventionally within the main kitchen. Once these regeneration trolleys have been transported to the wards they are plugged in at ward level in the phase

1 and Hospital 4 wards to keep the food hot. Catering and domestic staff portion and serve the food at ward level to the patients. Patient meals in the South Block building of Hospital 1 are procured by exactly the same method.

Food for patients in the South Block of Hospital 1 is provided from a kitchen in the nurses' home building of this hospital. Patient meals produced in this kitchen are procured by the same method as patient meals in the phase 1 kitchen. This kitchen only provides food for patient consumption.

2.2.1 The Patient Meal System in the Phase 1 Building

2.2.1.1 *Menus*

The hospital runs on a 3 week cycle menu. At breakfast the patient fills in a menu form to choose that day's supper and the next day's breakfast and lunch. Once completed, the menu forms are sent down to the Catering Department where they are scrutinised by the dietitian. The dietitian may add items from an additional menu onto the patient menu forms. These menus are generally only scanned through and the dietitian is mainly concerned with those patients on special diets. Menus are scrutinised in this way from Tuesday to Saturday lunch but are not scrutinised from Saturday supper to Monday lunch. The menus are then forwarded to a catering clerk for collating.

2.2.1.2 *Meal Preparation*

Some food items are prepared in the diet kitchen but all other main meals are produced in the patient service area of the kitchen. Kitchen staff load up the regeneration trolleys with the cook-chill food prior to service and this is regenerated. Other items, such as custard, are prepared conventionally in the kitchen and are put inside the regeneration trolley only when the cook-chill food has been fully regenerated and ready to go to the wards. Prior to service, a member of the kitchen staff loads up another trolley with: trays; cutlery; crockery; napkins; condiments; and other sundry items which are necessary for food service and this is taken up to the ward. This trolley will also contain other special items from the diet kitchen, e.g. special supplementary drinks for patients etc.

2.2.1.3 *Transportation and Distribution*

The regeneration trolleys are manually taken up to the wards by a member of the food service staff. Wards in the phase 1 building are located on upper levels, the kitchen being in the basement. In each of the phase 1 wards the regeneration trolley is plugged in at ward level to maintain the temperature of the food. This is in the patient day/dining area. Generally, patients are encouraged to dine in this area and patients who assemble for their meals here, are served first. Patients who stay by their bedside are served last. The food in the regeneration trolley is portioned out according to what the patient has written on their menu form.

Domestic staff at ward level assist the catering staff in serving food. Meals for patients, who stay at their bedside to eat, are loaded onto a trolley (no heating or cooling mechanism) by a member of the domestic staff. Once the trolley is full of trays with patient meals the staff member will wheel the trolley around the ward matching up the right meal to the right patient. This continues until all the patients have been served. All courses are served together and presented to the patient on a tray.

2.2.1.4 *Removal of Trolley and Dirty Crockery and Cutlery from the Ward*

Once service is complete the trolley is unplugged and all the dirty cutlery and crockery is cleared away and taken to the main kitchen for cleaning in a central dish washer. The food trolley is taken back down to the ward where it is cleaned and prepared for the next meal time. Meals are served at 8am, 12pm, and 5pm.

2.2.1.5 *Beverage Service*

Domestic staff serve the beverages on the wards. Patients are allocated a maximum of seven beverages per day. A member of the domestic staff will tour the ward at set times during the day serving the patients beverages. These beverages are made up from a disposable-cup beverage vending machine.

2.2.1.6 *Ward Kitchens*

Wards in the phase 1 building all have ward kitchens but they are not large enough to accommodate the ward trolleys except for the children's ward. These ward kitchens have cupboard and worktop space along with a sink for dish wash and a basin for hand wash. There is also a microwave oven and a fridge freezer. The children's ward has more space and is better equipped because often children do not eat at set meal times and so provision has been made for items to be heated up outside normal service times.

2.2.1.7 *The Children's Ward*

On the children's ward it is the domestic assistant who serves the food to the patients. There is no beverage vending machine for patients on the children's ward. These patients do not tend to take much tea or coffee but a milk dispenser in the ward kitchen provides milk as the main beverage for children. The ward kitchens are all internal rooms except for the children's ward kitchen, which does have a window.

2.2.2 The Patient Meal System in Hospital 1 South Block Building

In the South Block building a similar system operates but with slight differences. There are three wards for which food is provided. These wards are at different levels, the kitchen is located on the ground floor. The patient menu system is the same as per the phase 1 building except for the ward on the upper-most storey.

2.2.2.1 *Ward on Uppermost Storey*

Patients on this ward are, generally, only admitted for the day, or a very short length of time. Usually, they have quite intensive diagnostic and treatment regimes and are often not on the ward at the same time. On this ward the procedure for ordering meals is that the staff member in charge informs the kitchen of how many patients will be on the ward for a particular day. At each meal time the catering department then sends up a selection of menu items to provide meals for all patients on the ward. Meal times on this ward tend to be more flexible: on the day of service the staff member in charge of the ward will telephone the South Block kitchen and specify the time which the food regeneration trolley should be sent up to the ward. Food in this case is, therefore, regenerated at ward and not kitchen level.

2.2.2.2 *Ward Level Dining Facilities*

The ward occupying the uppermost storey is the only ward in the South Block which has specific day/dining facilities. However, the plug-in point for this trolley is in a corridor adjacent to the day/dining room. In the other two South Block wards there are various day rooms but none of these are suitably equipped as dining areas.

2.2.2.3 *Food Distribution*

In the ward on the uppermost storey, patients select their food from the trolley, which is served by a member of the catering department of the South Block kitchen. In effect, this is a cafeteria type system whereby patients are "first-come-first-served". The regeneration trolley is taken off the ward after a certain time period (there are strict limits determining how long cook-chill regenerated food can be kept hot) so patients arriving late after treatment may miss meals. In the other two wards in the South Block building the food trolleys are plugged in at a point along the ward corridor. Catering staff from the South Block kitchen serve the food assisted by domestic staff.

2.2.2.4 *Removal of Trolley and Dirty Crockery and Cutlery from the Ward*

The food regeneration trolley, and trolley containing dirty dishes and cutlery etc. are taken back down to the South Block kitchen. There is a central dish washer here for cleaning crockery and cutlery and the regeneration trolleys are cleaned and prepared for the next meal time. Transport of all food trolleys to and from the wards is carried out by the kitchen staff of the phase 1 and South Block kitchens.

2.2.2.5 *Ward Kitchens*

All the wards in the South Block building have ward kitchens but they are not large enough to accommodate the regeneration trolleys. In the ward kitchens there is cupboard and worktop space, a sink for dish wash and a basin for hand wash. There is also a microwave oven and a fridge freezer.

2.2.2.6 *Beverage Service*

The beverage service in the South Block building is the same as the service provided in the phase 1 building.

2.2.2.7 *Service Out of Hours*

Patients on any ward, who arrive after the regeneration trolley has been removed, are allowed a hot meal in the phase 1 dining room if food is still being served. Otherwise the patient will be offered a sandwich and a piece of fruit.

2.3 Retrospective Project B : Overview

The new catering department has been operational since November 1990. The department provides a service to all patients, visitors and staff on the district general hospital site. Food is also provided for in-patients at another hospital located in the district, whose kitchens had been closed at the end of 1988. The department caters for approximately 450 patients and 250 staff.

All patient meals are cooked conventionally from a variety of raw, semi-processed and fully processed foods. Once the food is cooked, the food is placed in bains-marie beside the plated meal conveyor belt in preparation for meal plating. Food is then plated, put into heated trolleys and transported to the wards by hospital porters. At ward level domestic staff and nursing staff are involved in service, with nursing staff maintaining overall responsibility for patient feeding.

Some of the health care of the elderly wards have maintained a bulk service because it is better able to meet the needs of patients and staff on these wards. In these cases food is not plated in the catering department. Instead, the wards' meal requirements are placed in bulk into a heated trolley and taken to the wards by porters. At ward level the food is plated by nursing and domestic assistants.

In the mental illness unit, a servery system similar to the one operated in the staff/visitors' restaurant operates. The food is cooked in the new catering department and transported by hospital porters to the mental illness unit dining room. Patients do not complete menu cards but nursing staff order adequate quantities to cover all patients' requirements.

For staff and visitor food service a mixture of raw, semi-processed and fully processed foods are purchased. According to the state of the food and the menu requirements, these foods are then prepared for cooking. After cooking the food is kept hot on a servery system and plated to dining room customers according to demand. The cooking of staff/visitor restaurant food in batches ensures that the servery is continuously supplied with freshly cooked food.

2.3.1 The Patient Meal System

2.3.1.1 *Menus*

The menus at Project B are designed to meet the nutritional and dietary needs of patients in a variety of different physiological states. The hospital operates on a 21 day cycle menu. Between 3pm and 7pm a clerk from the catering department tours the wards issuing blank menu cards and collecting completed ones from patients. These cards relate to the following day's meal information. All cards are returned to the department by about 7pm in the evening. In addition to providing meal information, patients also have to indicate their name, ward and bed location to assist ward staff in matching up meals with patients.

On the day of service, between 8am and 9am, two clerks from the catering department telephone each ward to confirm the menus that have been returned are correct. Any adjustments can be made. For example, if two patients have been discharged then their meals will still be sent to the ward. Any new admissions would then receive this food. The clerks also prepare menu cards for any new patients and any special dietary needs would have to be taken into account. The main problem with new admissions is that completion of menu cards is not seen as a priority, often it is too late to ask the patient what they would like to eat and so the catering clerks have to fill in a menu card for the patient. Consequently, this means that until the patient starts completing their own menu card they may well receive meals, which they do not like.

2.3.1.2 *Meal Preparation*

The menu information is collated by 10am for meal production staff. A production profile for dishes can be built up based upon previous production uptake so the catering department has a very good idea of what demand for certain items will be like. This makes ordering food items from suppliers much more accurate.

A variety of fresh and semi-processed foods are cooked conventionally for both staff and patient consumption. Once food for patient consumption has been cooked it is placed in bains-marie on the meal plating line to keep it hot. At 11am the plating up process commences for the lunch time menu. Food is portioned onto plates according to what the patient requested on the menu card. The plates are put into heated trolleys. Almost all the wards in the hospital receive a plated meals service. The exceptions are: the hostels; mental illness unit; children's ward; health care of the elderly day hospital; and some of the health care of the elderly wards. These wards run on a bulk service. Meals are delivered to the wards in bulk in a trolley and nursing and domestic staff plate up the food on the wards for patient consumption. The mental illness unit dining room offers options on the menu and runs on a first-come-first-served basis. The meal plating process is usually finished by about 11.45am.

2.3.1.3 *Transportation and Distribution*

Porters collect the meal trolleys for delivery. Food being distributed on the hospital site is distributed via an electric tug. Food going off site, (to a ward in another nearby hospital, whose kitchens were closed at the end of 1988) is delivered in a van with a tail lift. By about 12pm the food trolleys are on the wards and are plugged in to keep food hot during service.

Trolleys are usually plugged in at some point on the ward corridor. On the wards, food service is carried out by either nursing or domestic staff, although at ward level it is a nursing responsibility to ensure that patients are fed accordingly. The domestic staff are actually trained in food service techniques. Meals from the trolleys are put onto trays with appropriate cutlery, condiments and a napkin and given to the patient. The individual menu cards accompany the food trolley so that domestic and nursing staff can deliver the right food to the right patient and the patient can check that what was ordered is what they received. A master menu card is also sent up with the trolley as a further check for ward staff. This allows ward staff to check the card against the number of meals/portions in the hot food trolleys. Meals are served with different courses arriving one after the other, with the patient given enough time to eat one course before moving on to another, i.e. the starter, entree and dessert do not arrive on one tray all at the same time.

2.3.1.4 ***Removal of Trolley and Dirty Crockery and Cutlery from the Ward***

Domestic staff clear away all the dirty plates and crockery and trays etc. from the wards. By about 1pm the food trolleys have been returned by the porters for cleansing in the central dish washing area in the kitchen.

2.3.1.5 ***Lunch and Breakfast Service***

By 11am confirmation of the supper meal is organised. A plating and distribution procedure similar to that for lunch, is carried out for supper. For supper, meal plating starts in the kitchen at about 4pm and is usually finished by about 4.45pm. Trolleys are taken to the wards by the portering staff and ward service begins at about 5pm. Porters return dirty trolleys, crockery and cutlery etc. to the kitchen.

Breakfast items e.g. fruit, juice, bread, jams and marmalade are delivered to the wards with the supper meal. Timing of breakfast service varies from ward to ward but is usually served between 7am and 9am. Service is carried out in the ward pantries. A cooked breakfast for patients can be provided from the main kitchen on request, for very ill patients.

2.3.1.6 ***Beverage Service***

Beverage service varies from ward to ward. The surgical wards all use a beverage vending machine is used for procurement of drinks. On the maternity ward, this machine is plugged in for use 24 hours a day and patients help themselves. On this ward, fathers are also offered a drink. On the other wards, where this service is in operation, the machine is switched on seven times during the day to provide patients with their allocated seven beverages per day. On these wards, the domestic staff ask patients what they would like to drink and then make take the appropriate beverage from the vending machine.

The vending machines are not intended for staff use although the system is sometimes abused by staff. On remaining wards, beverages are prepared in the ward pantries by traditional means, i.e. teapot. Different wards have their own standard times for beverage service; this is between 7am and 10pm. Beverages are served: early morning; breakfast; mid-morning; lunch; mid-afternoon; supper; and night time. The domestic staff make all the drinks on the ward; this is their responsibility.

2.3.1.7 *Ward Level Dining Facilities*

In the new part of the hospital, phases 1 and 2, there is a day room at ward level where patients may eat their meals sitting down at a table. Patients also have the choice of eating their meals in bed, which is what the majority of patients in this hospital tend to do. The old hutted wards of the hospital house the elderly patients and all these patients eat at their bedside.

2.3.1.8 *Ward Kitchens*

Ward kitchens in phases 1 and 2 of the new hospital development are extremely compact. Ward kitchens are equipped with the usual domestic appliances: refrigerator; cooker etc. plus cupboard; sink; and wash hand basin.

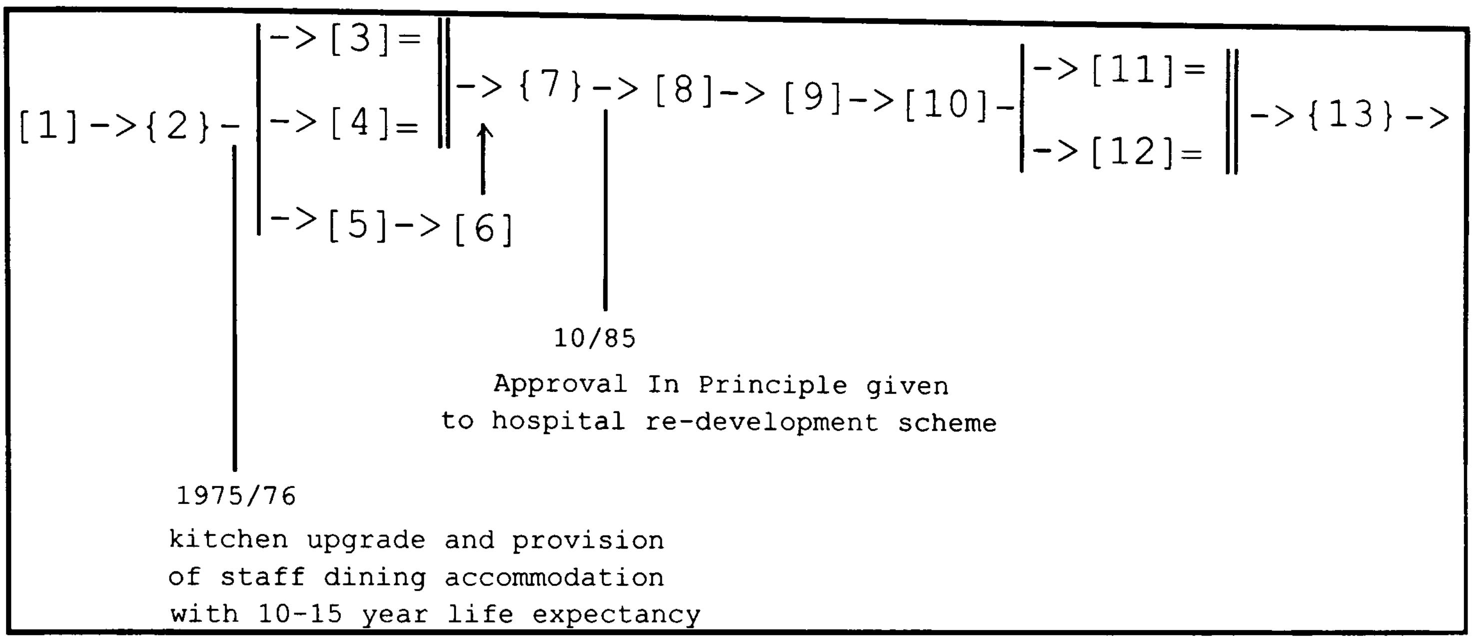
APPENDIX 3

Evolution of the Relationship Between Building Design And Operational Planning/Policy During Food Services Development for all Projects

APPENDIX 3
Evolution of the Relationship Between Building Design And Operational Planning/Policy During Food Services Development for all Projects

3.1 Longitudinal Project

Figure 3.1 Precedence Diagram for Longitudinal Project C



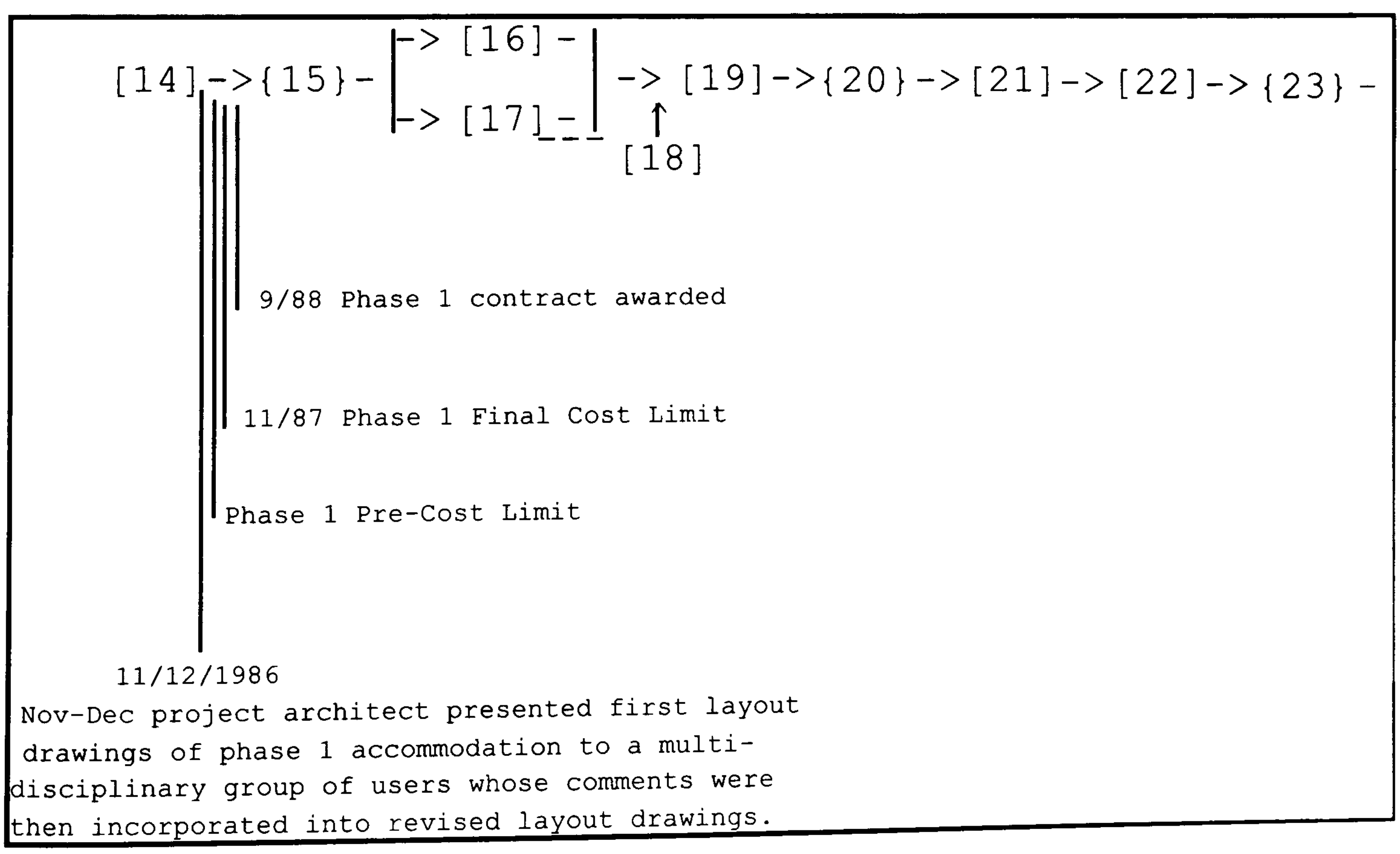


Figure 3.1 Precedence Diagram for Longitudinal Project C

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-> [24] -
          -> [26] -> [27] -> {28} -> [29] -> {30} ->
-> [25] -                                    |
                                         27/5/91
                                 Phase 1 contractor takes possession
                                 of new kitchen site
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              Phase 1 opens        Phase 1A new kitchen goes into use
                  8/91                          10/10/92
                   |                               |
[31]->[32]->[33]->[34]->[35]->{36}->[37]
                                |    |
                             29/5/92 |
               Staff training programmes
               being arranged        |
                                  12/6/92
              Practical completion of works on new kitchen
```

3.1.1 Stage 1 [1]-{2} Inception

The earliest planning data located in client project files, which related to food services planning, was a decision made by the North Eastern Regional Hospital Board in 1972: a trayed meal service was to be provided for patients in the new hospital who required it and it was anticipated that the future design of the kitchen would be influenced by the use of pre-cooked frozen foods.

3.1.2 Stage 2 [3]-{7} Feasibility

Almost ten years later in January 1981, an architect's report on the existing recreation hall and kitchen and staff dining area indicated that since the dining room was a recent addition (1975/76) and was in good condition, it's early replacement in the re-development scheme should not be envisaged. Similarly, the kitchen had been upgraded in 1975/76 with a life expectancy of 10-15 years. Therefore, at this stage, planning for a replacement catering system was not a priority. Although major re-development of the catering system was not considered likely until later phases, the planning team did foresee that short term adjustments and ongoing improvements and maintenance to the existing system would be necessary. The kitchen was, therefore, deleted from the brief. There was a clear policy for patients to eat in the day/dining area of wards but provision was being made for a cafeteria for patients and visitors to use to be located near the phase 1 concourse. In these early planning stages the long term predictions estimated a requirement for some 1,250 main meals. It was agreed that food would be prepared in bulk in the main kitchen and taken to the various units, including the cafeteria, for serving. The earlier planning concept of a centrally organised plated meals service was not seen as being practicable or desirable for the development. It seemed likely that not all the hospital units would be capable of connection by corridor so food would have to travel outside. Impending EEC regulations were placing much more rigorous demands on the arrangements and conditions under which food was prepared and delivered. It was considered that continuation of the bulk delivery and service system would allow food to be served according to the needs of patients and staff in the different units. The plated meals system did receive support from the Divisional Nursing Officer as this system was seen to save nursing time at ward level.

There was also a clear policy not to over-centralise dish washing facilities which lead to the incorporation of a servery of $16m^2$ for each 30 bed ward section. This was a higher provision than had been outlined but took account of the need for crockery wash facilities and trolley parking. The Common Services Agency (CSA) Catering Adviser had agreed to this servery size in other developments so the space allocation was considered to be justified. It was agreed that where it was possible to have more centralised crockery wash facilities the associated serveries could be more limited in size. The CSA Catering Adviser prepared an outline schedule of catering accommodation on this basis although it was envisaged that the schedules would probably require adjustment at a later date. These schedules were incorporated into the submission to the SHHD. Approval In Principle for the three phased development was granted by the SHHD at the end of 1985.

The desire to maintain the catering service from the old kitchen meant that the architect had to examine the effect of this accommodation retention on the overall site development. Despite the fact that retention of this accommodation sterilised a large part of the site for re-development, a decision was made to retain the existing kitchen and staff dining room to serve the new scheme's catering requirements, at least until the later phases of development.

3.1.3 Stage 3 [8]-{13} Sketch Design

By July 1984 the planning team was still convinced that the existing kitchen would be retained at least in the first phase of the re-development. However, in order to prepare the Development Control Plan, the Project Team had to take account of the fact that the kitchen would be replaced at some future date. At the request of the Health Board, the

Project Architect earmarked an area of the site which would be capable of taking a future kitchen complex. For costing purposes, no costs were identified at the time so the preliminary cost estimates indicated no provision against catering services. No money was included in any phase for work to the kitchen.

A revision of the 1981 catering services schedule indicated that a staff dining area would also be provided in the phase 1 accommodation, adjacent to the patient/visitor cafeteria. Apart from this change, there were no other changes to the phase 1 catering accommodation. Thirty bed ward sections still had a pantry and a servery with crockery wash facilities. The 54 bed acutely disturbed and back up accommodation had a crockery wash/servery area of $16m^2$. The 40 place psychogeriatric day hospital had a $16m^2$ servery and the 120 place psychiatric day hospital had a $40m^2$ servery.

In February 1986, the Project Architect confirmed that the building which housed the kitchen and staff dining accommodation could be retained without adversely affecting the proposed new buildings. It was envisaged that any major kitchen/staff dining development would take place within existing accommodation and in the latter stages of the development, i.e. in approximately nine years time (1995). In 1986 the Planning Core Group began to review and develop the hospital policies, concentrating on phase 1, which had previously been agreed in 1981 and revised in 1984. As regards the catering policy, advice was sought from the CSA Catering Adviser in view of possible changes and/or developments in catering practice since the policy was first formulated. At about this time, the Health Board began a review of catering services. This was prompted by the increasing importance being placed on the promotion and enhancement of catering services. Developments in catering technology also urged the Health Board to look for a more uniform approach to catering throughout its units. A cook-chill strategy seemed to be the direction in which the Health Board was going.

Review of the catering policy with the Core Group, CSA Catering Adviser and Board Catering Adviser led to investigations into the provision of a cook-chill type of catering system, as opposed to the conventional bulk method which the brief proposed. Ward based regeneration of the cook-chill food was considered to be best for the patient as this minimised the transportation of hot food. However, the planners envisaged that this would be more expensive than more centralised regeneration. Several regeneration options were investigated.

By May 1986, the basis of a cook-chill catering system had become much clearer. At this time the catering policy could be outlined by the following.

(1) The catering service for the whole hospital was to be provided by a cook-chill system based at the hospital or a central production unit elsewhere. Meals were to be prepared in bulk quantities of approximately 10 meals, chilled and stored then dispatched once daily to the regeneration points around the hospital. Delivery was to be by portering staff using internal transport vehicles;

(2) Regeneration was to take place in regeneration ovens at ward block level. When the costs of cook-chill were identified, the Project Team decided it was too expensive to regenerate in every ward kitchen. The $16m^2$ standard ward serveries serving each 30 bed ward section were originally based on traditional guidelines by the CSA Catering Adviser. However, these were considered inadequate for the envisaged cook-chill service and were replaced with a $60m^2$ kitchen serving a 3 x 30 bed ward block. This meant there was one large ward pantry on the ground and the first floor of the phase 1 buildings serving the 3 x 30 bed ward sections. The ground floor servery was also to serve the regeneration and dish washing requirements of the psychogeriatric day hospital located on the ground floor. The individual ward serveries were then deleted from the brief and replaced by a very small ward kitchen. It was envisaged that the regenerated food would be transported by mobile counter service to the nearby ward/day hospital dining rooms where it would be plated according to individual requirements. Regeneration of food for patients in the phase 1 day hospital and washing of crockery and cutlery from this day hospital was to be carried out in the ground floor ward block kitchen serving the 3 x 30 bed psycho geriatric wards on the ground floor;

(3) The staff dining room as well as the cafeteria for use by patients and visitors, was to be located in the concourse. These facilities were to be served by common regeneration and dish washing equipment. Since it was considered more economical for the staff and patient dining areas to share regeneration and wash up facilities, the staff dining area in the existing old accommodation was obsolete. The night and weekend staff were to be provided with a vending machine service;

(4) Like regeneration, dish washing was to take place at ward or ward block level. Beverages were to be prepared at ward block kitchen level although it was

recognised that the ward kitchens would have to be equipped for an out-of-hours service and for patients to prepare their own food if this was appropriate. As far as possible, disposal of food waste was to be by waste disposal units at ward/day hospital level. Any waste not suitable for the units was to be containerised for uplifting by the portering staff.

At this stage, cook-chill was still a planning assumption, therefore, the ward block kitchens were designed so as to enable the adoption of a cook-chill system whilst still remaining suitable for a more traditional system. Additional cost allowances were obtained for phase 1 because of the cook-chill policy, the additional space being required for ward based regeneration. The Regional Health Board was considering the direction of its future catering strategy so until it had made a firm decision, planning of the hospital's catering service continued on the assumption that cook-chill would be the preferred option. Although the city wide cook-chill policy was anticipated, planners still felt the need for duality in the phase 1 ward block kitchens and catering system: this meant that for whichever system was chosen, only small internal changes would have been required to finalise their detailed design and operation. There was no indication where meals were to be produced, although a central production unit seemed the most likely option. The existing kitchen was to continue supplying the old wards and wards in the new accommodation until a new production unit was operational.

3.1.4 Stage 4 [14]-{15} Detail Design

At the end of October 1989, the Catering Strategy Review Group was still deciding on a region wide policy for catering. However, it was becoming increasingly unlikely that the Health Board would adopt a city wide cook-chill policy. The fact that the Health Board was doing an about turn on cook-chill as the preferred catering option for the region had a huge impact on the catering policy at hospital project C. Phase 1 of the development had actually received higher cost allocations since it was anticipated that cook-chill would have been the Board's preferred catering policy; this meant that the operation of an upgraded conventional service from the old kitchen was an increasing possibility.

3.1.5 Stage a2 [16]-{20} Feasibility

The planning team was now in a position where a review of the hospital's catering policy was urgent. A solution to the catering question had to be found: various options appeared to be open. The first option was to upgrade the existing kitchen to provide a conventional service costing around £1m. This brought into question whether the existing equipment ought to be retained or scrapped. The second option was to go ahead with a central production unit allowing for cook-chill or conventional service. A third option was to provide a new kitchen based on a conventional type service as an adjunct to phase 1 at an approximate cost of £1.8m. It was clear that funding of a new kitchen would had to have been funded separately from the other three phases of re-development and that a revised catering policy would emphasise meal finishing : this suggested a plated meals service.

Visits were made to the existing kitchen to determine whether it could be upgraded to provide catering services to the new hospital or whether a replacement kitchen was more appropriate. The existing kitchen was built as part of the main hospital in 1820 and was upgraded in 1975/76 with a life expectancy of approximately 10-15 years. The Catering Services Review carried out in the mid 1980s had already identified that approximately £132,000 had to be spent to bring the kitchen up to an acceptable environmental health standard. Of this, £72,000 had to be spent in 1990 on urgent work. Most of the problems in the kitchen were common to many old kitchens: cracked and broken floor tiles; insufficient drainage; condensation problems and poor decoration. An inspection made by an environmental health officer at the beginning of 1990 indicated that the catering operation was never going to be satisfactory until the main problem of the unacceptable layout and general state of depilitation of the kitchen, and some of the ward kitchens, had been addressed. In particular, there were several problems unique to this hospital kitchen. The layout did not allow for correct work flow, in that deliveries were brought into the kitchen for storage, past cooking areas. No upgrading could have remedied this basic design fault. The design of the kitchen made it difficult to separate areas of cooked food production and preparation from raw food production and preparation. This greatly increased the risks of cross contamination and the possibility of accidental food poisoning. Due to the nature of the building, the fumes and moisture from the cooking processes throughout the kitchen made their way upwards towards a very high ceiling. On the ceiling they collected and condensed creating unsightly stains. They also created a potential hygiene hazard as the condensation dropped back onto the food below. Although plastic guttering was fixed around the edge of the kitchen walls, it was only a partial solution. A much lower false ceiling was required with canopies over the cooking ranges and water boilers. Fluorescent strip lights collected grease from the cooking processes. As the kitchen cooled this solidified, and melted once it had heated up, dripping back onto the cooking ranges. In short, the age and inadequacies of the kitchen meant that constant minor repairs were needed. Although space in the existing kitchen was satisfactory, its division amongst the different kitchen areas also created problems. More space was required to store high risk food and a major upgrading of the dry goods store was required. There was also a risk of contamination by air blowing through the goods entrance door. Cleaning was very difficult and although great efforts were made by the catering and domestic staff to keep the kitchen clean, it was impossible to maintain desired levels of cleanliness.

Moreover, some of the existing equipment in the kitchen was very old and required replacing. In addition, the increasing demands which would have been made on production facilities, which were not geared to meet these demands, would have caused great problems. The equipment problem was compounded by the fact that a large proportion of it operated on steam - boiling pans, tilting kettles, bain-maries and speed cookers. The new boiler was to become operational in the summer of 1990 and this would have meant no steam available on the site. In the short term, the existing boiler was to remain operational, albeit on a much reduced load, to supply those areas of the existing hospital for which no alternative arrangements could be made. However, this would have been a highly inefficient solution which could only have continued for a short time. Replacement of all the steam-fed equipment or provision of an alternative source of steam, e.g. steam generators, would have been essential to provide a catering service from the old kitchen. There were also problems with the electricity supply to the kitchen which was not sufficient to cope with the load. Additionally, the older equipment was less energy efficient than modern equipment : it was estimated that modern equipment, coupled with careful energy management, would result in a reduction of energy costs of approximately 25%. A redundant boiler being kept operational to supply outdated catering equipment was considered to be highly uneconomical.

The existing kitchen was located in a central part of the lower hospital and was the only part briefed to remain when the development was complete despite the fact that retention of the kitchen did sterilise a large part of the site for re-development. Meals would had to have been provided while the upgrading was being carried out and no other hospital in the vicinity could have supplied meals to this hospital. The only alternative was to obtain a temporary mobile kitchen, at great cost.

Thus, the option to upgrade the existing kitchen looked extremely remote. Essentially, the kitchen had outlived its upgraded life before a permanent catering solution for the development had been adopted. The abandonment of the cook-chill strategy demanded an urgent re-think. The planning team moved increasingly towards the development of an entirely new kitchen as an adjunct to the phase 1 building, providing a conventional service rather than cook-chill, at least in the short term. There were considerable advantages to building a new kitchen. If its location were convenient for the bulk of the hospital, the need for upgrading of ward kitchens would have been reduced. Its design would have been appropriate for modern catering; revenue costs would have been lower: and cleaning and hygiene would have been of a higher standard. It was estimated that a new kitchen would have cost approximately £1.5m.

Despite the optimism for a new kitchen there were problems. The changes to the ward kitchen/pantry set up in the mid 1980s created difficulties when planning switched to a more conventional type service. The reduced size of the ward pantry meant that it would not have been possible to prepare toast and beverages etc. there, so most patients' needs would had to have been met from the large $60m^2$ central ward block serveries located on the ground and first floors. The ground floor ward kitchen would be serving 90 patients at breakfast, evening meal and supper and 130 at lunchtime, because the servery still had to provide for the needs of the psychogeriatric day hospital. All ward supplies had to be stored in this central kitchen, which would create problems for monitoring and re-stocking. All crockery and cutlery would have to be moved from the central kitchen to the wards each meal time. Additional equipment was requested in these kitchens because of the change to conventional catering : some of this was group 1 equipment which would add significant costs to the contract: phase 1 was due to open in July/August 1991. At this very late stage in the phase 1 contract it was considered too late to make any changes.

Similar problems were also experienced in the regeneration kitchen serving the staff and patient and visitors' dining rooms in the phase 1 concourse. As a result of the change to conventional catering there was a desire to upgrade the kitchen to more than a finishing kitchen to allow "cook-to-order" meals; again substantial additional equipment was being requested at a very late stage in the contract.

The location of any new kitchen and its relationship and proximity to various parts of the hospital were critical, particularly as no designated space had been allowed. In 1981 the architect earmarked an area of the site capable of taking a kitchen at some future date. However, the need for a new kitchen somewhere on the site was probably disregarded when it seemed likely that a central production unit would be supplying the hospital's meals. The south part of the site was to become very congested once phase 2 had been completed so the possible locations for a new kitchen were very limited. Ideally, the planners wanted the kitchen on the ground floor or, failing this, the bulk provisions store to be on the ground floor. It was thought desirable to have the new kitchen physically connected to the new hospital to reduce the use of transport. The new kitchen also had to be accessible to the main traffic routes to ensure good access for delivery vehicles and for transporting food elsewhere (for income generation). In addition, loading bays and storage areas had to be provided. The kitchen had to be conveniently located for service requirements, and most importantly, it had to be located centrally to allow the highest quality meals to be provided in the shortest possible time. After discussion with Unit representatives and the Project Architect, the best location for the new hospital appeared to be at the end of the concourse between the clinical staff area and the 120 bed dependent long stay unit. The clinical staff area had to be moved slightly to achieve this but no alterations to its design were necessary.

The CSA Catering Adviser provided a draft schedule of accommodation for the proposed new kitchen. This was based on standard guidance contained within Health Building Note 10 (catering departments). This accommodation schedule was discussed with the Project Architect and the Unit Catering Manager. The CSA allocated areas to various activities based on a bulk food distribution system, as the majority of psychiatric hospitals use this system. However, the Catering Strategy Review Group recommended that a plated meal service was the preferred method of catering for large hospitals in the region. A policy decision was urgently required on the means of meal provision. There were basically three alternatives to the meal provision service and these were thoroughly investigated. Firstly, a central tray service. Under this system patients would choose dishes in advance of each meal on menu cards which would be collected in the wards and returned to the catering department. Meals would be assembled in the kitchen using an electrically powered variable speed conveyor belt. Heated bain-maries would be plugged in at intervals along each side of the belt and serving staff would stand between the equipment to serve the food. Sufficient space would be required for the conveyor belt and for service trolleys to pass around the area. Individual trays with each patient's menu card would move along the belt and the staff would add the appropriate items. Each plate would be on a pre-heated base. At the end of the belt the trays would be checked, covered and cutlery added. Each ward's trays would be loaded onto a trolley and dispatched for service to patients. At the end of the meal, trays and their contents would be returned in the trolleys to the central wash up area. The length of conveyor belt and the number of bain-maries would vary according to the number of patients and the choices of meal offered.

A second alternative was a centrally plated meals service. This system would be similar to the central tray service, with meals being plated either with, or without, the use of a conveyor belt. The plates would then be loaded into electrically heated trolleys and transported to the wards. Trays would be assembled in the ward rather than in the kitchen.

The third alternative was a bulk trolley service. This is the traditional method of hospital catering. Bulk quantities of food would be taken in insulated trolleys to the ward where staff would prepare the trays etc. The bulk trolley would either be returned to the kitchen for emptying and cleaning or the food emptied and the containers washed in the ward pantries. If dirty crockery and cutlery were to be washed in the central wash up it would have to be returned to the ward for the next meal.

Proponents of the plated meal service saw a number of advantages. These included provision of the most "non-institutional" approach to hospital catering, allowing patients the opportunity to choose the dishes they would require for each meal from an individual menu. This is seen as the preferred method of catering in most hospitals, where it can be justified by the number of meals to be supplied. Tray trolleys could be parked close together, taken to the assembly area for loading and returned to the bay after being unloaded and cleaned. Bulk service trolleys, however, would each require a socket outlet and would have to be spaced to enable staff to load them. There would be much less wastage than with a bulk delivery system. The bulk trolley system would require more storage space for crockery etc. in ward kitchen or pantries, whereas crockery would be stored centrally with a plated meals service. The ward pantries in phase 1 were very small (only $4m^2$) and the kitchen/wash-up area was to be shared between 3 x 30 bed wards (and the day hospital on the ground floor). Storage space in these kitchens had already been identified as a problem.

The main opposition to the plated meals system was from the Unit Catering Manager. The main reasons against the plated meals system were:

(1) Bulk trolleys would offer greater flexibility in the use of kitchen space, whereas plated meals would tie up valuable space which could be used for other types of catering;

(2) Bulk trolleys would allow greater flexibility in the use of staff. Plated meals would necessitate the use of large numbers of staff during service times;

(3) Bulk delivery would allow for greater flexibility in the timing of meal production;

(4) Bulk catering would hold the temperature of food at an acceptable level for a much longer period of time than plated meals. A successful plated meals system would be dependent on fast collection and delivery of meals to ward level by the portering staff, necessitating an increase in the number of porters required;

(5) The geography and layout of the hospital site would create transportation problems for a plated meals system. Once the new hospital had opened, meals would still have to be transported to the outlying wards. It was probable that the lorries used for transporting the food trolleys would require modification;

(6) There would be greater flexibility of presentation and production with the bulk system. Bulk catering would allow batch cooking of fresh ingredients whereas a plated meals system would not;

(7) If there was a problem during production, it would be easier to change the menu with bulk production than with a plated service;

(8) The hospital provided meals to hostels off-site. A change to plated meals would have incurred expensive modifications to facilitate delivery to these sites;

(9) A plated meals system would be heavily reliant on accurate food ordering which would be difficult to achieve with some of the patients at the hospital;

(10) A successful plated meals system would require a very disciplined regime at ward level. The informal atmosphere of the hospital could create major problems for a controlled plated meals service. The bulk system would allow patients to help themselves to food and to choose what they wanted to eat.

The overall view of the Unit Catering Manager was that although the bulk system was far from perfect, the introduction of a plated meals system would remove the flexibility which was vital to improving the quality of patients' meals. However, others saw the provision of a new kitchen as providing a unique opportunity to introduce modern techniques and methods in line with current catering practice.

Eventually, it was agreed that a plated meals system would be used with a central dish wash but the four satellite wards, and meals going off site, would still require to be bulk delivery. It was clear that the best option was to build a new kitchen on the hospital site so the Health Board approached the SHHD for the necessary capital. The SHHD did allocate money for the new kitchen, although it was part of the total earmarked for phase 3 of the development. £500,000 of it was available in the 1990/91 financial year so the planning team had to act quickly to ensure that the money was not lost. The Project Team decided that new build, rather than re-furbishment, was the best option. To expedite tendering and contractual proceedings the Health Board considered authorising negotiations with the phase 1 contractor regarding an extension to their contract.

3.1.6 Stage a3 [21]-{23} Sketch Design

The Project Architect began work on the detailed sketch design in consultation with the users and the CSA Catering Adviser. Initial schedules produced by the CSA for both a bulk catering and a plated meals service were combined to produce a layout which would provide bulk meals to five of the old wards and centres off-site. A plated meals service was planned for all phase 1 and 2 wards. It was acknowledged that in the short term, the balance between the plated and bulk services would require adjustment.

The areas for dispatch of plated meals and bulk trolleys were kept totally separate. The intention was that porters collecting the bulk trolleys should not have to enter the main production area. Similarly, all bulk trolley containers were to be returned to a separate trolley park and wash area. The whole meal collection, distribution and return system would be kept totally separate from the preparation and production areas.

The main store was strategically placed to allow the store keeper to control all deliveries. Ingredients were to be taken in at one end and the preparation areas fed with raw ingredients, which were prepared and processed ready for cooking. Each preparation area was to be temperature controlled. The prepared ingredients were to be transferred to the cooking area from which the cooked food would be transferred to plates and containers ensuring a linear flow.

Parts of the CSA plans were incorporated in the Project Architect's design but there were modifications to satisfy the users' and environmental health department's requirements. It was considered that natural light in the catering department was very important and this was included in the plans. The chilled areas were banked together for convenience and the dispatch and rubbish areas were located to have minimum impact on neighbouring buildings.

Catering staff access to the kitchen from the main hospital was to be controlled by security cards and electronic timers. The necessary ramping on the neighbouring corridors, to compensate for changes in level of the site, would be kept to a minimum and was to be within acceptable limits for plated meal trolleys. At the beginning of July, the Project Team approved the plans for the new catering department.

3.1.7 Stage a4 [24]-{28} Detail Design

Detailed equipment lists produced by the CSA Catering Adviser were revised and adjusted in conjunction with the Unit Catering Manager and Hospital Catering Manager and passed to the Design Team. Meetings took place to discuss preferred suppliers of the equipment in order to assess the exact service requirements. Room layout drawings were also produced. A revised schedule of accommodation was drawn up based on a different split between bulk and plated meals.

It was decided that the patients who would be in phase 2 from 1995 would be fed with bulk meals until then. This would mean a difference in the balance between plated and bulk meals in the short and longer terms. On the basis of these figures, the areas allocated for the clean and dirty trolley parks, and the detergent store, were increased and a bulk food assembly area was added to the original schedule.

At this stage, it was anticipated that the overall cost for the new kitchen would be presented to the hospital cost control meeting in August and an FCL forwarded to the department soon thereafter. It was reported that some costing difficulties had been encountered during the finalisation of the FCL for the new kitchen so the Design Team was forced to make savings to bring projected costs within allowances.

At the end of 1990, and the beginning of 1991, there was considerable communication between the Health Board and the Scottish Office Management Executive to ensure the proposals for the new kitchen would pass through approvals without any hold ups. Option appraisal cost estimates for capital and revenue were re-examined for each option. Comparison of design costs, between the option of upgrading the existing kitchen and new build, were considerable. The Scottish Office was unwilling to give approval to the new build option because it appeared the more costly option. However, the kitchen upgrade option had been thought out in 1989 when it was considered possible to provide the hospital's meals from other hospitals in the city during the 6-9 month period when upgrading work would have closed the kitchen. This window of opportunity had passed due to various service changes in hospitals throughout the city. Attempts to find a source in the private sector with sufficient capacity to provide meals to the hospital during the kitchen refurbishment period failed, largely because the private sector was fully committed to other sectors. Private companies could not produce a comparable range of meals suitable for patients at a cost comparable with hospital production rates. The Health Board argued that abortion of the new build option would actually increase the total cost of a kitchen upgrade since abortive fees of approximately £200,000 would have been added to the total cost. On the basis of these arguments, the Health Board was able to convince the Scottish Office that, despite the initial additional capital expenditure, the equivalent annual costs for new build versus kitchen upgrade were actually marginally less and that a new kitchen represented the best way forward. Achieving the earliest possible completion date was vital if the Health Board wanted to avoid being in the position of being unable to open the first phase of the development (completion date 22/3/91) and delay the start of phase 2. At the end of March, the Scottish Office approved the AIP and also a FCL cost of £2,506,000 for the provision of a new 1,300 meal kitchen and bulk store.

3.1.8 Stage 5 [29]-{30} Tender

It was agreed that because of the similarity in construction detailing of the building works, the basis of negotiation would be rates contained in the Bills of Quantities for phase 1. The dissimilarity with phase 1 nominated sub-contractors' works for mechanical, electrical and kitchen equipment installations meant that these elements of the works were subjected to competitive tender. The Health Board proceeded to carry out negotiations with the phase 1 contractor to extend the existing phase 1 contract to reduce the pre-contract time scale, thereby allowing the kitchen to be completed at the earliest possible date. Competitive tendering would increase the tendering period by three months: the phase 1 contractor was able to start on site immediately. Successful negotiations with the phase 1 contractor would also have had benefits for phase 1 snagging. The Health Board had a £2.5m delegated procurement limit and proceeded with an immediate acceptance of the negotiated tender which was within the FCL. At the end of May 1991, the tender had been agreed and the phase 1 contractor commenced work on the new kitchen.

3.1.9 Stage 6 [31]-{36} Construction

Formal tender approval from the Scottish Office was delayed because there was an excess of Departmental costs of 3.91% (£50,244). There was a limit to the amount of savings which could be made to offset the level of excess because the Design Team had previously carried out a savings exercise prior to FCL submission. Savings of no more than £13,336 could be effected without serious loss of function to the project. However, elemental comparison of the Departmental costs in the offer and the FCL showed that excess was not attributable to any particular element and was a result of the level of preliminaries spread over the various elements. The Health Board was able to convince the Scottish Office that the negotiated tender offer reflected what would have been expected from the phase 1 contractor had the offer been made in a competitive tendering situation. Formal approval to the tender offer was given by the Scottish Office in mid June 1991.

During the construction period of the new kitchen various design points arose which required clarification. These included moving the height of crash rails upwards to protect the wall in the main corridor because the food trolleys that were to be used for phase 1 were taller than the ones already in use. There was also a query regarding the windows in the new kitchen, whether they were to be sealed or fitted with wiremesh. This aspect had caused a serious problem in the phase 1 staff and visitor and patient dining room finishing kitchen.

The Supplies Division of the CSA was requested to undertake purchasing for the new catering department. The CSA was uncertain as to how the equipment figure (£210,334) for the new kitchen was compiled and the CSA expressed its concern at the fact that the Health Board wished to purchase the equipment within the then current financial year. A meeting between Board catering officers and CSA officers was able to amend the kitchen's original equipment requirements including group 2 items, except for numbers and types of dispensers and meal trolleys for the trayed meals system, this included items such as bowls, bases and covers. Unfortunately, these items accounted for a large proportion of the proposed expenditure, a decision was urgent as the CSA could not confirm that the equipment could be bought within the £210,334 equipment cost limit. The new kitchen had been designed to handle bulk and plated meals but management was still uncertain about spending money on equipment for running a bulk and plated meals service simultaneously. The money had to be spent by March 1992 but managers were still uncertain of the choice in January 1992. There was a desire to have the new wards on a plated meals service but it seemed unlikely because of the amount of staff needed to operate the service was not justified in relation to the number of meals that would be plated.

In May 1992 information was sought on a new type of wall covering which was proposed for use in the kitchen rather than the usual tile finish. Although it was relatively new to kitchen areas, the product had been used in operating theatres because of its ease of cleaning and the manufacturer rather than the contractor applied it. This meant that saving could be made on installation costs.

At the end of May 1992, staff training programmes were being arranged and the bulk of electrical and mechanical commissioning had been completed. On the 12th of May 1992, practical completion of works was achieved.

3.1.10 Stage 7 [37] Commissioning

After Practical Completion, slight modifications were carried out in the kitchen after catering users had visited their new premises and were able to comment on aspects requiring attention. The main areas causing concern were: poor standard of floor tiling, particularly in the cooking area; and poor drainage of water in the trolley wash area. On the 10th of October 1992, the new kitchen was brought into use. Between its opening and the opening of phase 1 in August 1991, meals were still provided from the old kitchen.

3.2 Retrospective Project A

Figure 3.2 Precedence Diagram for Retrospective Project A

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first meeting of the Joint Planning Committee
          |
6/61--31/5/67--[1]->{2}->[3]->{4}->[5]->[6]->{7}
 |
rebuilding scheme proposed

                    9/12/71
               Stage B3 reached

                      7/11/72
               Stage A1 approval

                            7/74
                  Stage A5 approval

                                14/4/75
                       formal B4 submission

     Completion of Stage 3C First Part Scheme Design 31/3/76

                                          8/76
      Termination of planning DHSS concerned over the size
                 of single phase capital projects.
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Figure 3.2 Precedence Diagram for Retrospective Project A

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3/78 Formal Stage A1 submission to DHSS
 |
 |->[8]=                                         |->[14]-
-|      ||->{10}->[11]->[12]->[13]-              |       |->{16}
 |->[9]=                                         |->[15]-
                         7/81
                    Stage 1 approval
                                           23/7/84
                                       Satge 2 approval
                  28/1/80
 termination of planning
 due to re-organisation
 of teaching hospitals
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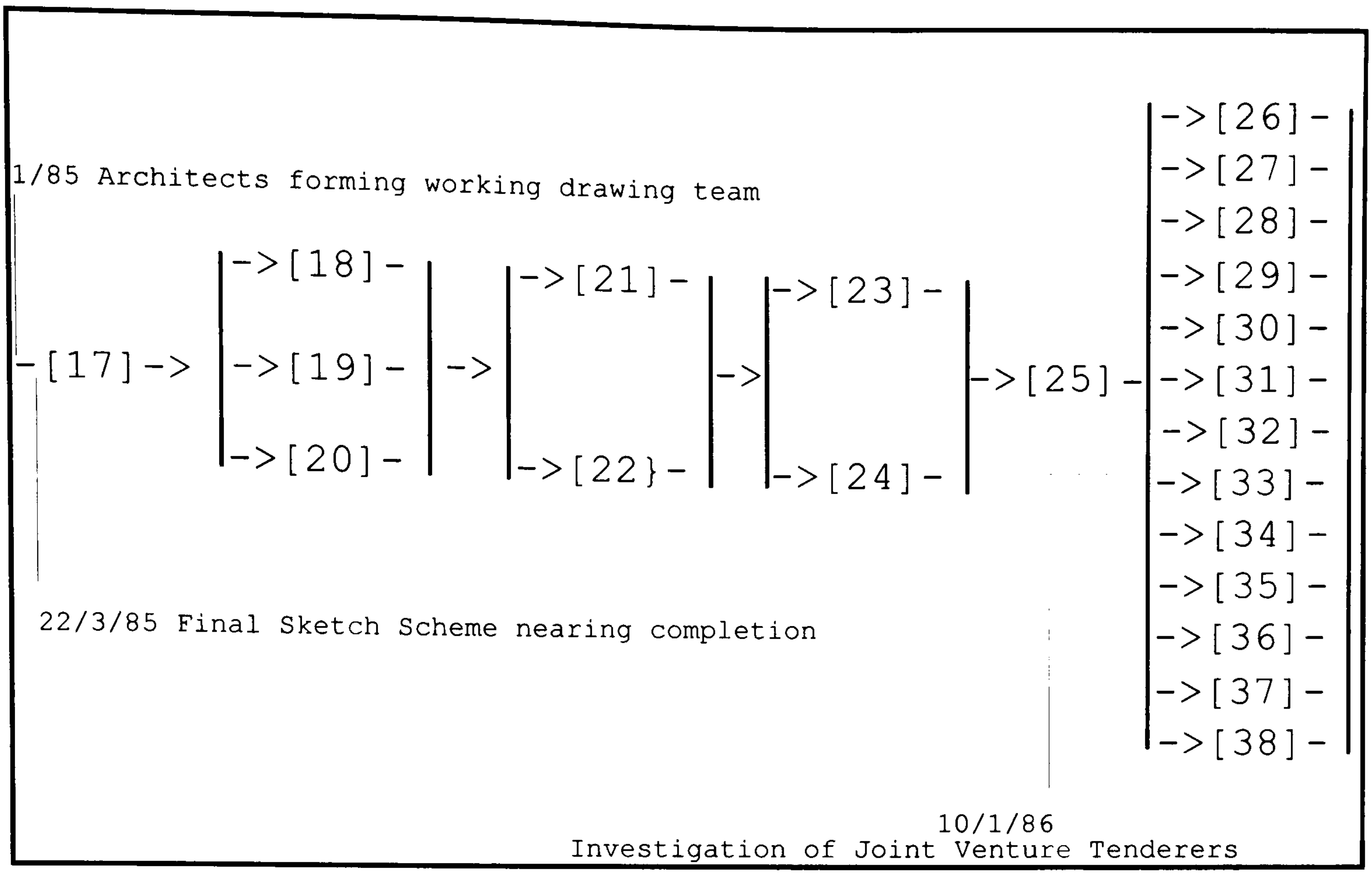
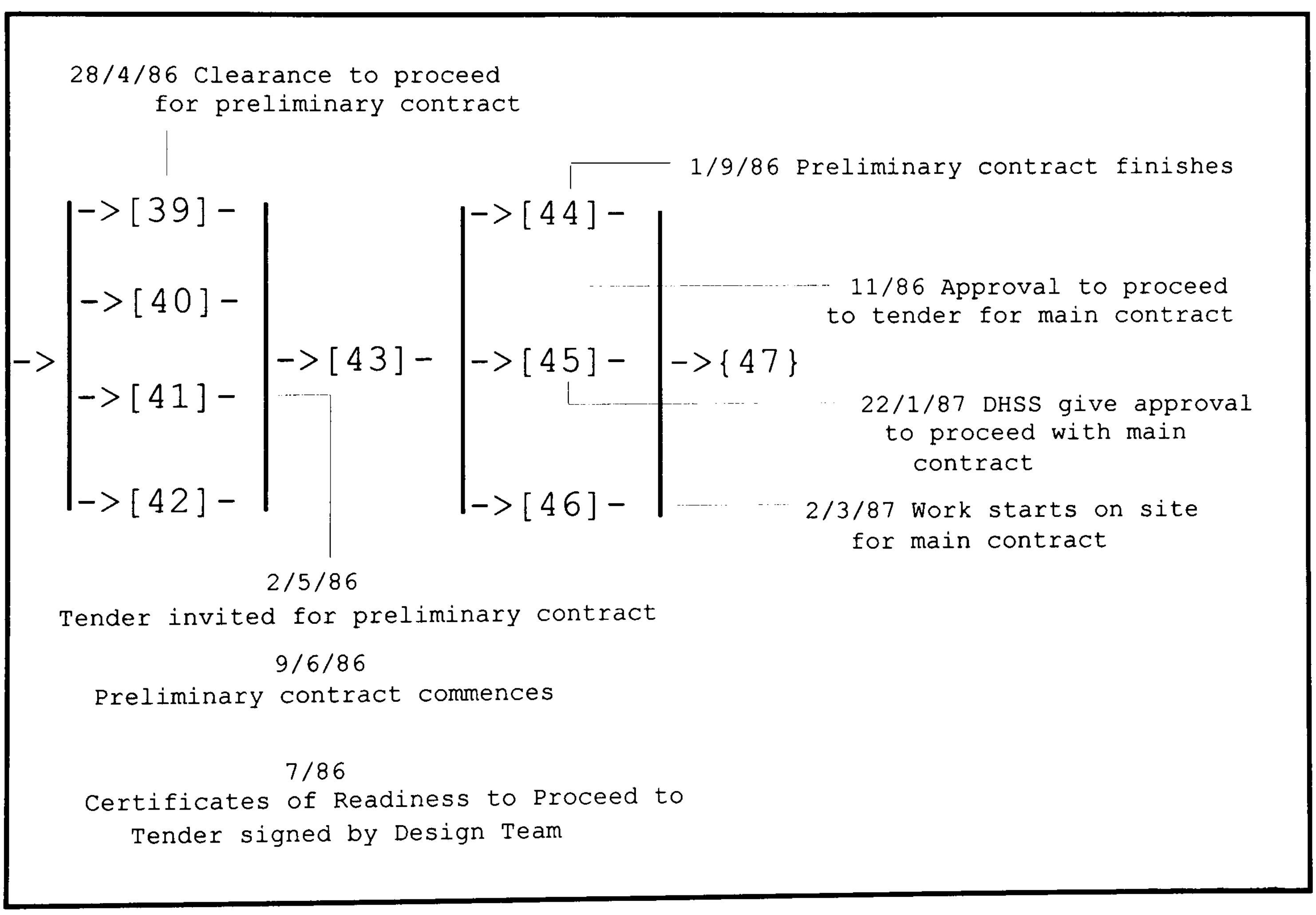


Figure 3.2 Precedence Diagram for Retrospective Project A



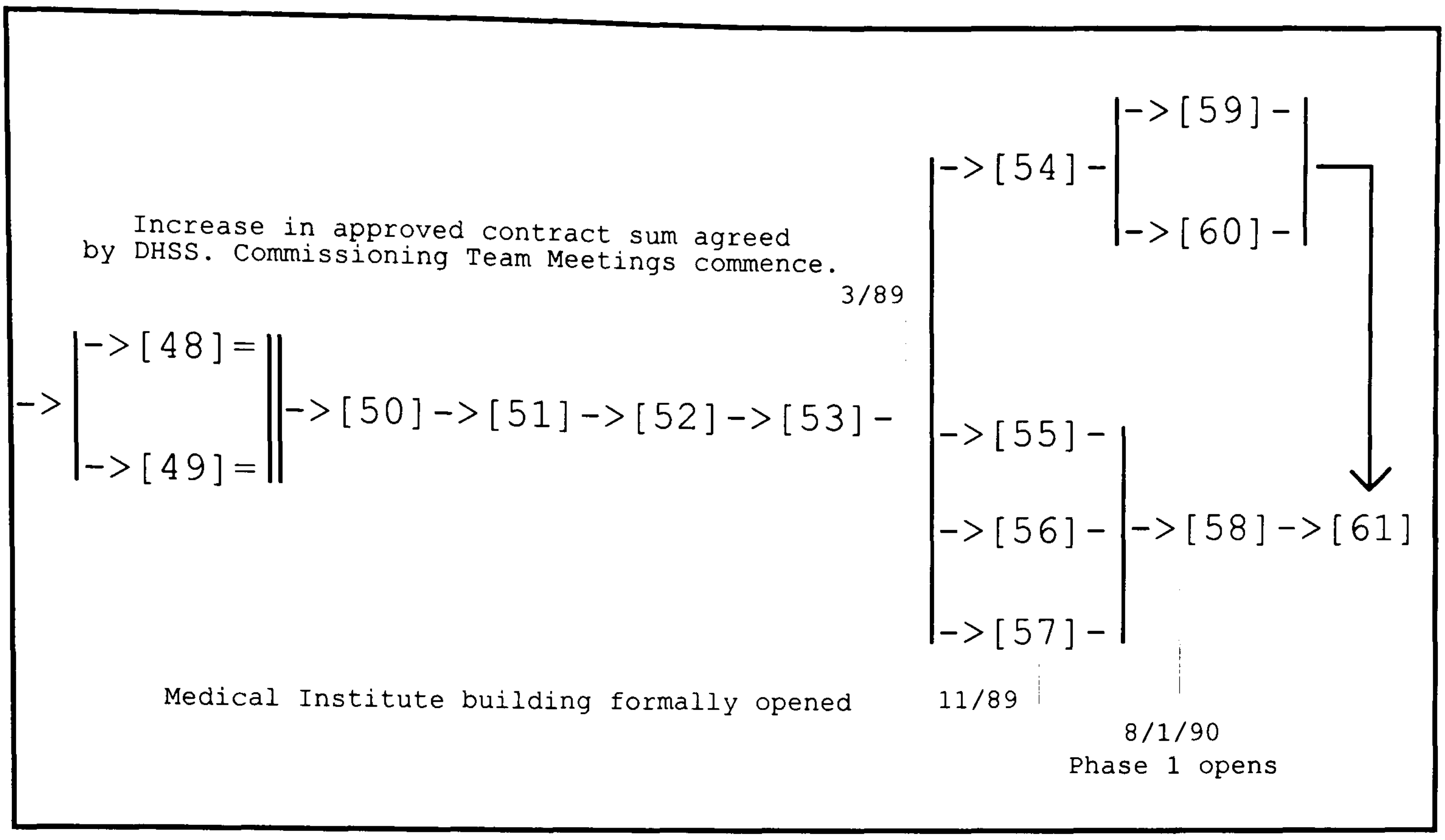
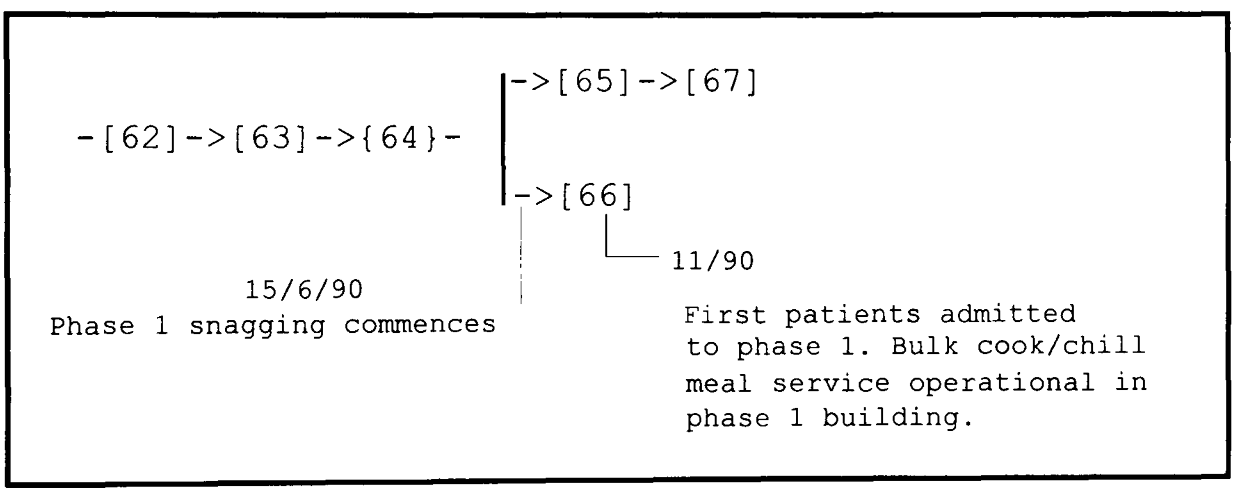


Figure 3.2 Precedence Diagram for Retrospective Project A



3.2.1 Stage 1 [1]-{2} Inception

When real planning for the scheme got underway at the end of the 1960s food services were included as part of the overall re-development, to be located in the new phase 1 building. By mid 1970, the nature of the food service system had been agreed. The catering policy was to some extent dictated by the necessity to save space on the clinical site and reduce to a minimum any "industrial" processes or activities. It was seen as essential that proper cooking and serving arrangements for in-patients were available from the start in the new building. These arrangements had to house the built in capacity to cater for staff needs too since all cooking facilities had to be centralised for economy in staff and plant. Based on these tenets, it was essential that the full sized main kitchen was included in phase 1 of the new development. This resulted in the decision to use commercially available frozen food, thus cutting out all preparation and detailed large scale cooking. The use of frozen food necessitated some form of food reheating/regeneration. It was envisaged that floor kitchens, inside the floor supply centre, would be the location for the end-cooking of meals in microwave ovens before plating and service, on trays, to patients. Similarly, one kitchen for end-cooking staff meals was to be adjacent to the staff dining room. As far as the patients' menu was concerned, it was agreed that ordering would be through an individual choice menu. Based on this policy, the main schedules of accommodation required were for a central kitchen, staff dining room and floor supply kitchens.

In the South Block of Hospital 1, the kitchens and staff dining room were earmarked for refurbishment into nurse training accommodation. This meant that the new central dining area and kitchens in the phase 1 building had to be planned for the additional meals being provided to staff from the South Block of Hospital 1. At this stage there remained the problem of feeding the in-patients left in the South Block of Hospital 1. The planning team decided that it would be preferable to keep phase 1 and the South Block on the same arrangements. Consideration of the problem indicated that the private patients' kitchen in the South Block could be adapted for use as a peripheral end-cooking kitchen for frozen meals. This would incur adaptations and provision of new equipment. At this stage in planning, the idea was to have a central dining room for all staff in the phase 1 building along with a central kitchen for meal production. Regeneration kitchens for the frozen meals would be provided for in the floor areas of the phase 1 building and in the private patients' kitchen of Hospital 1 South Block. This meant that planning the food services sub-system involved new build for the phase 1 kitchen and re-furbishment of the South Block private patients' kitchen to provide a regeneration unit.

Some time between the planning years of the early 1960's and 1984 there was a change in catering policy and planning proceeded on the basis of a conventional service. It was envisaged that phase 1 would still provide for the needs of patients and staff from the phase 1 building. The remaining patients and staff in Hospital 1 North and South Blocks were to be served by an extended kitchen, which at that time served the staff dining room in the nurses' home. At this stage, planning data did not indicate whether this was to be a conventional or cook-chill system. This change in policy may have been concomitant with the changes in user representation in the early planning stages. Lack of data during this period makes it difficult to determine why the original cook-freeze idea was abandoned in favour of a conventional service, especially since the original planning principle for catering was to limit large scale cooking on site, hence the cook-freeze option. Discussions with key project personnel suggested that the original cook-freeze decision was only short lived.

3.2.2 Stage 2 [3]-{4} Feasibility, Stage 3 [5]-{7} Sketch Design, Stage a2 [8]-{10} Feasibility

In 1975 sketch plans had been prepared for the catering component of phase 1. The Group Chief Dietitian and two catering user representatives viewed the sketch plans. All expressed their concerns about the large amount of internal planning of the kitchen area. More daylight could have been provided but the effects of this would have been lost when the ventilation plant was installed over the cooling area. This had to be at a fairly low level (approximately 2 feet off the ground) in order to be effective.

In 1978 two options for schedules of catering accommodation existed, these were dependent on the acquisition of Hospital 4 for use in the re-development scheme. At the end of the 1970's the detail design of the catering sub-system was being worked out. Information was being generated in order that this component of phase 1 could be incorporated into an outline sketch scheme. By the end of 1984, the location of the dining facilities, central kitchen and dining room layout were agreed. Planning related to staffing requirements and equipment fuel requirements had also been considered. More detailed equipment planning proceeded.

3.2.3 Stage a3 [11]-{16} Sketch Design

In March 1985, there was a further change in food service planning. The conventional service, which was being planned was in danger of being usurped by a cook-chill method of food procurement. At this juncture the Mechanical and Electrical Consulting Engineers were pressing the client for a firm decision on catering policy. The client had not yet reached a firm decision on catering policy although considerable detailed design work had already been carried out with regard to planning a conventional service. The engineers realised that a change from conventional to a cook-chill based system would have fundamental effects on the engineering services for the phase 1 kitchen. In April of 1985 information was indeed being sought from the Group Catering Manager on the implications of installing a cook-chill system in the phase 1 kitchen. Work began on modifying existing plans for catering services. In particular, the client requested the Design Team to work on the conversion of the pastry and sweet preparation areas to a cook-chill area, within the phase 1 kitchen. Since the catering policy had first been discussed several changes had taken place, not least of all the acquisition of Hospital 4, which meant that the catering system would have to serve this hospital's needs. Moreover, the client had decided that it would be more economical to serve the remaining patient/staff areas in the Hospital South Block from the phase 1 building. The system was to be effected in two ways:

(1) A conventional system serving the patients and the staff dining room in phase 1;

(2) A cook-chill system to serve the patients in Hospital 4 and patients and staff in Hospital 1 South Block.

All cooked main meals and suppers to be consumed by patients, staff and visitors, whether in the phase 1 building, Hospital 4 or the South Block were to be prepared in the phase 1 kitchen. Within phase 1 in all wards, all main meals/suppers were to be plated in the kitchen and taken in heated food trolleys to the wards. Food for consumption by staff and visitors would be brought from the kitchen to an adjacent staff servery in the staff restaurant.

Following conventional preparation and cooking in the phase 1 kitchen, food for patient consumption in Hospital 4 was to be portioned, chilled and stored in a cold store in the phase 1 kitchen. Each day chilled food was to be withdrawn from the cold store and taken to the wards where it was to be regenerated, plated and served to patients. It was envisaged that no cold storage facilities would be provided in Hospital 4. Again, staff were to take their main meals and suppers in the staff restaurant in the phase 1 building.

Following conventional preparation and cooking, food for patients' consumption was to be portioned, chilled and temporarily stored in a cold store in the phase 1 kitchen prior to transportation to a centrally located forward cold store in the South Block. Each day chilled food was to be withdrawn from the forward cold store and taken to the wards where it was to be regenerated, plated and served to the patients. For staff and visitors it was envisaged that each day food would be withdrawn from the forward cold store and regenerated close by the staff dining room in the South Block.

To meet the above operational requirements, the phase 1 kitchen required a capacity to chill 600 main meals/suppers per day with a cold store capable of holding 2,400 main meals/suppers or 4 day's needs. The wards in Hospital 4 also required regenerating facilities for holding 60 main meals/suppers. The forward cold store in the South Block required a capacity to hold 1,200 main meals/suppers or 4 day's needs with regeneration facilities on the wards and close by the staff dining room capable of handling approximately 310 main meals/suppers. This re-think in planning was also far removed from the initial planning principle regarding catering. The cook-chill system, as defined above, would have required a large kitchen for producing all patient and staff meals around the site and also a large amount of storage space would have been needed. This option would have tied up a large area which could otherwise have been used for clinical departments.

At the time, this was the system which the Group Catering Adviser considered to be the best for staff and patients across the re-development site. According to the Authority General Manager, the planning of the kitchen had been done in such a way as to allow for this change.

Although these changes had been agreed, alternatives to the cook-chill system were still being investigated. Reservations expressed by some Health Authority members prompted the Authority General Manager to initiate an investigation into hospitals where a cook-chill system was already functional. At the same time, work began on finding a specialist catering manufacturer consultant to advise on the kitchen layout. Selected manufacturers were invited to prepare a scheme based on the approved kitchen layout and equipment criteria laid down in the room data sheets. This method allowed service runs and approximate connections to be determined and information to be received regarding positions of spillage/drainage trays, gratings, floor channels and gullies etc. The mechanical and electrical services were to be developed on that basis.

An economic appraisal of the proposed cook-chill system was needed so that cost implications could be fully taken into account when a decision was made on the type of service to be provided. At the end of June 1985 the Design Team was instructed to work on the assumption that a cook-chill system was to be incorporated into the scheme. Detailed design of the phase 1 kitchen progressed and catering equipment suppliers were contacted to obtain more information on cook-chill equipment.

3.2.4 Stage 4 [17]-{43} Detail Design, Stage 5 [44]-{47} Tender

A report from the Group Catering Adviser was considered, this set out options for the catering service to the Hospital 1 South Block when phase 1 was in operation. The cost of equipment between the conventional and cook-chill systems was thought to be similar, although the revenue implications of a conventional system were considered to be considerably more than for those incurred by a cook-chill system. It was also envisaged that the building works for a conventional system in the South Block would also have been in considerable excess of those for a cook-chill system. The Catering Adviser was of the opinion that a large sized cook-chill operation for the whole complex would cause management problems, particularly in so far as stock turnover/control was concerned and also the quality of the product. He indicated that the DHSS was, at that time, not in favour of large-scale cook-chill operations. In order of priority it was felt that the following were applicable: standard of food; revenue implications; capital implications. On the evidence provided the standard appeared to be acceptable and the revenue implications of a conventional system were considerable, as were the capital costs. It was agreed that the following services were to be provided:

(1) Phase 1/Hospital 4 patients - a conventional system would operate from the phase 1 kitchen;

(2) Phase 1 staff dining room - a conventional system would be provided for phase 1 and Hospital 4 staff;

(3) Hospital 1 South block patients and staff - a cook-chill system would be included.

This change in planning did not reflect the original planning principle of saving space on site and reducing large-scale industrial processes. The idea of a conventional service still stood for both phase 1 and Hospital 4 staff and patients, but the phase 1 kitchen would had to have produced and supplied cook-chill food to the Hospital 1 South Block. Thus, from one kitchen there would be two different systems and two different services would operate on the phase 1 and the South Block sites. In the early planning stages it was agreed that both sites should operate under the same system; quality standards across the development would have been easier to maintain if this had been the case.

At the end of 1985, the decisions taken by the Hospital Planning Committee regarding catering services were endorsed by the Joint Planning Committee. The Engineering consultants suggested that the policy for a mixed cook-chill and conventional system in the phase 1 kitchen be re-assessed. Feedback from the catering industry indicated that a 100% cook-chill system would yield higher savings in energy and staff costs. Due to the high proportion of cook-chill produce contained within the catering policy, the engineers suggested that the hospital re-assess its decision to produce a mixed phase 1 kitchen of cook-chill and conventional hot meals, to a total cook-chill solution within the phase 1 development. The Group Catering Adviser considered the Engineer's proposals but was of the opinion that the mixed phase 1 service would remain, although from a commercial viewpoint, he suggested that the system was not, perhaps, the most cost or design effective.

The Environmental Health Department became involved in planning discussions regarding catering services and proposals for the new kitchen design were approved by this body.

Details relating to floor drainage, equipment and cleaning regimes were being considered in detail. In 1985, a firm of food service consultants was commissioned by the project management consultants. In particular, the consultants were asked to examine the proposals for the catering facilities, which had been developed by the Design Team in conjunction with the client and supported by drawings and a quotation by a firm of manufacturers and installers of catering equipment.

By 1986 the kitchen layout and equipment schedules were being worked out in further detail, from the client approved architect layouts. Kitchen cleaning and drainage details were being worked out. In April of this year, the Group Catering Adviser expressed his concerns regarding the lack of natural light and ventilation for most of the catering department. The Catering Adviser had to accept the situation as it existed, although it was suggested that there could still be changes in the way the catering service was to be provided before phase 1 was commissioned.

In mid 1986 there was still a considerable degree of uncertainty about the exact nature of catering arrangements in the phase 1 building. Some of this uncertainty was attributed to the fact that catering services had to go through a contracting-out exercise in September of 1986. It was suggested that a substantial part of the Authority's catering would be done off site.

In August, the washing of residual crockery and cutlery at ward level became an issue. With regard to the removal of Crown Immunity, the planners were anxious to improve the washing-up facilities at ward level. Since the space in the ward pantries was already limited, the installation of a double sink unit was precluded. However, the inclusion of domestic type dish washers was considered to be acceptable. As well as maintaining strict food hygiene standards, it was thought that the dish washers would not materially affect the way in which work was carried out in the ward pantries.

In September of 1986, the Health Authority was still continuing with evaluation of options for providing a catering service in the new phase 1 development. This included the possibility of a co-operative venture with other Health Authorities in the area. A working group was set up to examine the possibility of introducing a cook-chill service within the hospitals of four Health Authorities (including this one). Discussions ensued between this Health Authority and the Health Authority of Hospital 5. This led to the appointment of an independent catering consultant from another Health Authority in the West Midlands to investigate the situation.

At the beginning of 1987, still no policy had been agreed for the provision of catering services in the phase 1 development. It was still assumed that the phase 1 building would serve phase 1 with a conventional service and a cook-chill service to the South Block. However, there was now uncertainty surrounding the provision of food to Hospital 4 patients. Previously, it had been agreed that these patients were to be serviced by a conventional system operating from the phase 1 kitchen. There were suggestions that Hospital 4 could be serviced by a cook-chill system from the phase 1 kitchen.

The independent catering consultant from the West Midlands reported early in the year. His report suggested a re-drawing of the kitchen area in phase 1 to ensure separation of raw and cooked foods. The report suggested that there was insufficient space in the proposed phase 1 kitchen for either a cook-chill or a conventional service. A decision on catering services was becoming absolutely crucial because the contractor was due to start on site at the beginning of March 1987 on a no-variations contract.

In June 1987, an outside firm of catering consultants was brought in to work on the in-house tender. The independent report from the West Midlands consultant provided a basis for re-examining needs and cost appraisals. Joint catering arrangements were still being discussed with other Health Authorities. In July a meeting was held to discuss cook-chill food services within this Health Authority and two others in the area. It was agreed that the three Health Authorities would combine under the lead of Hospital 5 to commission an outside consultant to assist in the production of an AIP submission to the DHSS for a combined cook-chill central production unit. It was also agreed that the independent catering consultant from the West Midlands, who made the first report, would be approached and asked for a quotation on the cost of the exercise.

On this basis, this Health Authority expected a system which would deliver bulk food from a Central Production Unit (CPU) off a vehicle into the appropriate entrance of the new development, at which point service would finish. Thereafter, the exact details of service had not been decided upon but it was envisaged that the system would require delivery of bulk food made up of multi-portion smaller units. This would be held in a central chilled storage area and then distributed straight to the wards so that catering staff on the wards could select from the chilled unit the appropriate amount of food at the appropriate time for regeneration.

Planning on a joint cook-chill development continued but was disrupted at the end of 1987 when the Group Catering Manager (who was the catering user representative) of the Health Authority left. Still there was no firm commitment on cook-chill. By November 1987 a situation had been reached in which no work had been done to form the basis of a fully costed option appraisal for a joint cook-chill central production unit. Within this Health Authority, different views existed as to the financial and other benefits of cook-chill, when phase 1 was still actually being built and equipped to provide a conventional service to the phase 1 patients and staff. A catering adviser from the DHSS agreed that this was a major strategic decision and that the joint CPU option should be investigated further, only when a new Catering Manager was in post. The DHSS adviser agreed to write confirming his views of the options that should be considered.

3.2.5 Stage 6 [48]-{64} Construction

Changes in senior management within the Health Authority in 1988 led to renewed interest in the cook-chill option. A new Catering Manager had also taken up post. By August of this year the new Catering Manager had been able to review the catering plans. Proposals were made to alter some of the finishes and catering equipment, other suggestions were made which impacted at the design and operational level. The new Catering Manager envisioned that a cook-chill system would most likely be developed for phase 1. The Catering Manager suggested various changes which supported this. For example, the requirement for a food distribution hall at a controlled 10°C emerged. There was also the suggestion that the food distribution trolleys would have to be for cook-chill food and that there would be no need for hot line bains-marie or plate warmers (typically part of a conventional bulk service).

Changes were being specified to convert the kitchen to a cook-chill system of food procurement. It was clear that some of these changes would have to be incorporated into a post-contract works. The external project management consultants were loathe to incorporate some of these changes, they envisaged it would cause further delay to the working drawing (which was originally expected in mid February 1988) and that more changes could result in the contractor registering a claims situation. The Project Manager suggested that the changes might be better incorporated as part of a post-works contract.

The outline operational policy produced by the new Catering Manager indicated the following: the cook-chill food would be bought in ready-manufactured. In terms of detail surrounding distribution and dietary requirements, some amendments had to be incorporated following publication of the DHSS's guidelines on cook-chill meals and receipt of the dietitian's operational policy. The major change was to the beverage service and it was suggested that china cups might replace the disposable-cup system. In 1989 more detail was worked into the operational policy. In October 1989, the clearest and most detailed operational policy for catering services emerged. The first part of re-development was to comprise:

(1) The new phase 1 building and Hospital 4 linked by a bridge, with kitchen, dining and coffee lounge facilities at basement level of the new building;

(2) The Hospital 1 South Block which was to remain physically separate from the remainder of the complex was to be made available for staff dining.

Due to the nature of the physical separation of the two parts of the complex, and the impracticalities and potential hazards in terms of food hygiene, damage to equipment and hazards to persons of servicing one from the other, the catering service provision was considered separately on both sites for patients. This did not necessarily mean that there would be a duplication of services.

The new main kitchen in the phase 1 building was to provide meals for the new phase 1 building and the Hospital 4 complex. The main protein part of such meals for patients was to be bought in cook-chill form and supplemented by vegetables cooked on site. The preparation and/or cooking of any additional items, as would be required from time to time to supplement the menu, would be prepared in the phase 1 kitchen. The staff menu was to be complimented by a grill bar facility. In the new phase 1 hospital building, and hospital 4, a full choice menu was to be offered with patients making individual choice of meals from a menu card issued no more than 24 hours in advance of the last meal indicated on it. The Catering Manager would have the responsibility of issuing, collecting and collation of the menu cards. The Floor Housekeeper was to monitor that the task was done correctly, and provide information for the Catering Manager of any problems in this area. The Senior Nurse on the ward was to retain overall responsibility for ensuring that the patients were fed, and dietary requirements correct. The meals were to be provided from a central tray service. The Catering Manager would have the responsibility of providing staff to undertake the distribution and collection of meal trays. The Floor Housekeeper was to monitor this service at ward level.

In the children's ward, a special menu was to be provided, taking into consideration the age range of patients admitted to the ward. The adult patients' menu would also be available. The Catering User Representative wanted to adopt a flexible approach to take into account the particular needs of children. It was intended that meal choices would be ascertained as near to each meal time as possible. The Ward Housekeeper would be responsible for distribution, collection and collation of this information, and ensure its accurate transmission to the catering department. The Housekeeper would communicate with both the senior nurse in charge of the ward and the child's parent(s) in order to ascertain the needs of the child and the child's well being whilst in hospital. The Housekeeper would be involved in the drawing up of the child's meal plan. Chilled food would be issued to the ward for regeneration and service at ward level carried out by personnel from the Catering Department and monitored by the Housekeeper. There would be stocks of frozen meals to provide a wider range of choice, in addition to some fresh items (such as eggs) which could be cooked, as required, for a child. As the children's ward was located on the same floor as the private patients' ward, the Catering User Representative suggested that one ward floor kitchen of sufficient size and appropriate design and layout could provide the service to both areas. It was intended that certain items of crockery/cutlery would be specifically provided for the children to reduce the likelihood of loss at ward level. This meant that dish-washing would take place at ward level, using an industrial washing machine designed for the purpose. By nature of the location of the dish-washer it would have to be of a design producing minimum heat and noise.

Due to the ward kitchens being bound within the legal requirements of the Food Hygiene General Regulations 1970 and the Food Act 1984, it was considered inappropriate to allow anyone other than appropriately selected and trained personnel to use these areas. This policy definitely precluded parents from the ward kitchens. It was suggested that if there was a need for parents to cook for their children, over and above their full involvement in the meal/beverage system to be used, an alternative, clearly defined area would have to be identified.

The provision of both snack and beverage vending in the children's ward area was envisaged for the use of parents/carers, staff and other visitors. The maintenance of this would be the responsibility of the Catering Department and be maintained by the Housekeeper.

All adult NHS wards in both the new phase 1 building, Hospital 4 and South Block would be provided with beverages by means of an in-cup ingredient system. A trolley with an integral hot water boiler would be provided for each ward. Ingredients would be issued weekly on a top up basis by the Catering Department. Allocations would be calculated according to the agreed number of beverage rounds per day with an allocation for on-demand beverages agreed with the senior nurse on the ward. These beverages would not be for the use of staff, as alternative vending facilities would be provided for them. Usage would be monitored by the Housekeepers. Maintaining the trolley in a clean state, preparation and service of beverages would be the responsibility of the Catering Department, through staff allocated to the ward area to carry out the beverage service. The children's ward area would not use the in-cup system but the beverage services would be provided from ingredients supplied from the kitchen area using crockery held at ward level for this purpose.

In the old Hospital 1 South Block, the patients' meal service was to be operated with cook-chill meals utilising a bulk distribution and ward based regeneration system. Distribution, regeneration and service would be the responsibility of the Catering Manager. Patients were to have a full choice menu from a menu card issued no more than 24 hours in advance of the last main meal indicated on it. The Catering Manager would be responsible for issuing, collecting and collation of the menu cards. The South Block wards' Housekeeper would monitor that this task was done correctly and provide information of any problems to the Catering Manager. The senior nurse on the ward would retain overall responsibility for ensuring that the patients were fed and dietary requirements met.

All distribution of items required for the provision of the food and beverage service would be carried out by the hotel services department staff.

Staff services were to comprise the new phase 1 building staff restaurant/snack/coffee bar facilities. The restaurant was essentially open plan in design with segregation of areas being possible by mobile screening. The servery was designed for a free flow system of service. The restaurant would provide all meals and be open seven days per week. A full range of appropriate hot and cold drinks would be available at all meal times. A coffee lounge, located adjacent to the restaurant, would provide a separate service counter for the provision of snacks and beverages with vending machines to supplement the restaurant service. All staff were to be encouraged to take their coffee in this area, after meals, to speed up throughput in the restaurant. Coffee and tea breaks would be served only from this area.

The use of pantries or other self preparation facilities within the department was to be discouraged. Such areas tend to become untidy and dirty, and responsibility for upkeep becomes unclear. The use of vending facilities (snack/beverage) in all appropriate areas was considered to be advantageous in terms of provision of a service, and cash control. Locations for vending needed to be agreed. The machines would be the responsibility of the Catering Manager. Adequate facilities for waste and preventing damage (e.g. through leakage) to surrounding floor/wall coverings would be required. The appropriate Housekeepers would monitor all vending facilities in their area. It was envisaged that there would be a continuing need for facilities in the South Block site as staff break times, in many cases, were short and there would be a reluctance, especially in inclement weather, to make the journey to the new phase 1 building.

As it was not considered to be cost effective or efficient use of space to duplicate services, the South Block was to provide a mid-morning coffee service and a grill salad bar lunch time service until 2pm. These services were to be available Monday to Friday only and no afternoon or evening service was to be available within or adjacent to this area.

No prime cooking would take place in the South Block kitchen. All meals would be from bought in cook-chill or the grill bar at the rear of the restaurant. Sandwiches would be obtained from the central sandwich preparation area of the new kitchen, as would any prepared salad.

Details of changes required in the phase 1 kitchen area to permit the cook-chill system to be included had to be identified and sorted out by the middle of November 1989 so that all changes could be carried out in one post-contract works during commissioning.

In November of 1989 the Commissioning Progress Group decided that chilled food in bulk would be provided for regeneration and service at ward level throughout the phase 1 building, although Unit General Management still had to ratify the decision. A decision for the bulk option would have removed the necessity for a chilled plating area in the phase 1 kitchen but also brought into question the design and layout of ward pantries and day rooms at ward level. At the end of 1989, the phase 1 kitchen had been built as a conventional system but a post-works contract was being put together to change phase 1 patient meal provision to a cook-chill system during phase 1 commissioning.

At this time, some details surrounding the provision of South Block Catering services began to emerge. In 1990 the tenets of the operational policy produced by the latest Catering Manager still stood. Detailed requirements for catering in the South Block of Hospital 1 were still lacking. In terms of strategy, the Unit Commissioning Manager suggested that the South Block had to run on the same service as the phase 1 building so that quality standards were not compromised by two different services. The strategy was not always followed, since at various stages during planning the phase 1 and South Block services were different. In the situation then, the Unit Commissioning Manager saw that the only feasible way of providing cook-chill to the South Block was from a refurbished nurses home kitchen. Unit General Management had agreed on the cook-chill system in principle provided that the required quality could be achieved within the budget savings for hotel services. Unit General Management had made no decision on whether bulk or chilled distribution was the most appropriate option. A decision was delayed on this strategy until the capital costs of a chilled plating area in phase 1 had been calculated along with an indicator of the contract prices and terms of different menus. If the outcome of the option appraisal proved that cook-chill was not affordable by the unit in revenue terms, then the original decision of cook-chill would require review.

In May 1990, a decision was finally reached by Unit General Management that a bulk cook-chill system would be used in the new phase 1 building. The catering needs for phase 1 would be covered by bulk purchase of chilled, pre-cooked food, stored on site, sent to the wards in appropriate trolleys and reheated and served there. At the time, it was considered that existing provisions in the phase 1 building were adequate for this, both at catering and ward level, although there would be some implications for ward staff/housekeeping staff and trolley distribution. This meant that a chilled plating area was definitely no longer required. Post-contract works were carried out in 1990 to convert the conventional phase 1 system into a cook-chill system. Generally, this involved the conversion of some preparation and cold storage areas to meal chilling units. In November 1990 a bulk cook-chill meal service to patients was operational in the phase 1 building.

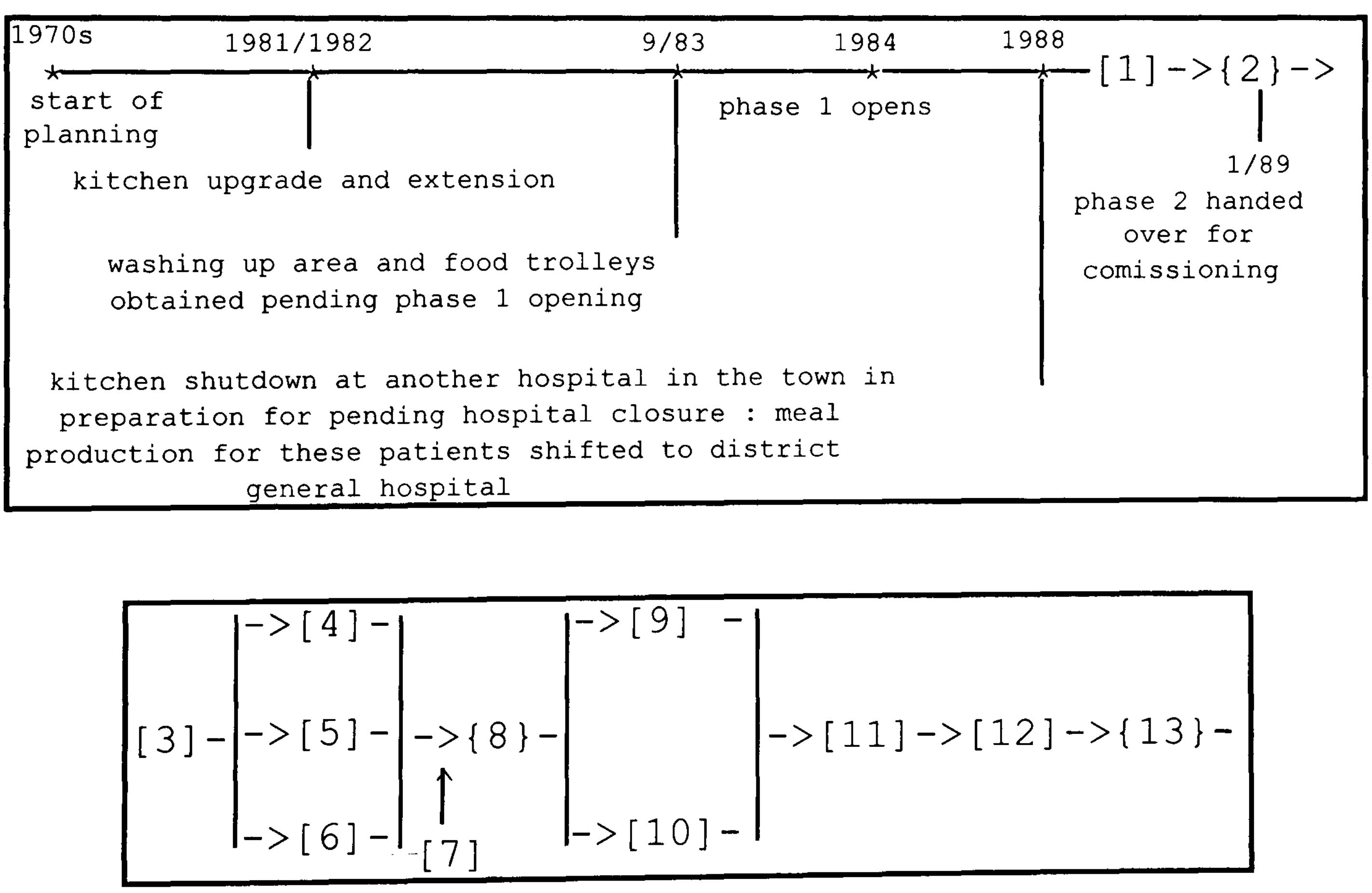
The implications for this decision also had to be determined for the Hospital 1 South Block kitchen. At the time, it was considered that there would be no more space requirements beyond those already allocated to South Block catering to provide a system of chilled pre-cooked food purchased in bulk and re-heated in suitable trolleys on the wards. The main problem with food service provision for the South Block was that access for food trolleys between the South Block nurses' home (kitchen location) and the South Block (ward location) was not good. In particular, a lift had to be built to enable food trolleys to be taken down to the basement floor in the nurses' home, wheeled through the tunnel link to the wards in the Hospital 1 South Block building.

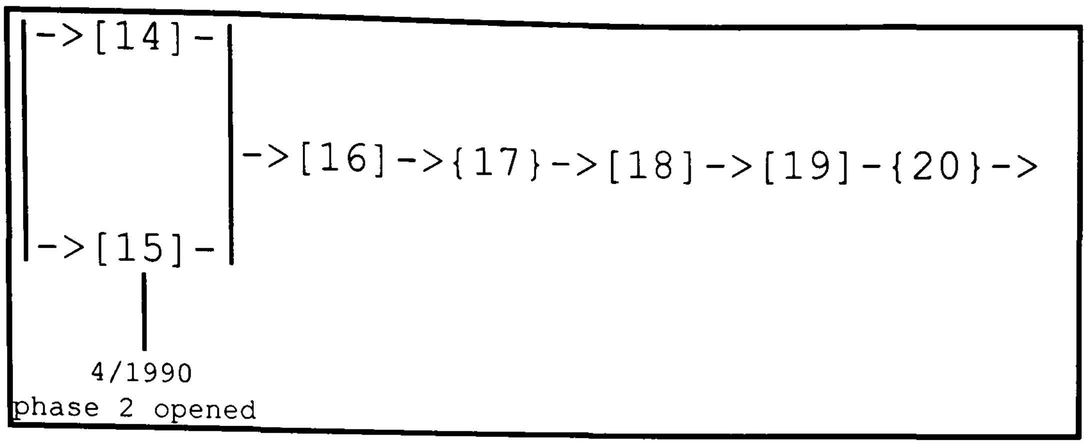
3.2.6 Stage 7 [65]-[67] Commissioning

During the snagging period the main problem with the phase 1 kitchen was due to noisy extractor hoods but this problem was successfully remedied. Ongoing work in the kitchens affected entry of catering staff and deep cleaning carried out by them.

3.3 Retrospective Project B

Figure 3.3 Precedence Diagram for Retrospective Project B





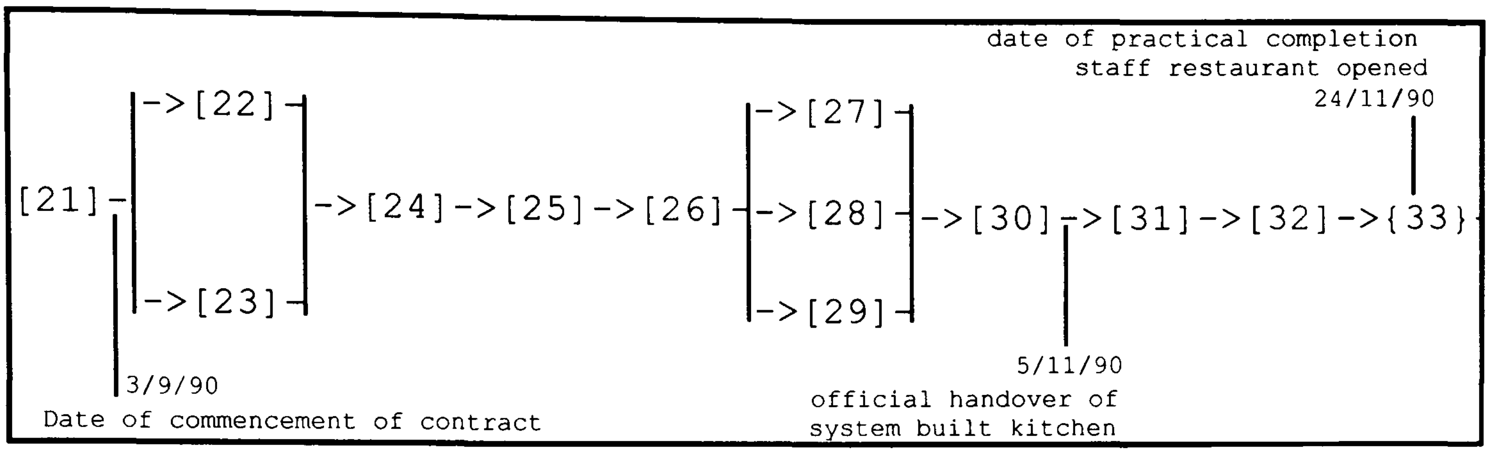
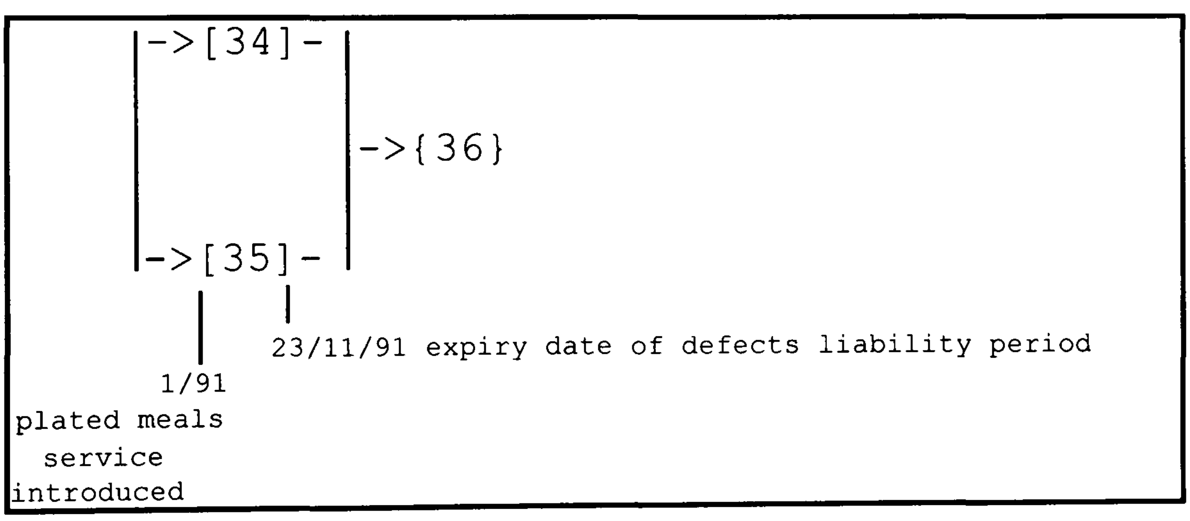


Figure 3.3 Precedence Diagram for Retrospective Project B



3.3.1 Pre Stage 1 [1]-{2} Inception

During the early planning stages of the new district general hospital, catering was discussed and it was decided that new kitchen and dining facilities would be provided in the third and final phase of the scheme, planned for opening in the mid 1990s. At the time, it was considered more important to provide accommodation "more directly related to patient care" and management was advised that the kitchens could cope until phase 3. This decision was taken despite the fact that the existing catering department was sited at a point remote from the planned new development and the kitchen was old, badly designed, and inadequately equipped. Moreover, the hospital dining facilities were already inadequate and visits to the hospital catering facilities by the local Community Health Council (CHC) indicated that staff were coping with conditions that were not ideal for meal production.

The then Catering Manager envisaged that the re-development would have no impact on catering, and the Regional Health Authority, which was very conscious of costs, decided to take the Catering Manager's advice which was to do nothing.

Despite this inertia, a kitchen upgrade and extension was completed in 1981/1982. In September 1983 a washing-up area and new food trolleys had been obtained in readiness for the pending phase 1 opening. At this time, a sub-committee had been formed to study transport of trolleys from the kitchen to the new district general hospital phase 1 wards. In 1985 further concerns were voiced by the Community Health Council on food transportation from the kitchen to the new phase 1 wards at the top of the hospital. Food transportation took about 20 minutes for these wards because of a 7 in 1 gradient. Coupled with the time taken to load and off-load food it was very difficult to keep meals hot. By 1986 two methods of meal distribution were in operation from the old kitchen hospital. Bulk food trolley transportation was used for the old wards. On arrival at the appropriate ward these trolleys could be plugged in and the food kept hot. Meals for the new wards were plated, put in insulated trolleys and transported to the new phase 1 wards on a wagon. In view of the distance travelled, this sometimes resulted in the meals arriving cold. In 1975 an earlier suggestion to use a plated meal system of food distribution had been abandoned because of problems with the hospital site topography. Plans for the new kitchen within phase had not, at that time, been finalised. Visitors from the Community Health Council in 1986 noted the very poor morale of catering staff, this was attributed to the contracting out exercise which was due to take place the following year. The CHC members also noted the poor state of repair of the kitchen walls. In March 1986 the Catering Committee were beginning to express their concern regarding the fundamental problems within the catering department which were severely restricting its operational effectiveness. In 1987 a further visit by the Community Health Council to the hospital again picked up on the problem of cold patient meals.

This was seen to be particularly bad for patients receiving the plated meals service. Site topography problems were compounded at ward level if there was an emergency or mealtime coincided with a consultant's ward round, in which case meal service had to take second place. There was also a shortage of the bulk food delivery trolleys which could be plugged in to keep food hot at ward level. The state of repair of the kitchen was noted to be much improved since the previous CHC visit.

By 1988, despite the upgrade in the early 1980s and continuing improvements, the old hospital kitchens were unable to provide quality meals, choice menus and food served at the correct temperature. Changing legislation was compounding these problems and putting increased pressure on catering establishments to enforce tighter controls of food service temperatures. Even before the opening of phase 2, it was clear that the existing catering system was inadequate and unable to cope with phase 1 requirements let alone the catering requirements for phase 2 of the re-development scheme.

At the end of 1988 senior management within the Health Authority took the decision to close down a kitchen in a hospital elsewhere in the town, in preparation for the total closure of this hospital in later years. The emphasis was that the old kitchen at the district general hospital would provide a catering service. In a sense, this became the final "nail in the coffin" for the old kitchens. In hindsight, senior management might have realised the devastating effect that this would have on a system which was already being stretched to its limits. The decision came at a time when the catering department was preparing for Christmas, one of the most intensive times of the year for hospital catering departments. There was also considerable doubt as to whether the old kitchen had enough power supply to cope with the electrical requirements of more food trolleys.

3.3.2 Stage 1[1]-{2} Inception

In January 1989 a request was made to Regional level for capital to purchase bulk food trolleys which would overcome some of the meal transportation problems in phase 1 and 2 of the new district general hospital. An immediate decision was not forthcoming; the Capital Equipment Officers at Regional level were concerned at the high costs involved and were loathe to make any decision which could have pushed catering in the new hospital towards the old fashioned method of bulk distribution of meals. As a result, the Capital Equipment Managers at Regional level referred the problem to the Regional Work Study Department in order to establish the best means of providing a service to phase 2.

The Community Health Council visited the kitchen premises in January 1989 and was still concerned by the apparent inadequacy of the facilities. The early 1980s kitchen upgrade and extension had allowed some kind of provision to be made for the phase 1 and 2 requirements. However, no allowance was made at that time to cater for the hospital located elsewhere in the town, whose kitchen had been shut down at the end of 1988. The area in the hospital kitchen allocated to this task was totally inadequate.

In the early part of 1989 the true extent of catering difficulties from the old hospital kitchen were becoming more evident. All the food distribution trolleys were stored in the main body of the kitchen and this had created severe congestion in the remaining area where all preparation and cooking processes were carried out. Approximately 40% of the total catering area was taken up by food trolley storage. The available space, after accounting for the food conveyors and cooking equipment, allowed for only two small preparation tables. All food preparation had to be carried out using these tables and, therefore, the separation of raw and cooked foods was not given the consideration it needed. The hospital was, therefore, in direct contravention of food hygiene regulations. There was no linear work flow. The level of activity in this area was so intense throughout the day, that the risk of accident was significantly increased. When extra services were requested, such as buffets, there was simply no preparation area or equipment available and it was common practice to use the tops of chest freezers as work surfaces, and this, once again was in contravention of legislative guidelines. There was insufficient chilled storage space to meet the demands of production and this occasionally infringed food hygiene regulations and restricted the availability of an extensive range of products. The capacity of prime cooking equipment was insufficient to meet demand. Each item of equipment was at least 10 years old, some was 30 years old. Production was severely restricted. The two steamers were at the end of a direct steam line which passed from the boiler house via the four boiling pans. Insufficient steam pressure meant that the steamers could not operate properly; the boiler house was also pending closure. Most foods had to be cooked in batches due to the lack of oven and stove equipment. No steamed desserts could be produced and, therefore, all hot puddings were baked. This resulted in all oven space being repeatedly used to its full capacity in the cooking of food from around 08.30 hours to 12.15 hours daily. Food cooked in the earlier batches deteriorated throughout the morning because it was cooked so early and there was no heated storage facility. This situation was so bad that menus were actually designed, not with the patient in mind, but with consideration to the capacity of equipment. Of all the complaints received at that time, this problem was the source of the majority.

The Catering Management Team followed every complaint made by patients. Tests repeatedly indicated that food lost up to 20 degrees from commencement of plating to consumption. Any delays in distribution or service at ward level resulted in further deterioration. The plating area and equipment was totally inadequate and inappropriate for the operation and the quality of food served at ward level was of a very low standard. There was no belt system normally associated with plated meals. The catering assistants and cooks grouped themselves around a small static hot-lock and passed the plate between one another until it was finally placed into an insulated but unheated trolley.

The process took about 10-15 minutes to fill the trolleys. The location of the operation was at one end of the kitchen adjacent to the trolley store and freezer area. The doors opened directly to the outside, and when opened, for delivery of frozen foods or to allow trolleys to be towed out, cold draughts blew directly onto the food plating area. The combination of the plating system, unheated food trolleys and the siting of the operation resulted in food cooling by about 11-12°C before it left the kitchen. During the summer of 1987, an exercise was undertaken to evaluate the performance of the plated meals system against a heated bulk food system. Results indicated that there was a significant loss of heat when food was plated and distributed in insulated conveyors. There was a significant improvement in food quality by using the bulk system. In light of these facts it is somewhat surprising that the plated meals system was introduced. Due to adverse factors in distribution, and in the variation of weather conditions, food really was in a poor condition on arrival at ward level.

The catering department regularly produced approximately 500 lunches, 350 evening meals and items to be sold through vending services. The level of staff employed within the catering department dictated that this production target was regularly achieved by three cooks and two assistants at lunch times and by two cooks during the afternoon. Any absenteeism, particularly when other members of staff were on holiday, usually made it impossible to provide a service without relying heavily on the expensive use of overtime. There were occasions, however, when there was simply no-one available to assist and on these occasions, catering managers had to work in the kitchens and consequently the departmental management became less effective. There was a substantial demand for the provision of extra catering services and at that time and for the foreseeable future, all extra services were prepared, delivered and served by managers. Frequently up to four special functions were required during one day, and this resulted in the entire management team being unavailable for any other matters or to monitor the catering service. Similar staffing problems were experienced in the service provided in the staff dining room, and it was quite common for cleaning staff to be deployed to food service, thus lowering the standard of cleaning in catering areas. When catering services for the other hospital in the town were taken on board the head cook took a great deal of time off work due to the enormous pressure and subsequently resigned. Permission to use the funded Assistant Head Cook grade was refused and, therefore, no-one had the responsibility for the daily functions of the kitchen.

A visit to the kitchen by the Environmental Health Officer in March confirmed all the problems which were so readily visible. In April 1989 Regional management finally gave the go-ahead for the purchase of bulk food distribution trolleys in order to alleviate at least one of the problems regarding catering services at the hospital. This was carried out as a post-works contract in order that phase 2 of the re-development could operate on a bulk rather than a plated meals distribution system for patients.

3.3.3 Stage 2 [3]-{8} Feasibility

By July 1989 the situation had become critical. The imminent introduction of new and more stringent food hygiene and safety regulations had put increasing pressure on management to make a decision so that a timely solution could be adopted to alleviate the health and safety problems in the old kitchen. The Health and Safety Executive was pushing for a kitchen upgrading as a short term solution but was also asking the Health Authority to consider total replacement of the facilities.

Options were analysed by both a management team at the Health Authority and by an external firm of management consultants. Essentially, the brief was to identify schemes that would meet the District Health Authority's short and long term requirements within its capital development programme. Several options emerged.

The first involved upgrading the old kitchen at an approximate cost of £500,000 to bring it up to acceptable hygiene standards. This figure did not include purchase of new prime cooking equipment or an adequate food distribution system. The real cost would have been approximately £700,000 plus. This still would not have solved the problems of quality. During upgrading work in the main body of the kitchen food production would had to have stopped; this had obvious implications for providing some kind of stop gap catering service. A second option was based on a cook-chill system of food procurement. This involved buying in commercially prepared meals for regeneration in an upgraded old kitchen. As far as staffing was concerned this was a politically sensitive as it would have resulted in staff redundancies. There would have been immediate savings from labour costs but in the longer term the revenue implications of buying in prepared food would have been very expensive. Food hygiene legislation also requires cook-chill regeneration to occur as close to the point of consumption as is possible but the old kitchen was a quarter of a mile away and downhill from this point. A third option involving cook-chill would have been to regenerate food at ward level. The huge capital investment needed in regeneration equipment at ward level and the partial responsibility for nursing and domestic assistants over catering provision made this an unsound viability. Moreover, some wards could not take the equipment because of their inadequate size and floor loadings. The fourth option was to bring forward the building of a new catering department (which was to be a part of the phase 3 scheme) as a tag on to the end of phase 2. This would have been at an approximate cost of £2,250,000. As a result of investigations of ways of providing an interim service in relation to the first option, it became apparent that a further option existed to provide new catering facilities. This was in the use of Portakabin structures.

A basic plan was established for the kitchen upgrade option in mid July 1989 and was worked up in detail by the Catering Manager with advice from the local Environmental Health Officer. In September 1989, an interim report by the food service consultants suggested that a kitchen upgrade would be a waste of resources. As a result, the District Health Authority tried to persuade the Regional Health Authority to release the necessary funds to bring forward the building of new catering facilities as soon as possible. By the beginning of October the District Health Authority had stopped the architects proceeding any further with plans for the kitchen upgrading, it was becoming increasingly clear that other options were more viable.

During this period, when phase 2 was being commissioned, the Catering Manager had the opportunity to inspect the phase 2 ward accommodation. Discussions in the 1980s suggested that pot washing for these wards would be handled by a central pot wash area, but there was not one. An assessment of the phase 2 ward pantries by the Catering Manager and Domestic Services Manager indicated that these were ill-equipped for washing of crockery and cutlery. The architect suggested that extra equipment could have been installed but this would have further restricted a proper working arrangement for domestic staff. Provision of a central pot washing facility seemed the most viable option for securing a safe, hygienic and effective pot washing service throughout phase 2.

3.3.4 Stage 3 [9]-{13} Sketch Design

At the beginning of November 1989, a specialist company manufacturing and supplying portable kitchen units submitted three outline proposals for a kitchen at the hospital. The first of these was a system built kitchen providing a traditional bulk service to patients with a restaurant facility for staff contained within the building. This would have a 20 year life at an approximate cost of £40,000. The second was for a scheme based on a traditional service for patients, to be sited in a series of cabins rather than a system building and incorporating a staff restaurant area. This would have been on a 3-5 year rental basis at a cost of approximately £68,000 per annum. The third scheme was based on the use of linked cabins and designed for regeneration of chilled food for patients;

again this scheme would incorporate a staff restaurant. This was also a rented option at a cost of approximately £47,000 per annum.

At the beginning of December Regional officers approved the transfer of resources from phase 3 of the re-development scheme to the District Health Authority. This was to enable the District Health Authority to undertake an option appraisal for catering services at the hospital. These funds were to be allocated to the district once the contract details of the chosen scheme had been submitted to the Regional Health Authority.

In January 1990, the Catering Manager was pushing heavily for a system build kitchen as a solution to the hospital's catering problems. Eventually this was seen as being the best solution to the short term catering problems. The specialist system build kitchen company was preparing detailed plans for such a facility. The proposed site for the system build kitchen was on the area then occupied by temporary operating theatre accommodation and to be linked to the recently completed phase 2 buildings. The facilities to be provided were needed to supply meals to 400 patients with restaurant facilities for a proportionate number of support staff. Food was to be distributed to wards in trolleys and dish washing was to be centralised in the system built kitchen. Deliveries were envisaged on a weekly basis so adequate storage needed to be provided with separate cold room for general produce, meat and frozen foods to meet these requirements. Office facilities were also required for catering management and changing rooms with shower facilities for catering staff. Toilet facilities for restaurant staff were also needed including a toilet for the disabled.

3.3.5 Stage 4 [14]-{17} Detail Design

District officers were in close consultation with Regional officers regarding funding of the proposed scheme and its siting within the hospital re-development. By March 1990 the funding situation had become clearer. Regional management insisted that there was no likelihood of the element of phase 3 of the district general hospital (which included the kitchens) being brought forward to 1990/1991. Regional managers also suggested that if the Health Authority went ahead with the system build temporary kitchen solution (life expectancy of 20 years maximum) then the District should give consideration to re-assessing the sub-phasing of phase 3. There was doubt as to the priority of the kitchen in sub-phase 1 of phase 3 when an interim scheme had been implemented with a life expectancy of 20 years, especially since this could be at the expense of other priorities. The Regional Health Authority guaranteed that the catering sub-phase of phase 3 would get the go-ahead whenever it was programmed but suggested that it was prudent for the

District Health Authority to maximise its usage of the interim catering scheme beyond 5 years and bring forward one of the other sub-phases. The District Health Authority was planning to fund the interim catering scheme by selling off health centre properties in the District. The Regional Health Authority suggested that it would give underwriting support to the interim catering scheme to enable the tender to be let as soon as possible in 1990/1991 as long as the District could guarantee the health centre sales.

At the end of March 1990 proposals for the temporary kitchen, pending the construction of a permanent catering facility in phase 3 of the hospital re-development, were forwarded to the local council for planning approval.

In 1990, final details relating to the temporary system built kitchen were being worked into the design, this included incorporation of the fire officer's requirements. During this period, the local council gave its verdict on the temporary kitchen proposals. The council made no observations relating to the scheme requested except that the building be retained for a period of five years only and that before the building was used replacement car-parking should be provided for the area of parking that was to be displaced.

3.3.6 Stage 5 [18]-{20} Tender

The tendering procedure commenced at the end of May. The District Health Authority requested that Regional managers give approval to go outside standing financial instructions. The District Health Authority wanted to obtain prices from only one firm with regard to manufacture, supply and erection of the system kitchen together with the relevant equipment. At the end of June an order had been placed for food trolleys and the District Health Authority was delaying the catering contract procedure as a result of the Authority's review of catering options. In July 1990 the specialist system build kitchen firm had forwarded final drawings for the proposed system build kitchen along with a tender sum. The tender figure of £427,024 was accepted by the District Health Authority and arrangements were made to finalise the contract documents. Tendering for the electrical and engineering works also commenced.

3.3.7 Stage 6 [21]-{33} Construction

Groundwork for the temporary catering facility commenced at the beginning of September. Sub-contractors for the electrical works were confirmed and the specialist firm of system build kitchen manufacturers and suppliers were confirmed as the mechanical services contractor. The sectional building was delivered to the site at the end of September and by the 2nd of October the main building structure and foundations for the kitchens had been completed and installation of the main services followed shortly after this. The contract completion date was confirmed as 17/12/90. During this period, details relating to interior design were finalised along with fire officer's requirements for the fire alarm system. Arrangements were also being made regarding opening and commissioning of the new facility. During the construction period of the new facility interim arrangements were made to improve and maintain standards of food service. In particular, an interim menu was introduced at the end of September along with the new food trolleys.

3.3.8 Stage 7 [34]-{36} Commissioning

On the 15th of November the new catering facility was officially handed over. After the building was handed over various snagging items required attention. The main problems were:

(1) Inadequate electrical loading;

(2) Continuous blocking of drain from ovens resulting in the flooding of main kitchens and sometimes the dining area;

(3) The potwash area was affected by excessive steam build up when the pot wash was used. The result of this was a buckling of ceiling cover trims and excessive condensation causing unsafe/unhygienic walls and floors;

(4) The fans above the restaurant servery were so noisy that when the fan was used normal speech was drowned;

(5) Artexing on the ceiling in the dining area was unsatisfactory; boards were still visible;

(6) Problems with the water softening mechanism on the gas combination ovens.

On the operational side of the catering system, in general there were only a few teething problems, which required rectifying. The three main problems were:

(1) Portering staff arriving in the kitchen before food was ready for distribution. This caused congestion and restricted the effectiveness of the plated meals system. This

problem was overcome by the porters refraining from collecting the food trolleys until catering staff had telephoned to confirm that they were ready;

(2) The second problem was with the operational effectiveness of the food trolleys. Although the situation was alleviated by a timeous repair and maintenance programme, it did not alter the fact that the trolleys were not particularly suitable for travel outside the hospital building along uneven surfaces;

(3) The third problem was with the introduction of choice menu cards for patients from the mental illness unit. So many cards were being incorrectly completed by patients that the service was being adversely affected. The problem was resolved by ensuring that a member of the nursing staff ordered meals on behalf of the patients.

These problems were all rectified by the end of the defects liability period on 23/11/91. A plated meals service was introduced at the beginning of January 1991 operating from the new catering facilities. At the end of January 1991 the Community Health Council visited the new premises and publicly commented on the greatly improved catering services to the district general hospital.

APPENDIX 4

Assessment of the Environment Impacting on Food Service Planning for all Projects

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Assessment of the Environment Impacting on Food Service Planning for all Projects

4.1 Longitudinal Project C : Overview

Problems in the planning of catering services at the longitudinal Project were based on several assumptions which proved to be untenable. These are explained in the following. In the early stages of planning, in-patient food services developed around a cook-chill or freeze method of food production with a tray meal method of food distribution. An early decision on the exact nature of in-patient food services was not considered necessary since the existing hospital kitchens had been upgraded in 1975/76 and it was envisaged that the upgrade would have a lifespan of 10-15 years and the existing conventional bulk distribution system from this kitchen would serve the needs of the first phase of re-development until the new cook-chill kitchen was operational. It was on this basis that no re-development of the kitchen was included in the design brief. At that time, it was anticipated that most of the new hospital would be operational by the mid 1980s and any re-development of the kitchen would, therefore, have come beyond this.

However, progress was not made as expected and, at the end of the 1980s, this posed a serious problem since the existing kitchen had outlived its upgraded life (it was in fact, environmentally unsound) before any of the new accommodation was complete. The situation was compounded because the planning strategy had proceeded based on a region-wide cook-chill policy but this was not approved. At this crucial point a speedy solution to the catering problem was necessary to avoid disruption to the rest of the hospital re-development. The solution was the development of a stand alone catering department, built as a separate contract from the first phase of development but physically linked to it.

The impact of different environmental factors on food services planning is discussed in the following section. The environmental influence diagrams indicate at which periods during the project these environmental factors came into effect and indicates their impact.

4.1.1 Certainty/Uncertainty

The uncertainty surrounding food services planning was due largely to the inability of regional management to make a decisive statement on catering policy strategy. In the mid

1980s planning of food services had progressed on the assumption that the Region would opt for a cook-chill policy, however, this was abandoned as explained below.

A catering strategy review commenced when it became increasingly clear among Regional management that the profile of catering services needed to be promoted and enhanced and that catering had to be regarded as integral and complementary to other aspects of health care. Moreover, central government reforms, intended to introduce an element of competition between NHS units, was considered to be a potentially important factor impacting on catering and other "hotel services". It was thought that such services would be central in determining the perceived quality of the hospital.

Adoption of a cook-chill system had many perceived benefits: promising reduced costs, better food quality and better ward service. It gave economy of scale in production and removed the conventional peaks of activity in the kitchen at meal times, allowing a more economical use of staff throughout the day and nine to five working hours. It also allowed meal times to be adjusted to suit individual wards. Time could be released to allow managers more time to plan, organise and supervise the production process. The operational difficulties of a cook-chill system were considerable. The DHSS guidelines were weak in areas and it was almost impossible to abide by them for some foods. The margin for error was very small and expert supervision was required to avoid temperature fluctuations due to equipment failure or human error. Tight temperature control was required throughout the cooking, storage and distribution processes. The initial costs for buildings and equipment were high, however, there were also hidden costs such as the requirement for stringent hygiene and quality control procedures; strict adherence to delivery times; and staff redundancy costs. Moreover there was a lack of accurate information on the operating costs of cook-chill. Cook-chill was by no means universally accepted as the safest method of food production and storage.

The proposed cook-chill system was criticised by Environmental Health Officers because of the crucial temperature controls required throughout the system and the short five day time period during which food could be stored in the chilled state. It would have been impossible to operate a cook-chill service in dilapidated buildings with antiquated equipment such as existed in the old hospital. The introduction of a cook-chill system would have almost guaranteed new equipment in a new building.

With the removal of Crown Immunity at the end of the 1980s, there was concern that health catering premises would come under much greater scrutiny from environmental health departments and that the risk of hospital kitchen closure was a real possibility. The uncertainties surrounding the new cook-chill/freeze catering technologies, with their accompanying stringent hygiene regulations, did little to alleviate the fears and doubts of Regional managers. At the end of the 1980s, there were several public health scares relating to microbial contamination of foodstuffs. These included Salmonella in eggs and Listeria in soft cheeses and cook-chill food items. Coupled with the latter, was a second public concern related to the effectiveness of regeneration of cook-chill meals in microwave ovens. This considerable uncertainty lead to the abandonment of the anticipated cook-chill policy and abortion of much of the planning work that had already been achieved.

Once the decision had been made to build a new kitchen, operating on a conventional service, there was the problem of obtaining the necessary funding. This short term financial problem was alleviated when central government agreed to advance finance allocated for phase 3 of the development.

Environmental uncertainty regarding the cook-chill technology pressurised the project organisational structure which could not respond. This led to delays in the decision making over which type of production system to opt for which was compounded by: management structure changes, (originally the hospital was governed by a Unit General Manager but this then changed to a Hospital General Manager); and the inability of decision makers to take responsibility and commit to a decision. The decision was originally vested in the Hospital General Manager but it was passed to the Hospital Divisional Management Team. Had this group been unable to make a decision, responsibility would have passed to the Unit Management Team.

4.1.2 Conflict

The most contentious area of debate which arose, during the latter stages of food service planning, was that surrounding the method for meal distribution. Once it was resolved to operate food service from a new kitchen, based on a conventional system of meal preparation, there was conflict as to the type of service to run. The Catering Strategy Review Group had advocated a plated meals system. Nursing staff were split in their opinions regarding the advantages and disadvantages of such a system; catering management, however, preferred the traditional bulk system. The Catering Manager favoured operation of the new kitchen on a bulk service but was prepared to run the kitchen any way hospital management desired so long as sufficient funding was allocated. The kitchen staff dreaded the introduction of a plated meals system.

Management at Board level was pushing for a plated meals service: their preference was driven by market forces, however, they were unable to consider the system from an operational perspective. One of the motivators to opt for plated meals was the potential savings that could be accrued because it was considered to be a more cost effective service. It was only at a late stage (construction of the phase 1A kitchen) that questions started to be asked about revenue implications, and the real ramifications of a plated meals system transpired. Although savings could accrue on a plated meals system through commodities, it was only at this stage that it was acknowledged that a plated meals system would be far more costly in terms of labour than an equivalent bulk system.

Eventually, it was resolved that a mixed bulk and plated distribution system would operate. This decision had a major impact on the design and operation of food services in terms of kitchen design, distribution system and ward level service. These important repercussions were not fully appreciated and translated into the design solution as evidenced by some of the problems post-occupancy. For example, it meant that bulk trolleys travelling externally would have to be kept separate from those trolleys remaining within internal transportation routes. Moreover, it was recognised that the proportion of bulk to plated meal distribution would vary according to commissioning of various later development phases of the hospital and the decanting of patients into new parts of the building.

The protracted decisions relating to the type of food production method and distribution/service system resulted in equipment purchasing problems at the end of 1991.

4.1.3 Technical Complexity (Spatial, Structural, Services)

4.1.3.1 *Spatial*

The form and location of the building were dictated by the fact that the new kitchen building had to logically connect into phase 1 of the new hospital development and the proposed phase 2 accommodation; and be centrally located to allow the highest quality meals to be provided in the shortest possible time. The site was already very congested but the kitchen had to be accessible to the main traffic routes to ensure good access for delivery vehicles and for transporting food off and around the site.

4.1.3.2 *Structural And Services*

In addition to the constraining siting factors, the building had to blend visually with the rest of the complex. This limited the size of the building, including height limitation to two floors. The ground floor contained the bulk of the accommodation in the form of cooking, preparation, food storage and dish wash areas, all served by a common service yard. This service yard was in turn to be serviced by part of the internal road network which was originally to be constructed as part of the phase 2 development. First floor accommodation was to consist of office and staff areas and the main plant room; the first floor to be served by two staircases. Additional single storey accommodation to the kitchen was a link corridor from the concourse of phase 1 and plant areas for transformers, emergency generators and switch room. All of these aforementioned areas had been designed into the proposed phase 2 of the hospital development but had to be constructed along with the kitchen in order that it could function at full efficiency.

4.1.4 Aesthetics

Due to its direct links with phase 1 and phase 2, and the resulting close proximity of all the buildings, materials and forms of construction had to be the comparable in order that the kitchen visually blended in with the total complex. Traditional construction was proposed, utilising cavity wall construction, concrete slab ground and first floors, the latter supported in loadbearing blockwork was supplemented by re-inforced concrete columns. Timber trussed pitched roofs completed the shell. The external specification was identical to that of phase 1. Internally, the kitchen had to be easily cleaned; durable wall and floor tiles specified for cooking and preparation and elsewhere painted plaster wall finishes. Suspended ceilings were to be used where appropriate, as were carpet finishes. Close proximity of the new kitchen complex to the rest of the development demanded that sensitive areas such as refuse disposal had to be designed in such a way as to create minimum environmental impact.

4.1.5 Function

There was never any doubt that some form of catering would be necessary at the hospital but the exact timing for the introduction of a new catering system was apt to change along with the nature of the system. The only factor which remained relatively constant was the number of meals which the prospective catering system would have to provide. In effect, the uncertainties and delays during planning created a "moving goalposts" syndrome. During the early planning years re-development of catering facilities appeared to be a low priority but as planning progressed and management changed their minds the need to provide a new catering system became increasingly important until, at the end of the 1980s, the lack of a new facility was jeopardising the later phases of hospital re-development. Although the catering system was initially designed with a certain degree of duality (i.e. catering design progressed on the basis of a cook-chill solution but was flexible enough to accommodate a more conventional operation) the switch to a conventional system was by no means a simple task. The final solution attempted to provide a facility that would be flexible enough to accommodate the expected changes in catering that would be commensurate with the commissioning of later phases of the hospital and to leave the door open for a review of cook-chill catering.

Figure 4.1 Environmental Influence Diagram for Project C, Operation 2

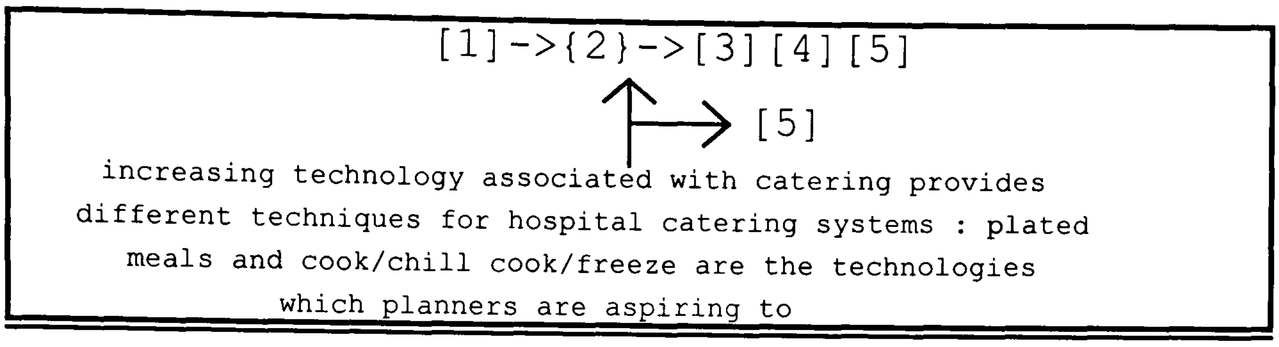


Figure 4.2 Environmental Influence Diagram for Project C, Operation 3

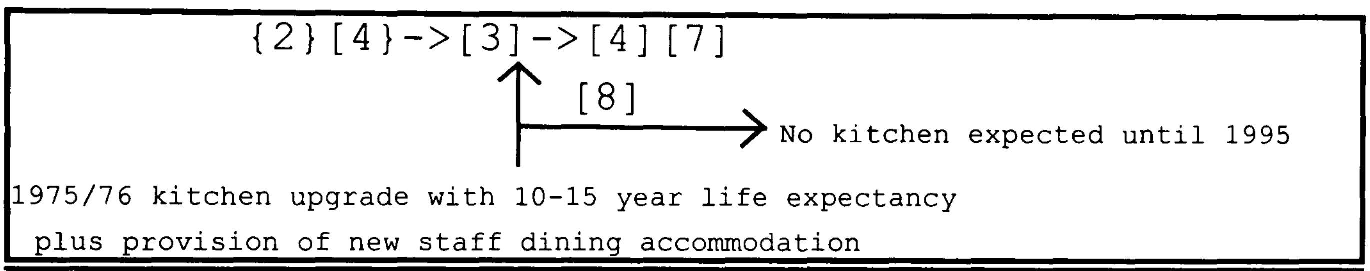


Figure 4.3 Environmental Influence Diagram for Project C, Operation 4

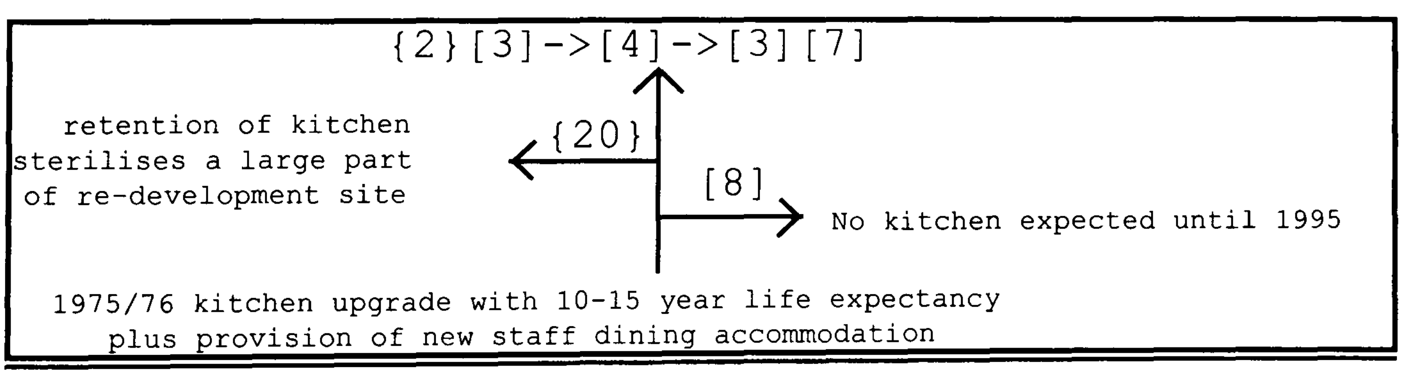


Figure 4.4 Environmental Influence Diagram for Project C, Operation 5

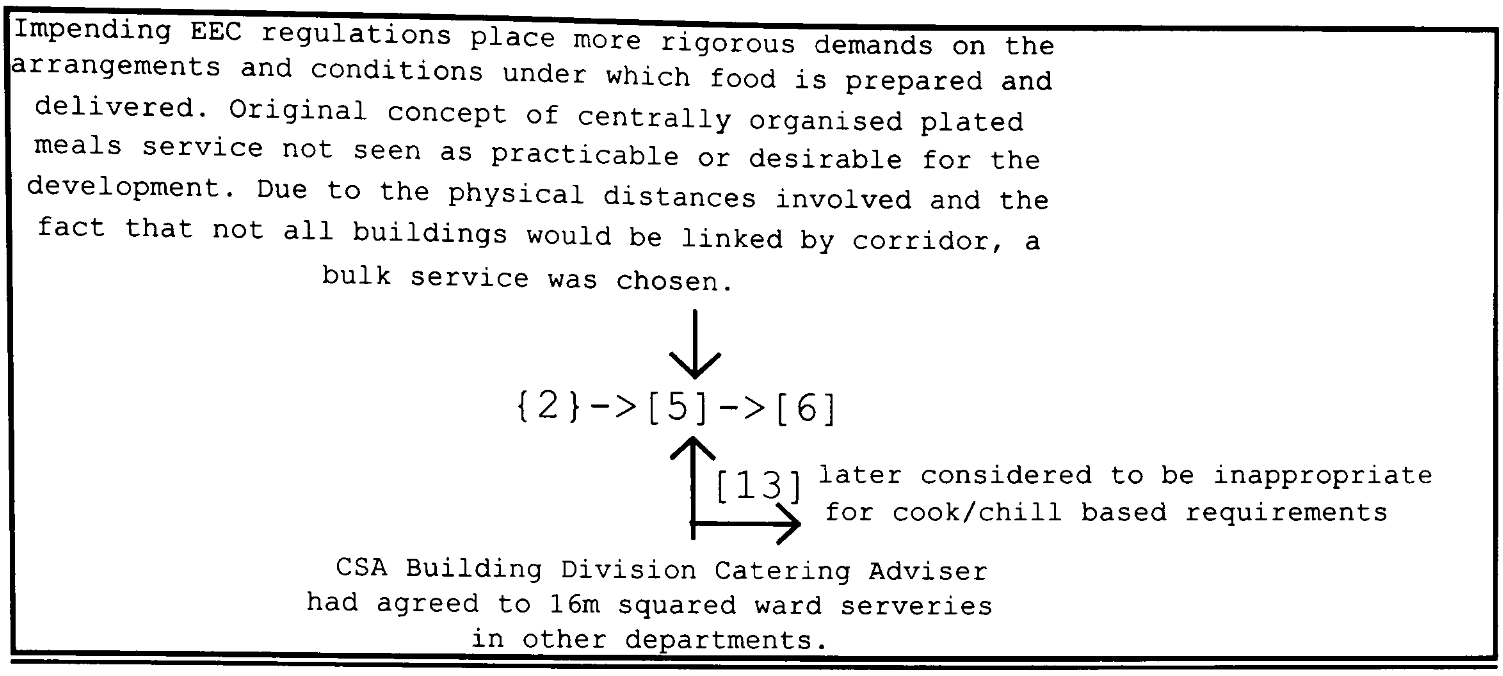


Figure 4.5 Environmental Influence Diagram for Project C, Operation 6

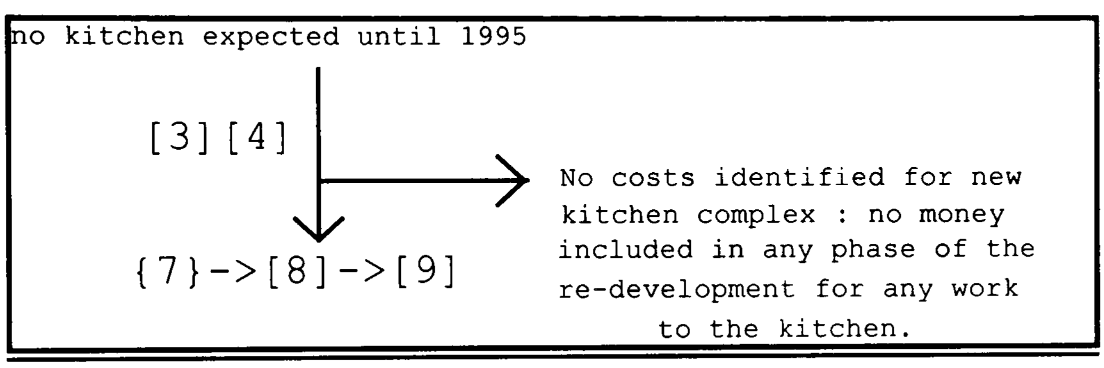


Figure 4.6 Environmental Influence Diagram for Project C, Operation 10

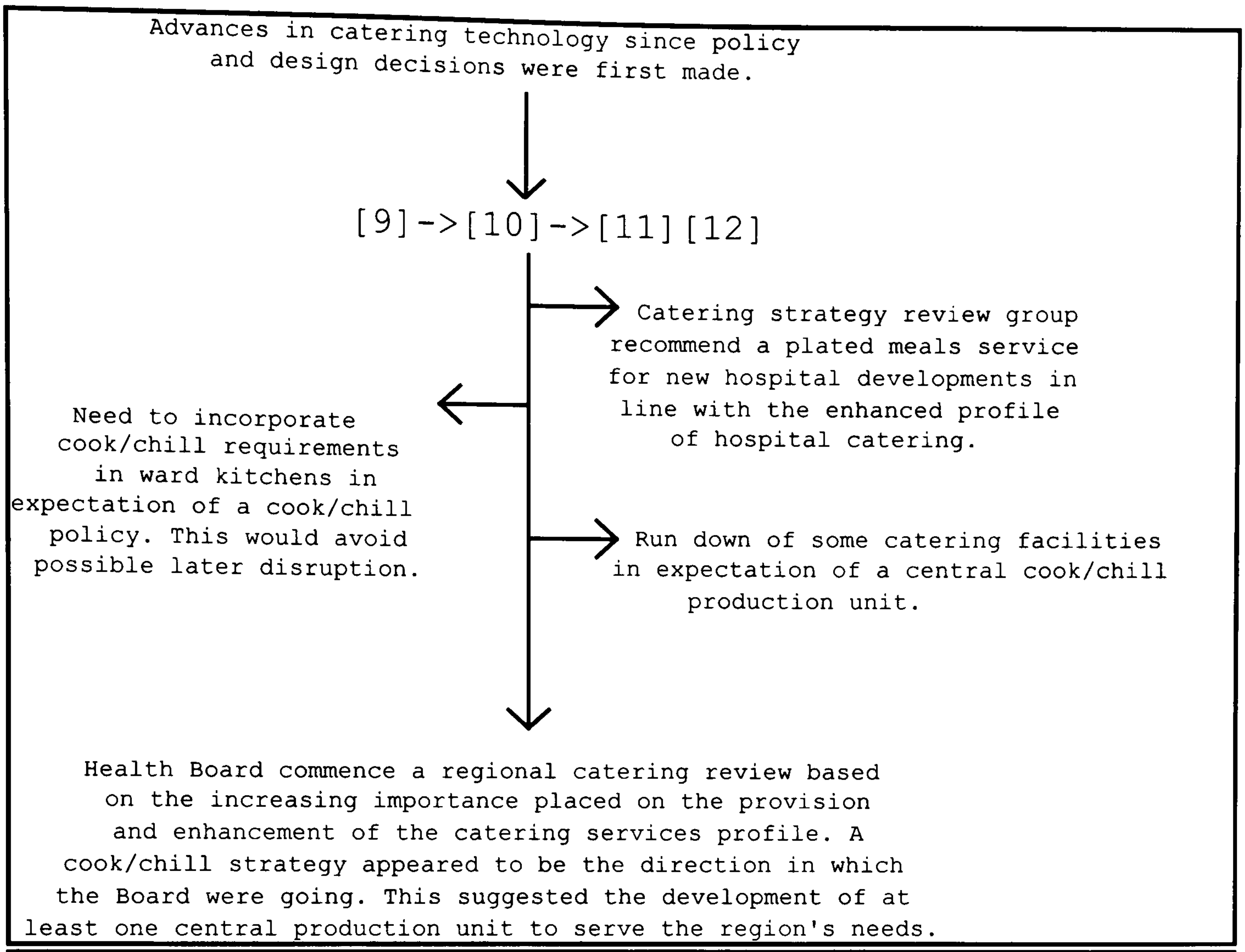


Figure 4.7 Environmental Influence Diagram for Project C, Operation 13

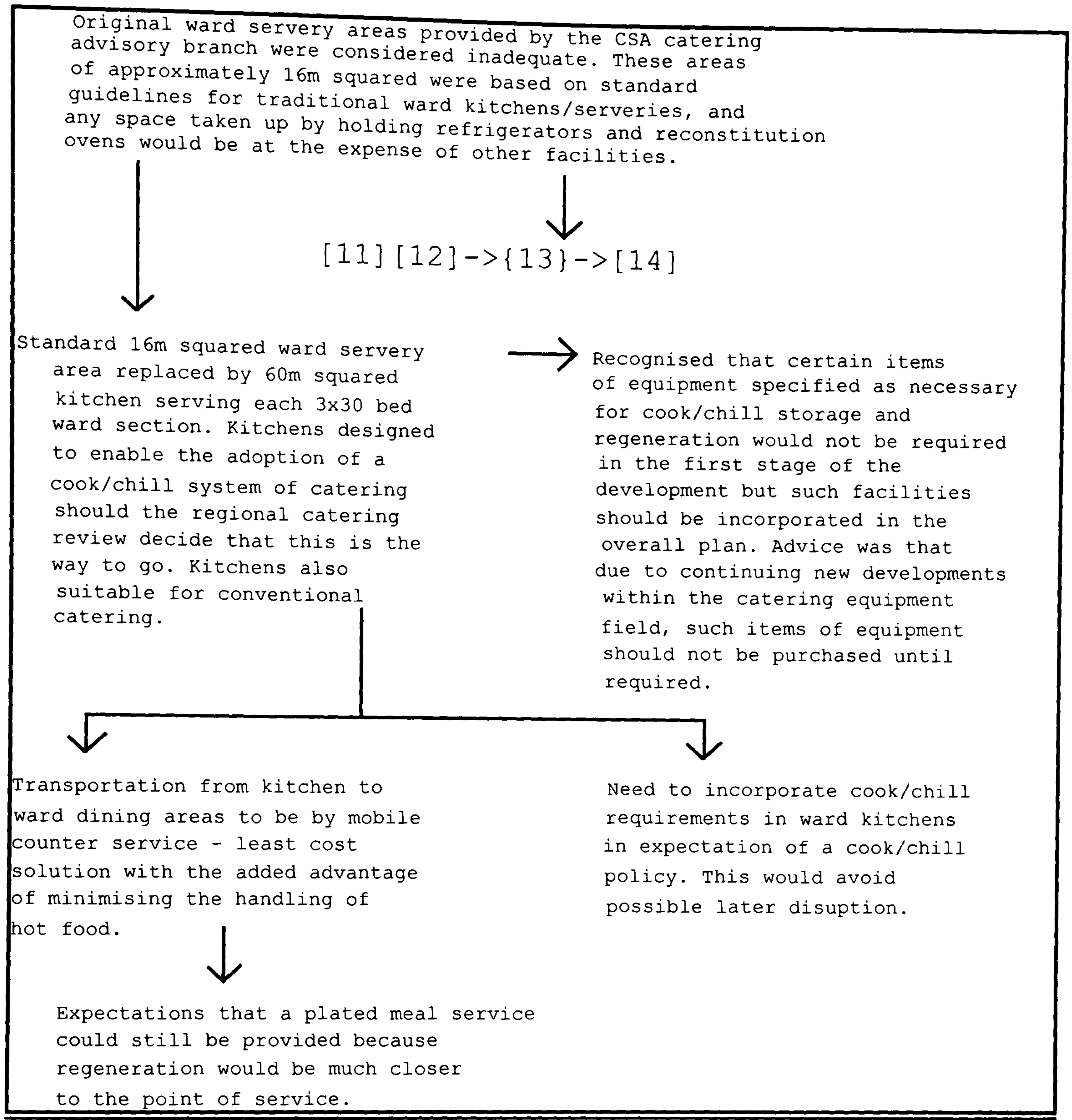


Figure 4.8 Environmental Influence Diagram for Project C, Operation 15

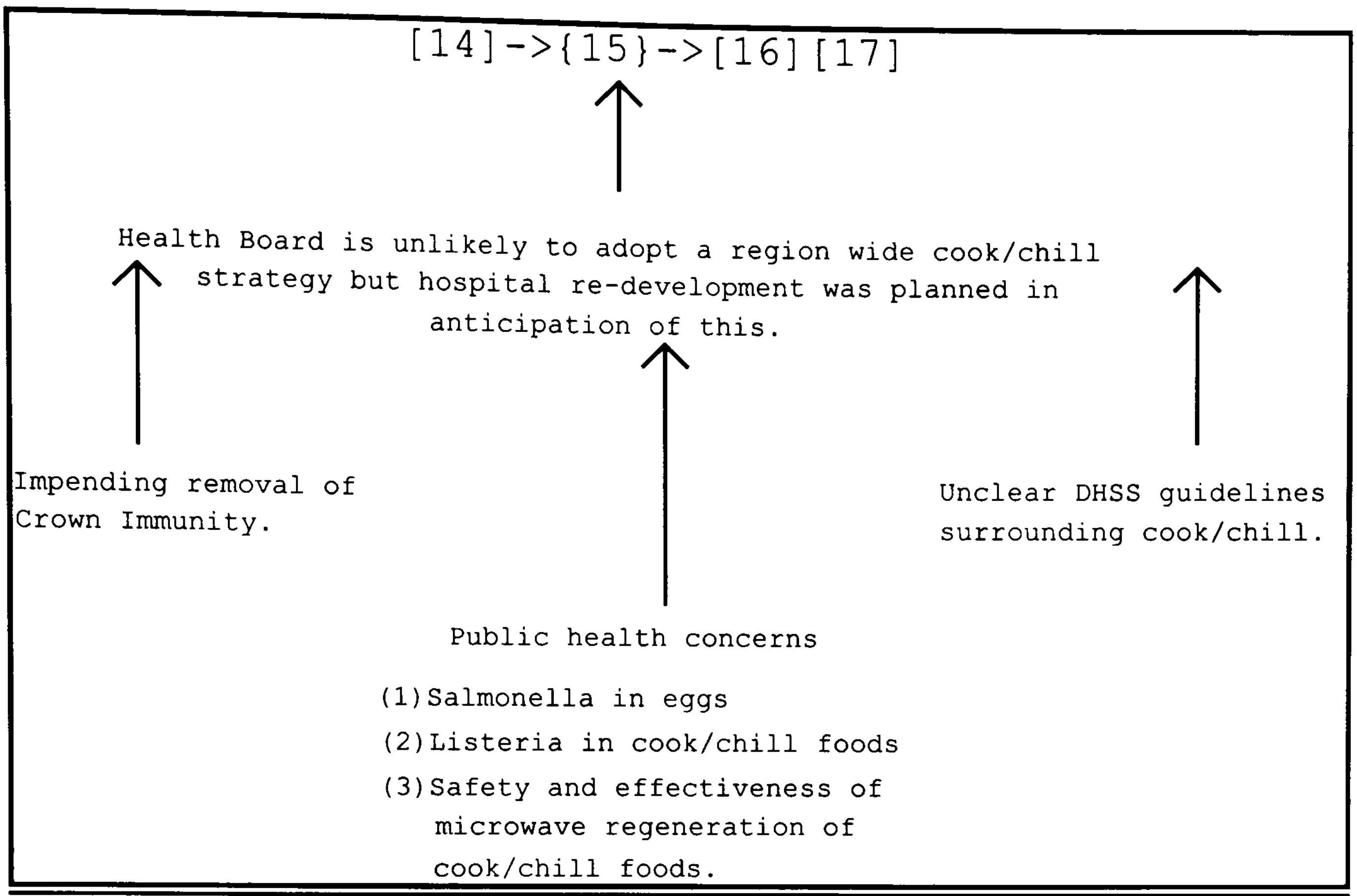


Figure 4.9 Environmental Influence Diagram for Project C, Operation 16

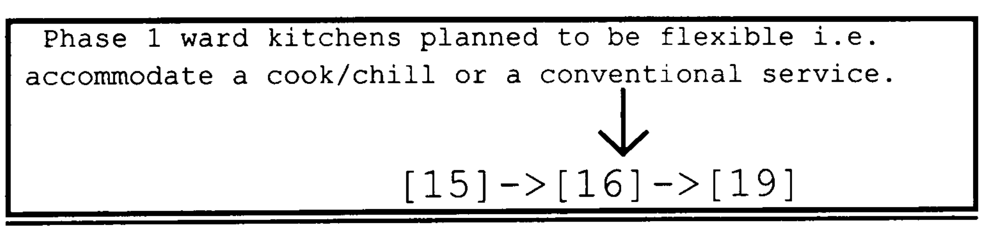


Figure 4.10 Environmental Influence Diagram for Project C, Operation 18

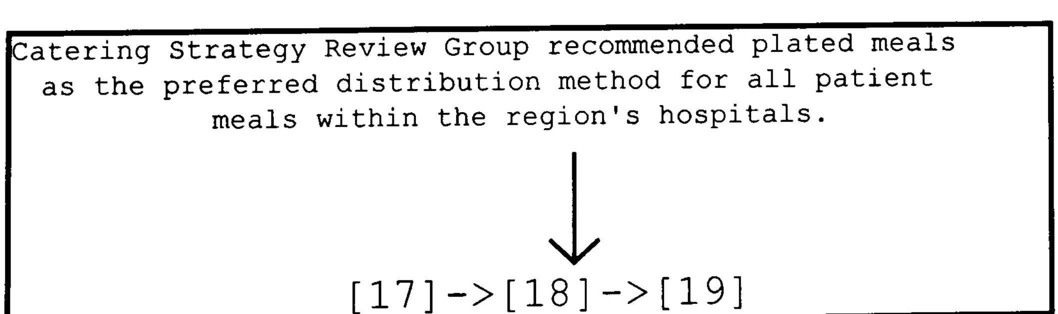


Figure 4.11 Environmental Influence Diagram for Project C, Operation 19

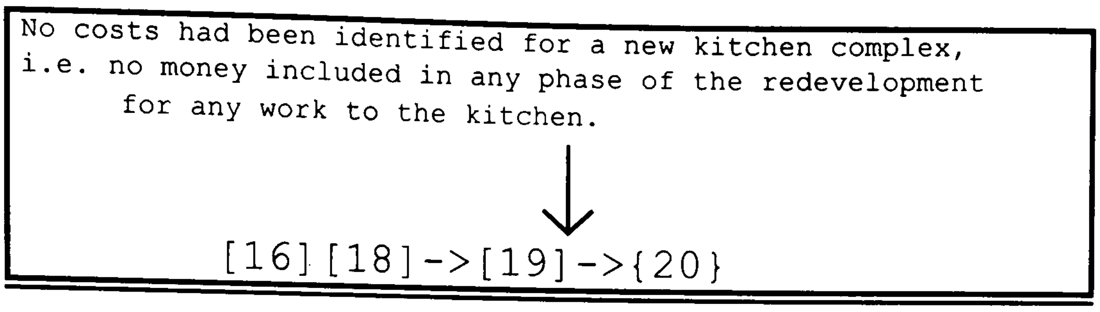


Figure 4.12 Environmental Influence Diagram for Project C, Operation 20

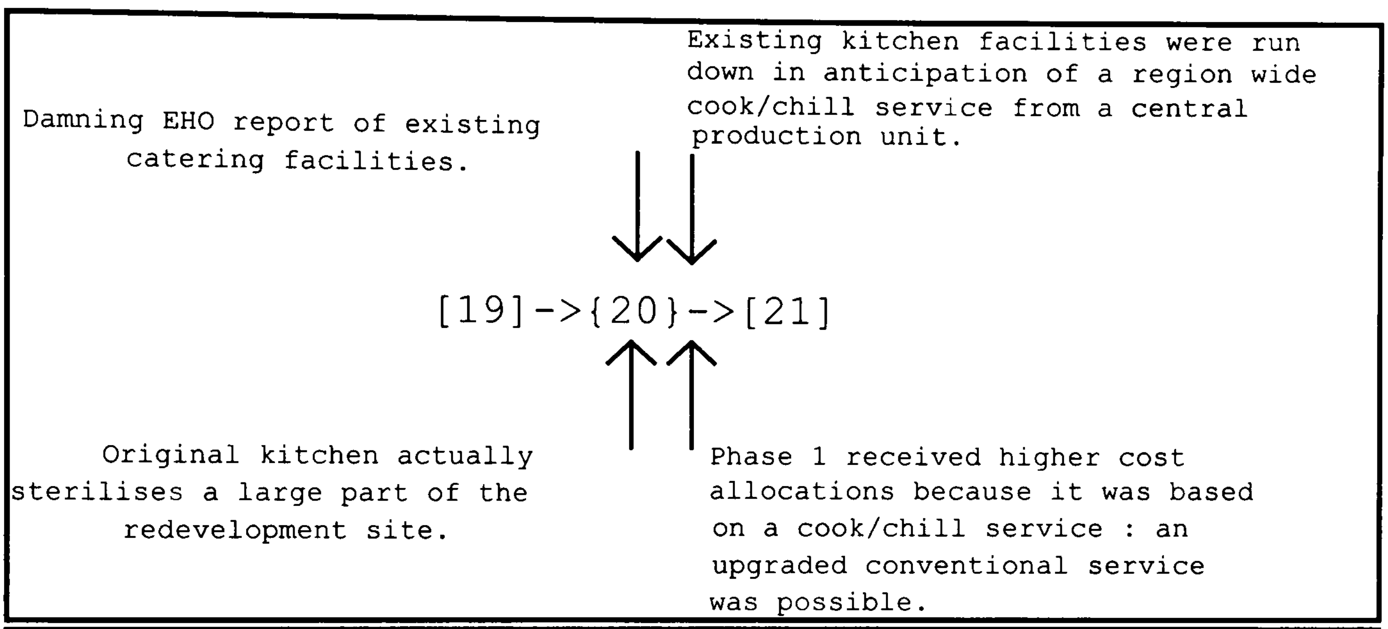


Figure 4.13 Environmental Influence Diagram for Project C, Operation 22

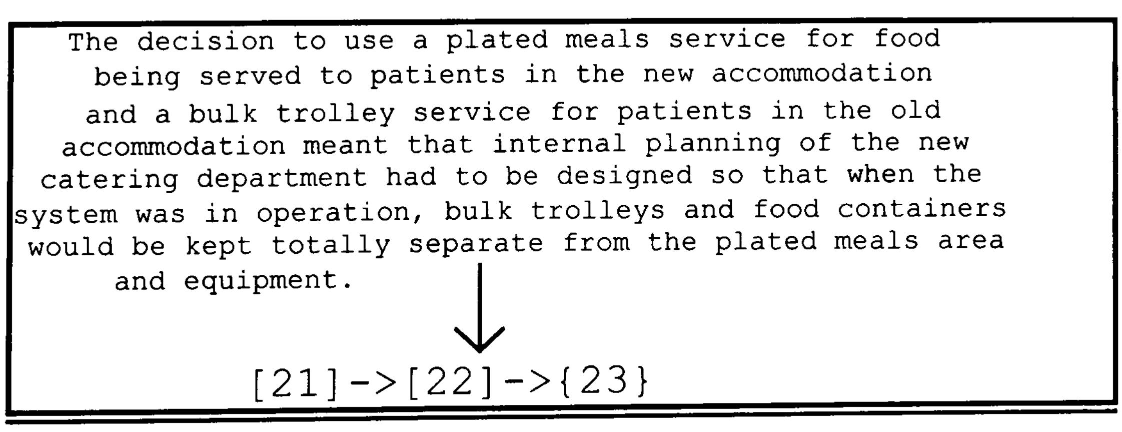


Figure 4.14 Environmental Influence Diagram for Project C, Operation 26

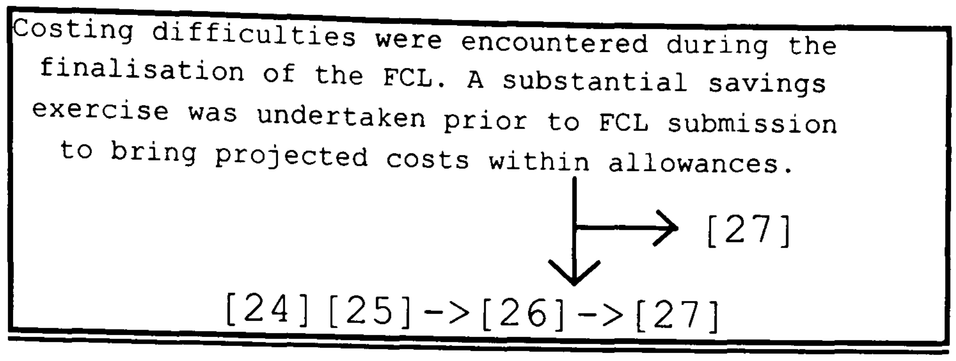


Figure 4.15 Environmental Influence Diagram for Project C, Operation 27

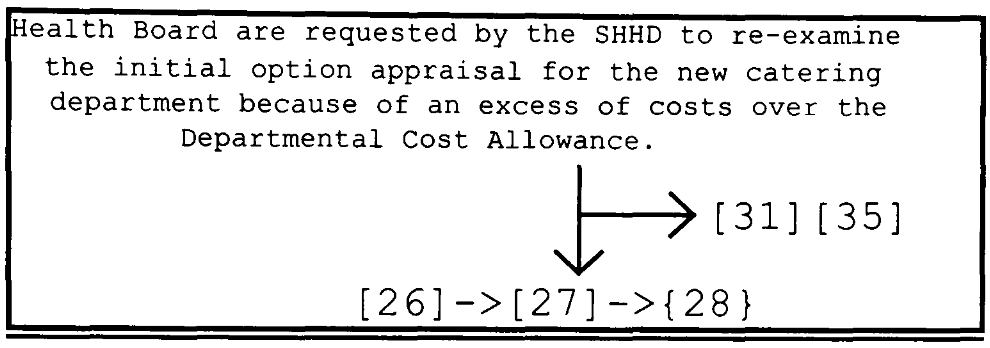


Figure 4.16 Environmental Influence Diagram for Project C, Operation 31

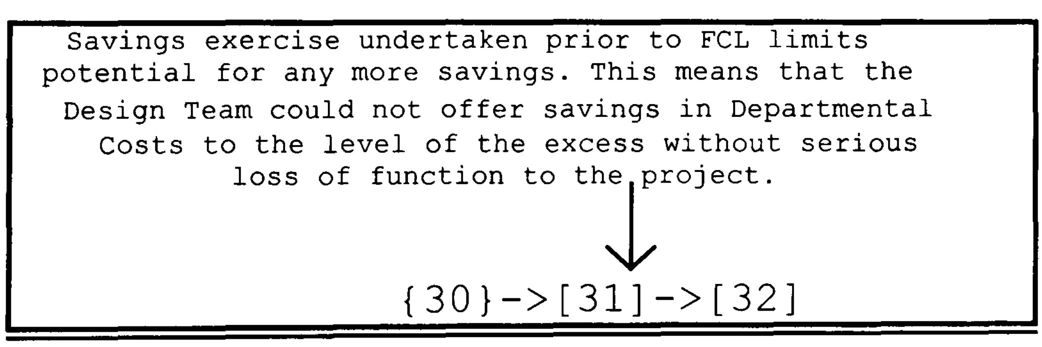


Figure 4.17 Environmental Influence Diagram For Project C, Operation 33

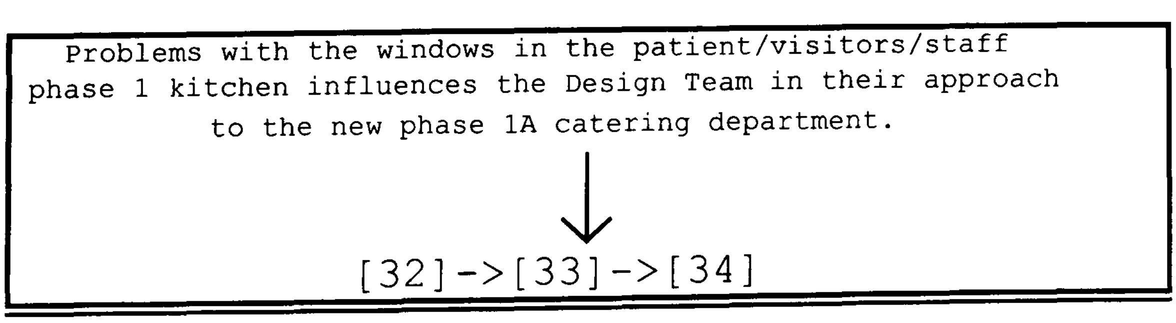


Figure 4.18 Environmental Influence Diagram for Project C, Operation 34

The new kitchen had been designed to handle bulk and plated meals but management were still unsure about spending money on equipment for running a bulk and plated meals service simultaneously. Money had to be spent by March 1992 but managers were still uncertain of the choice in January 1992. The "wait and see" attitude regarding catering system technological developments had forced management into making a snap decision over equipment needs.

↓

[33]->[34]->[35]

Figure 4.19 Environmental Influence Diagram for Project C, Operation 35

Need for savings to be sought to offset : replacement of tiled kitchen areas with painted plaster wall finish.

↓

[34]->[35]->{36}

4.2 Retrospective Project A

4.2.1 Certainty/Uncertainty

Throughout food service planning there was a great deal of uncertainty surrounding the nature of the system that would operate in both the new phase 1, redeveloped hospital 4 and South Block buildings. At the beginning of re-development in the 1960's some very firm principles were set out to guide food service planning, but these were not adhered to. Many changes of policy occurred and it was not until May 1990, when construction was completed on the phase 1 building, that the Unit Management Team had made a firm and certain decision. This final decision had to be worked into a post-contract package; food service system design and construction had continued along a conventional type service but the final decision was for cook-chill. The design changes necessary were relatively easy to achieve, the extra space needed for storage in the cook-chill system was offset against a decrease in the spatial requirements for preparation and cooking areas.

The final outcome, however, is still removed from the original planning principles. As far as uniformity is concerned the patients in the phase 1 and South Block buildings all receive food procured by a cook-chill system. In the phase 1 kitchen a conventional service operates for staff but this does not reflect original planning principles which required "industrial processes" to be reduced to a minimum. In effect, in the phase 1 kitchen two types of system operate. A cook-chill system does require some items of prime cooking equipment to cook foods that are not suitable for the cook-chill process. However, had the staff service also been on a cook-chill system the amount of prime cooking equipment required would have been much less. In this case, the greatest requirement in the kitchen would have been for storage space of chilled foods.

4.2.2 Conflict

During food service planning no obvious incidences of conflict occurred although different people involved in the project had very different ideas on what service should have been provided. The changes in user group representation may have compounded this problem along with changes in other key personnel.

4.2.3 Technical Complexity (Spatial, Structural, Services)

At the beginning of planning, guidelines were laid down in order to limit the extent of cooking processes on site. This naturally led to the decision to buy in frozen meals and simply regenerate at ward level. It is not clear why later planning decisions moved away so drastically from this original principle. As well as the changes in ideas concomitant with the change in project personnel, there are a number of factors which probably led to the swing between a cook/freeze or cook-chill system and a more conventional type of service.

At the start of hospital re-development, cook-chill and cook/freeze concepts in large scale catering were relatively new ideas. On the face of it, these new systems may have appeared to have been a panacea for hospital catering services, but they were in the early stages of development and little was known about their inherent strengths and weaknesses. The DHSS guidance on catering had no mention of these types of systems and in the mid 1980s the DHSS was not in favour of large scale cook-chill units. Coupled with the changing technology surrounding food services there has also been constant change in food legislation. Food hygiene law requires constant interpretation, there is an incessant need to plan for the future and take into account any changes in legislation/practice which may be forthcoming. In particular, there have been increased requirements relating to food temperature control, influenced by the phasing out of Crown Immunity in 1991. This has meant that all hospitals now come under the same strict food hygiene laws that govern other food serving premises. Without clear guidance from the DHSS and Environmental Health Departments, on the technical aspects of cook-chill or cook/freeze systems, planning would have been difficult. Without knowing precisely the full effects of this kind of system, some of the staff involved in decision making were probably loathe to agree to something so new and unfamiliar.

The Salmonella and Listeria food scares in the late 1980s, coupled with the controversy surrounding the safety of microwave regeneration of chilled food, may also have caused wavering in the cook-chill decision.

4.2.4 Aesthetics

Since the catering department for phase 1 was planned as a sub-system of the phase 1 building, aesthetic criteria applying to the phase 1 building applied to individual sub-systems.

4.2.5 Function

As far as function was concerned, at the start of planning it was clear that the phase 1 building was going to house the major element of the catering sub-system. This policy decision did not change throughout the lengthy project history. Additionally, it was always envisaged that some element of catering would be located in the South Block building of hospital 1, to provide food for the patients remaining in existing ward accommodation. The distance between the proposed location of the phase 1 building and the old Hospital building excluded any form of food transportation between the two sites.

What remained undecided throughout the majority of the building procurement process, was exactly how the food would be produced. The client had a major decision to make regarding the type of system, either conventional, or cook/freeze/chill which would produce the food for staff and patients. Although this decision did not have a major effect on location of the catering sub-system within the whole hospital, it did have important consequences with regard to other design and operational matters. Although planning progressed based on a conventional food procurement system, the cook-chill option was never totally abandoned and eventually this was the type of system which the phase 1 and Hospital 1 buildings operated for patient meal provision. Ultimately, the phase 1 catering sub-system was able to produce food conventionally for staff consumption but held commercially bought in chilled food for patient consumption. The situation still exists despite the fact that it would be much more economical to procure both patient and staff food conventionally, especially since the kitchen has most of the requirements for a full conventional service.

Figure 4.20 Environmental Influence Diagram for Project A, Operation 2

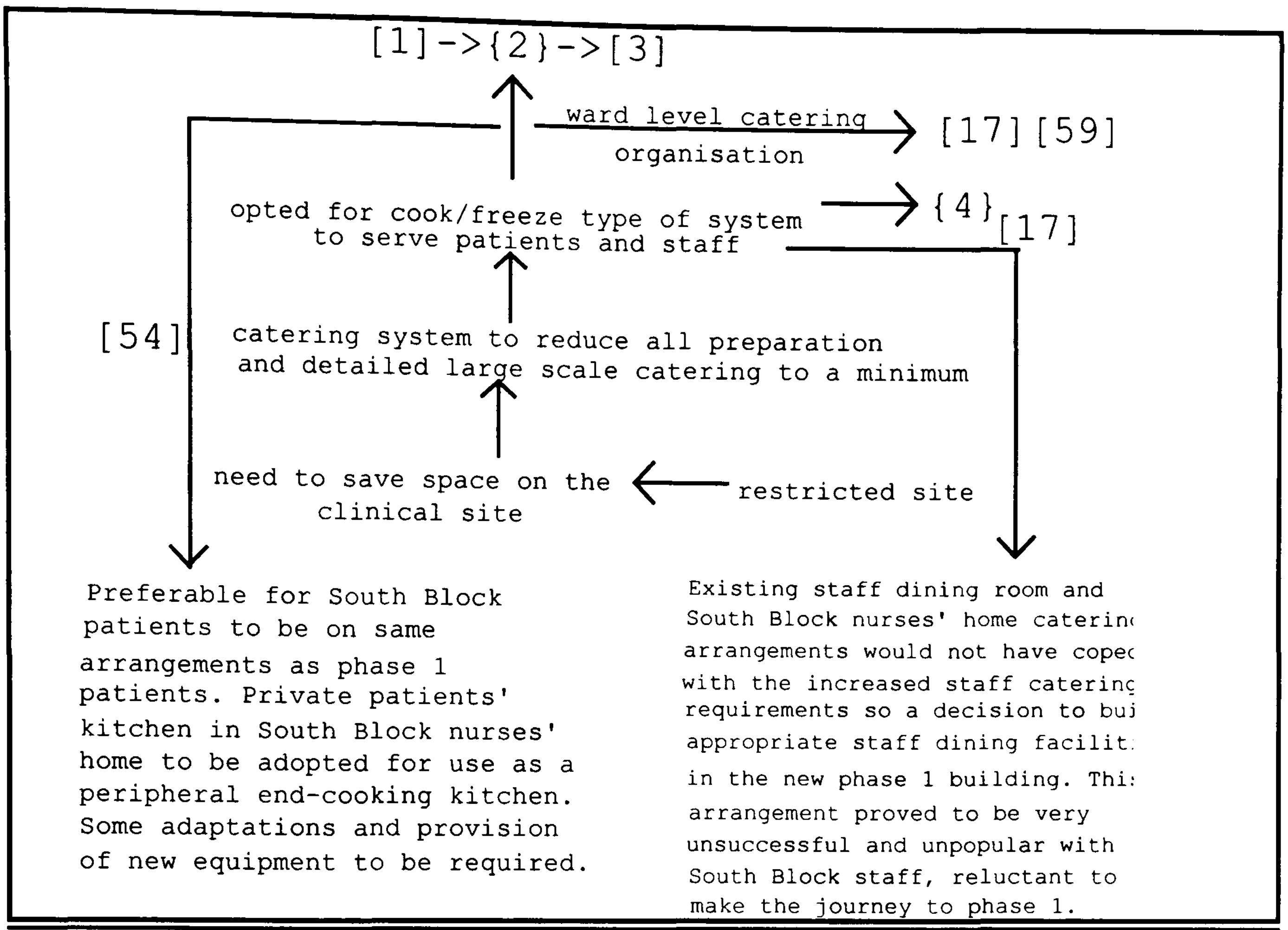


Figure 4.21 Environmental Influence Diagram for Project A, Operation 4

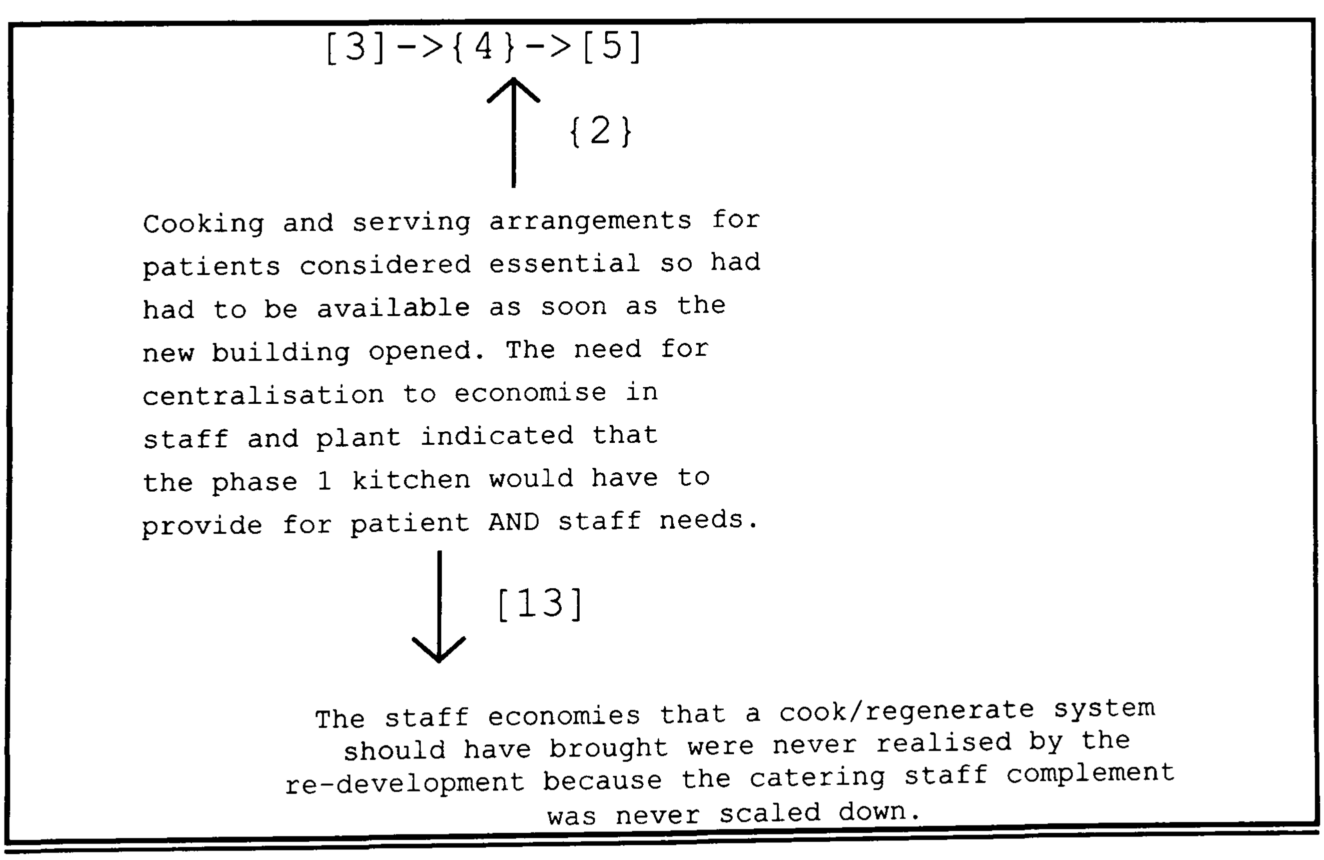


Figure 4.22 Environmental Influence Diagram for Project A, Operation 6

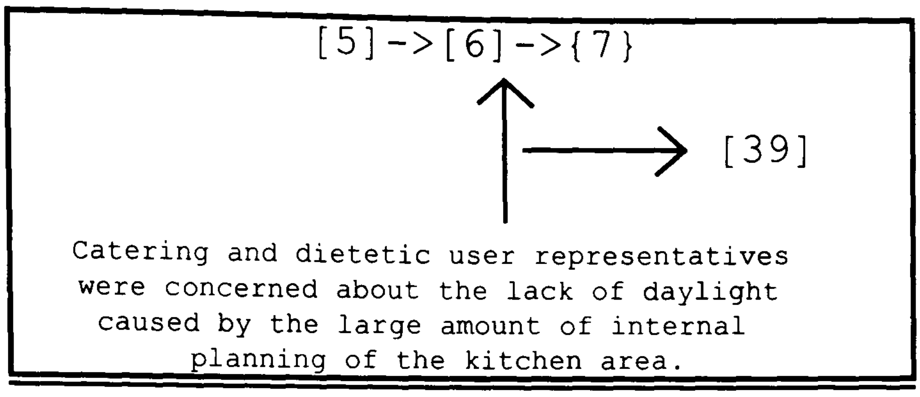


Figure 4.23 Environmental Influence Diagram for Project A, Operation 8

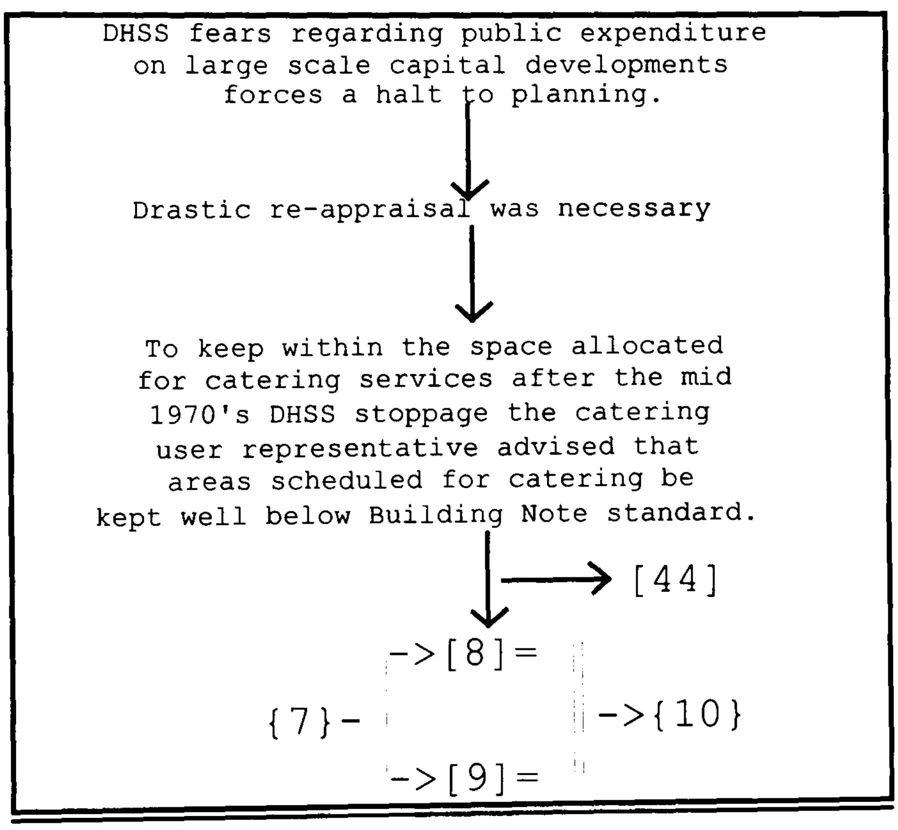


Figure 4.24 Environmental Influence Diagram for Project A, Operation 17

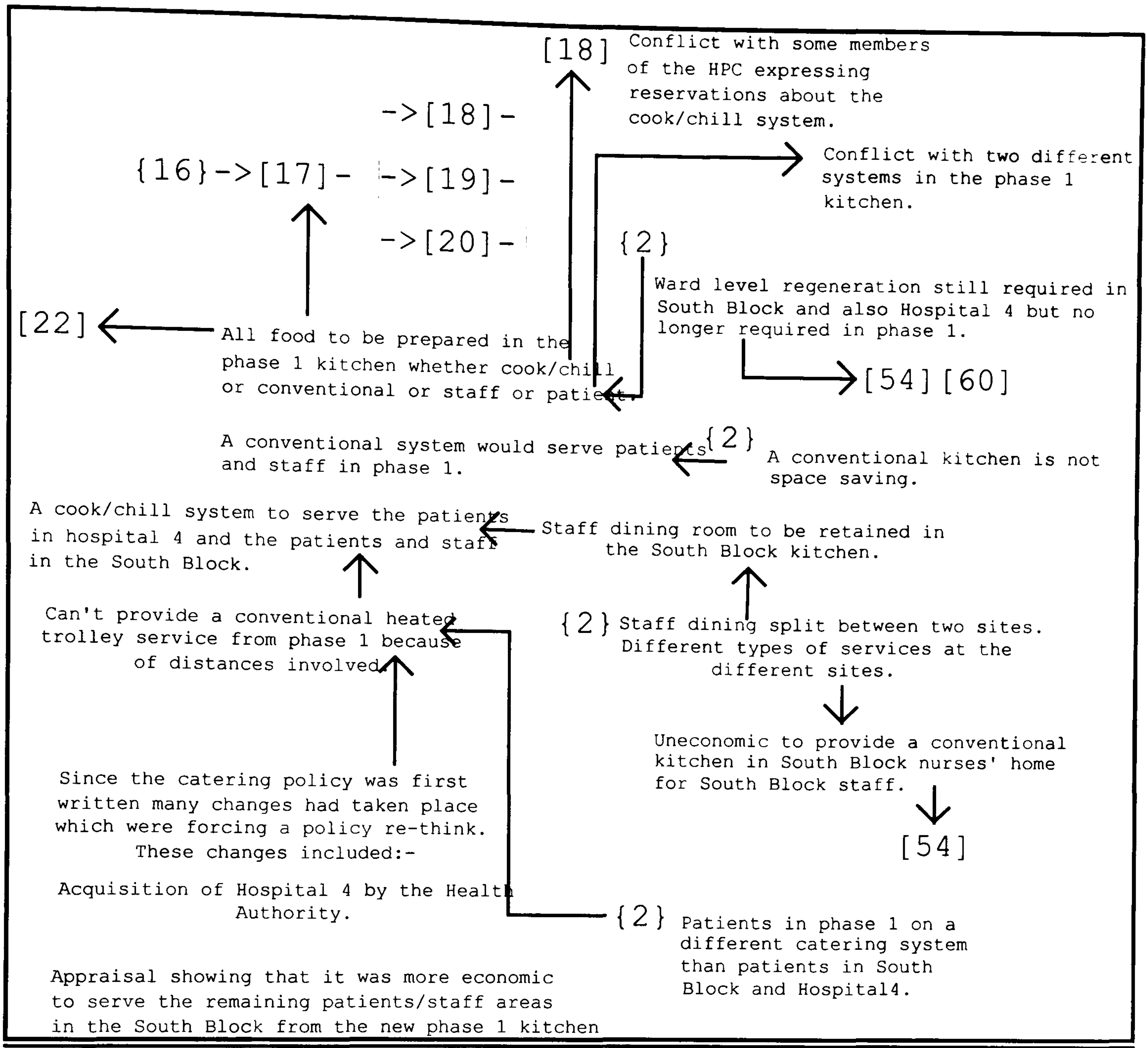


Figure 4.25 Environmental Influence Diagram for Project A, Operation 18

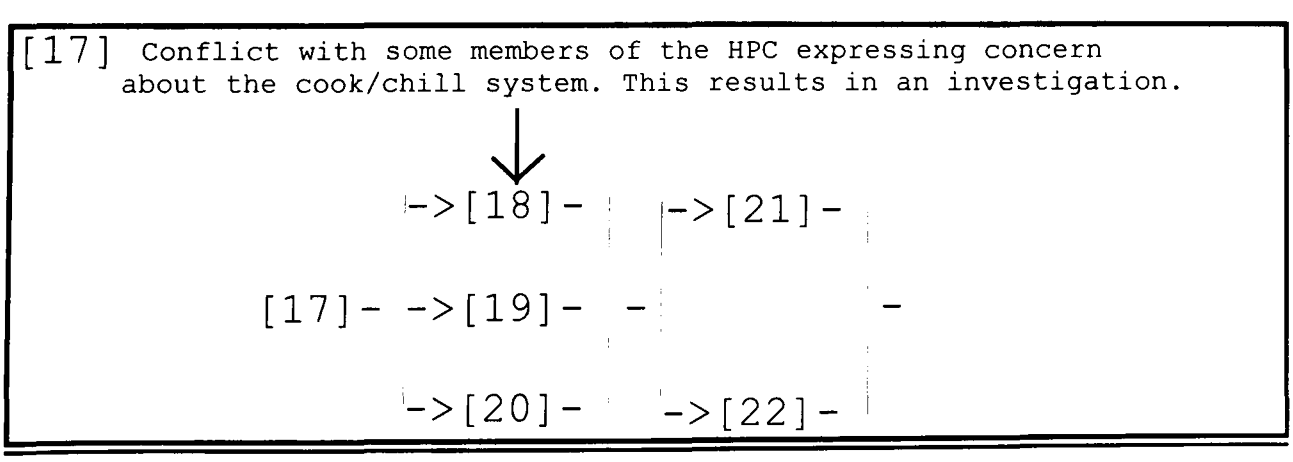


Figure 4.26 Environmental Influence Diagram for Project A, Operation 22

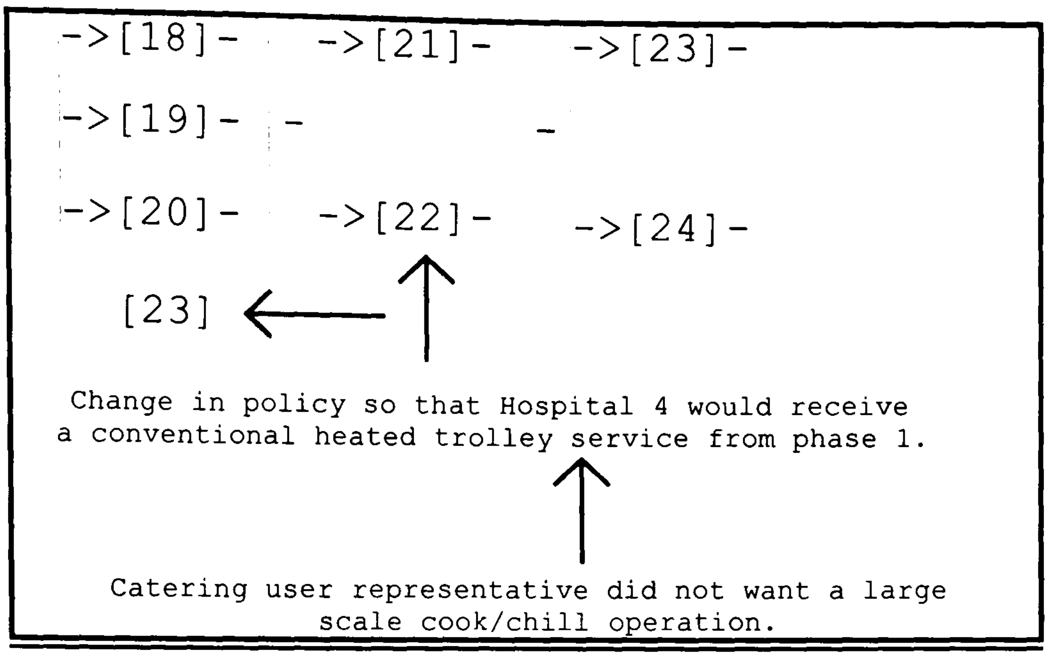


Figure 4.27 Environmental Influence Diagram for Project A, Operation 23

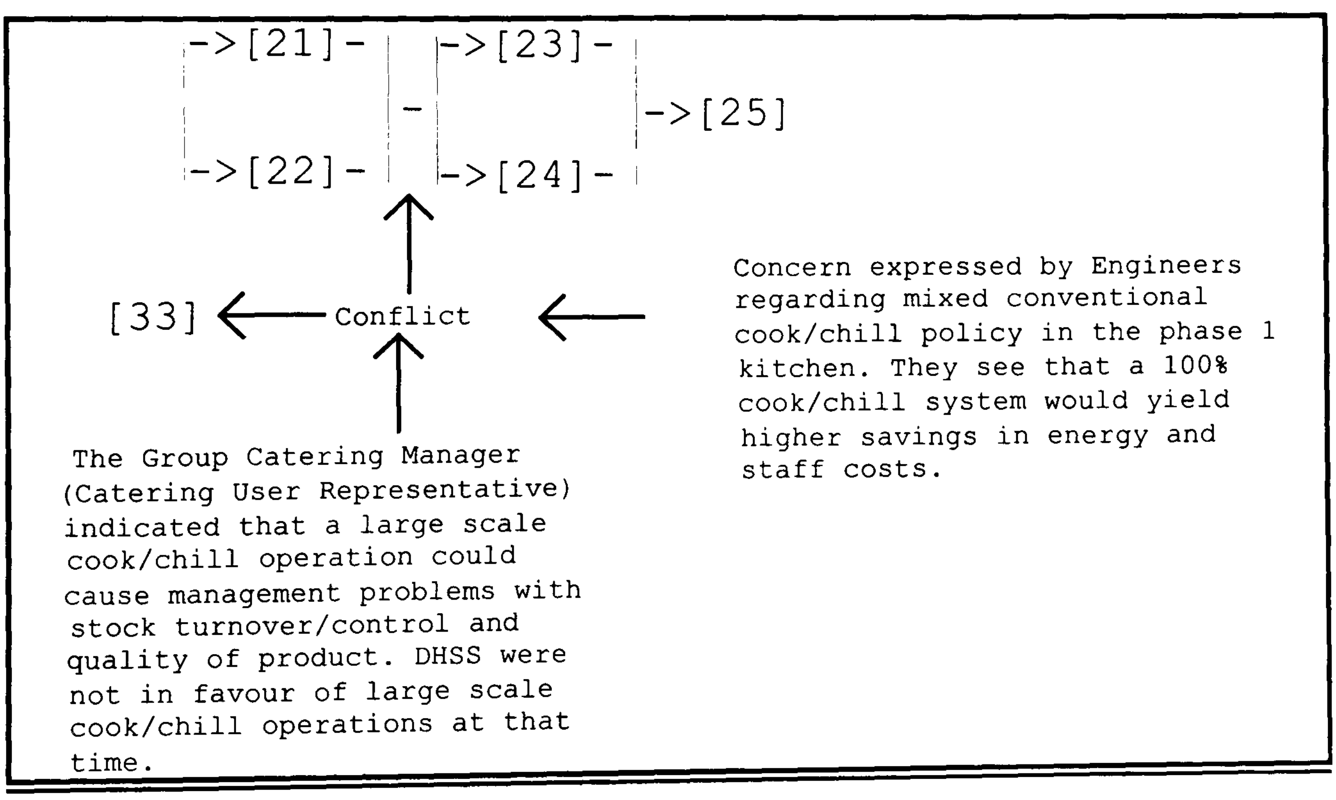


Figure 4.28 Environmental Influence Diagram for Project A, Operation 33

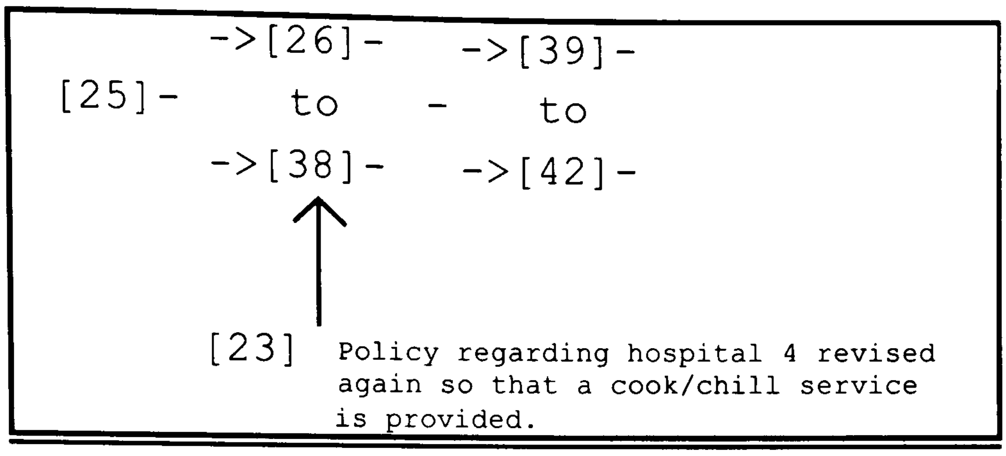


Figure 4.29 Environmental Influence Diagram for Project A, Operation 39

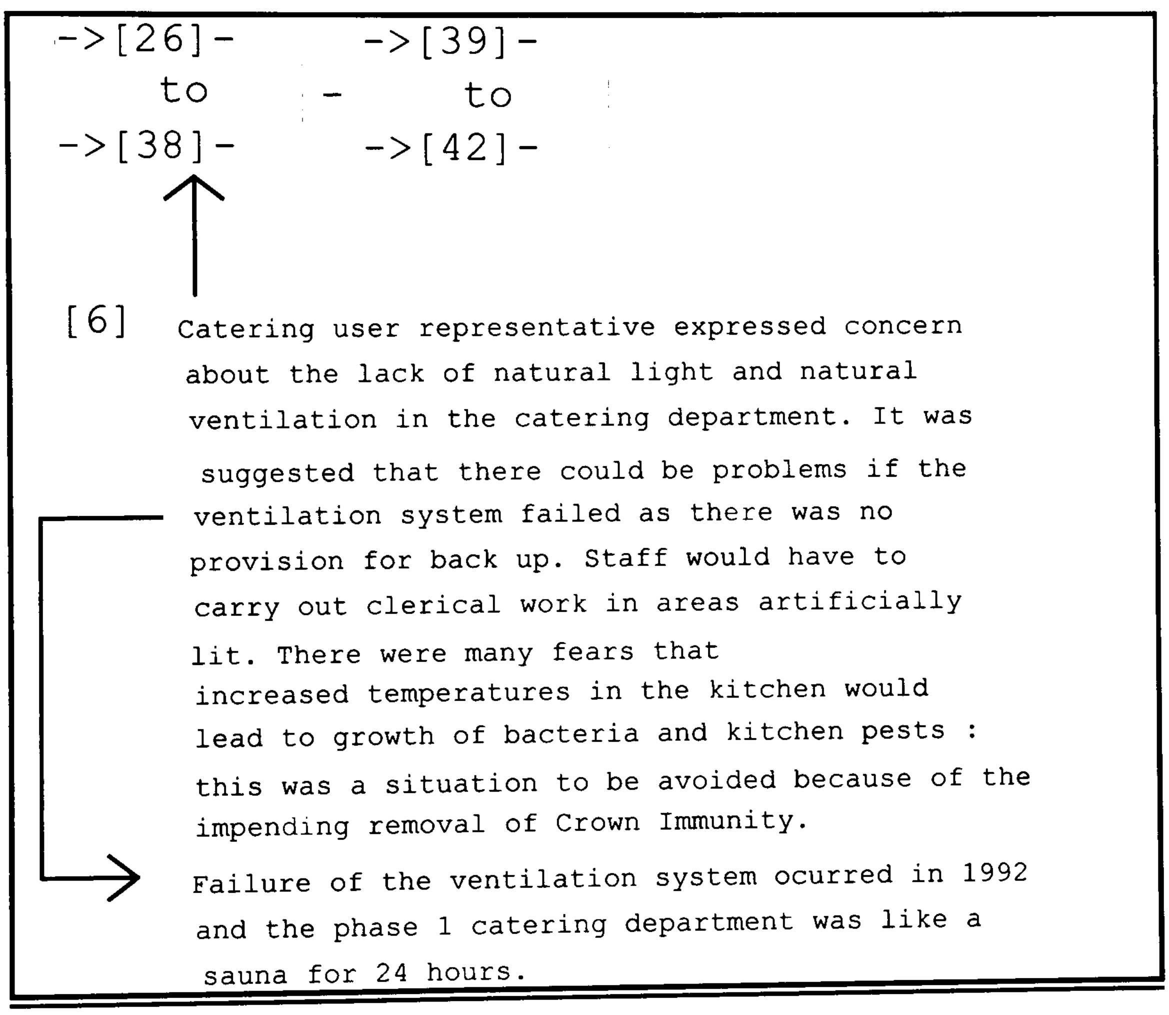


Figure 4.30 Environmental Influence Diagram for Project A, Operation 42

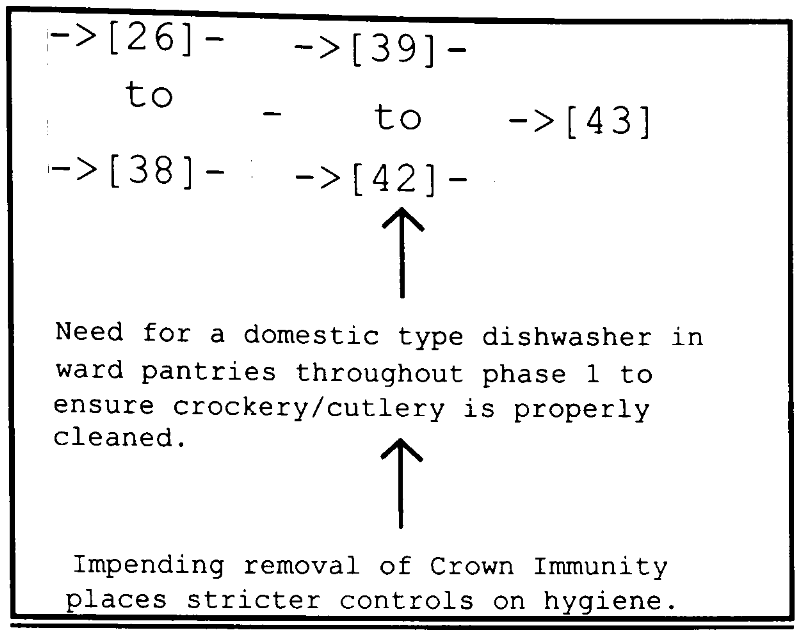


Figure 4.31 Environmental Influence Diagram for Project A, Operation 44

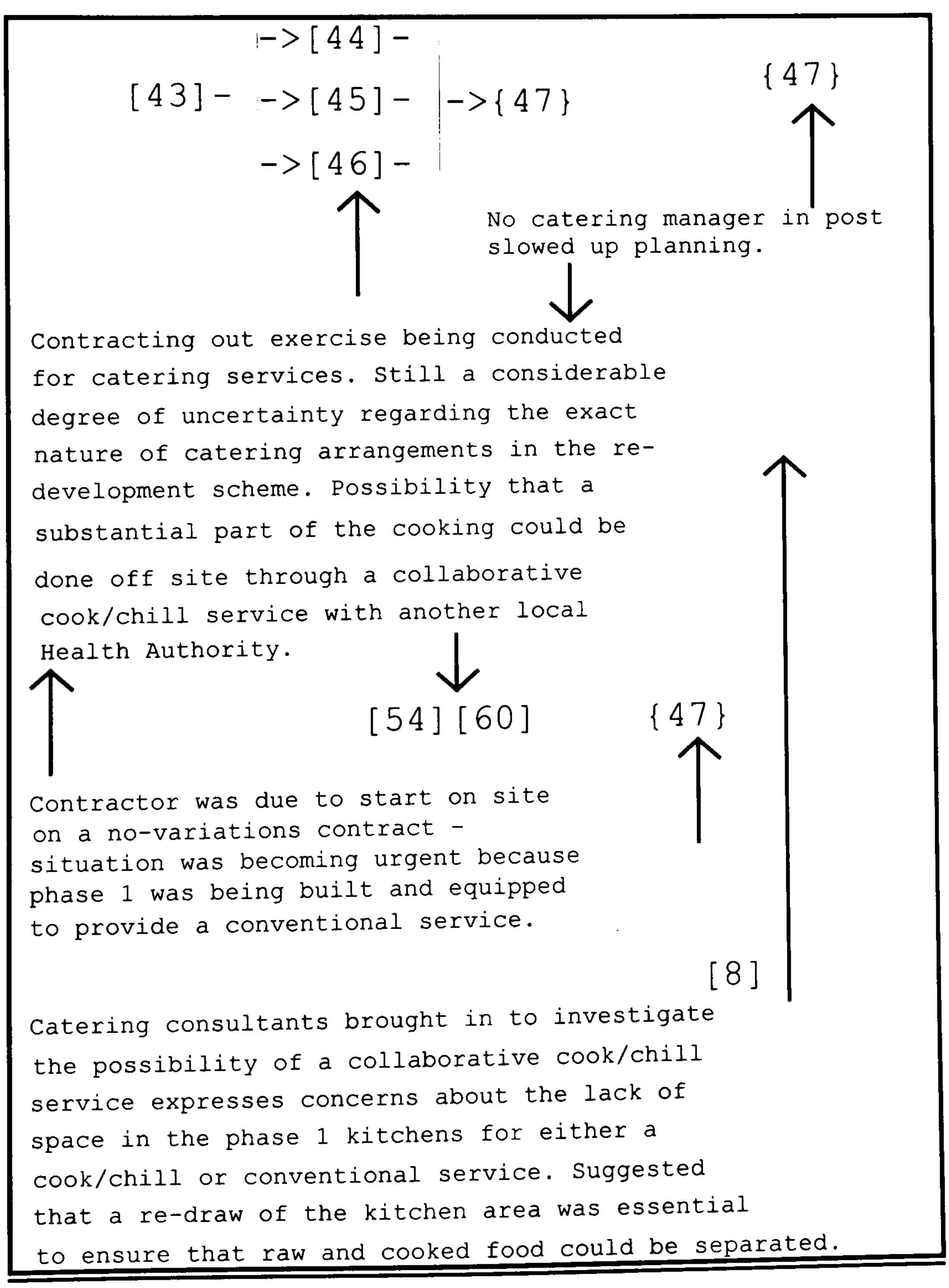


Figure 4.32 Environmental Influence Diagram for Project A, Operation 47

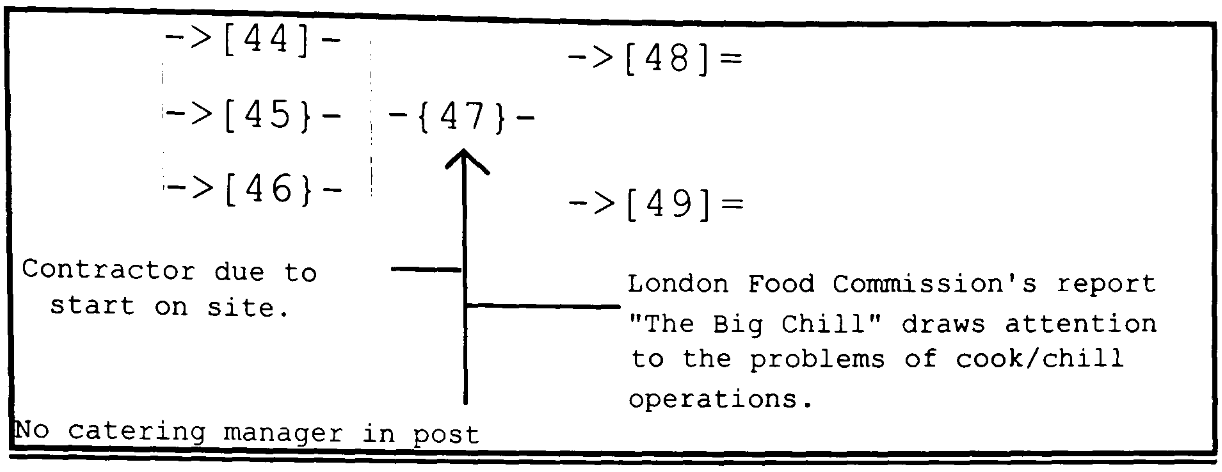


Figure 4.33 Environmental Influence Diagram for Project A, Operation 54

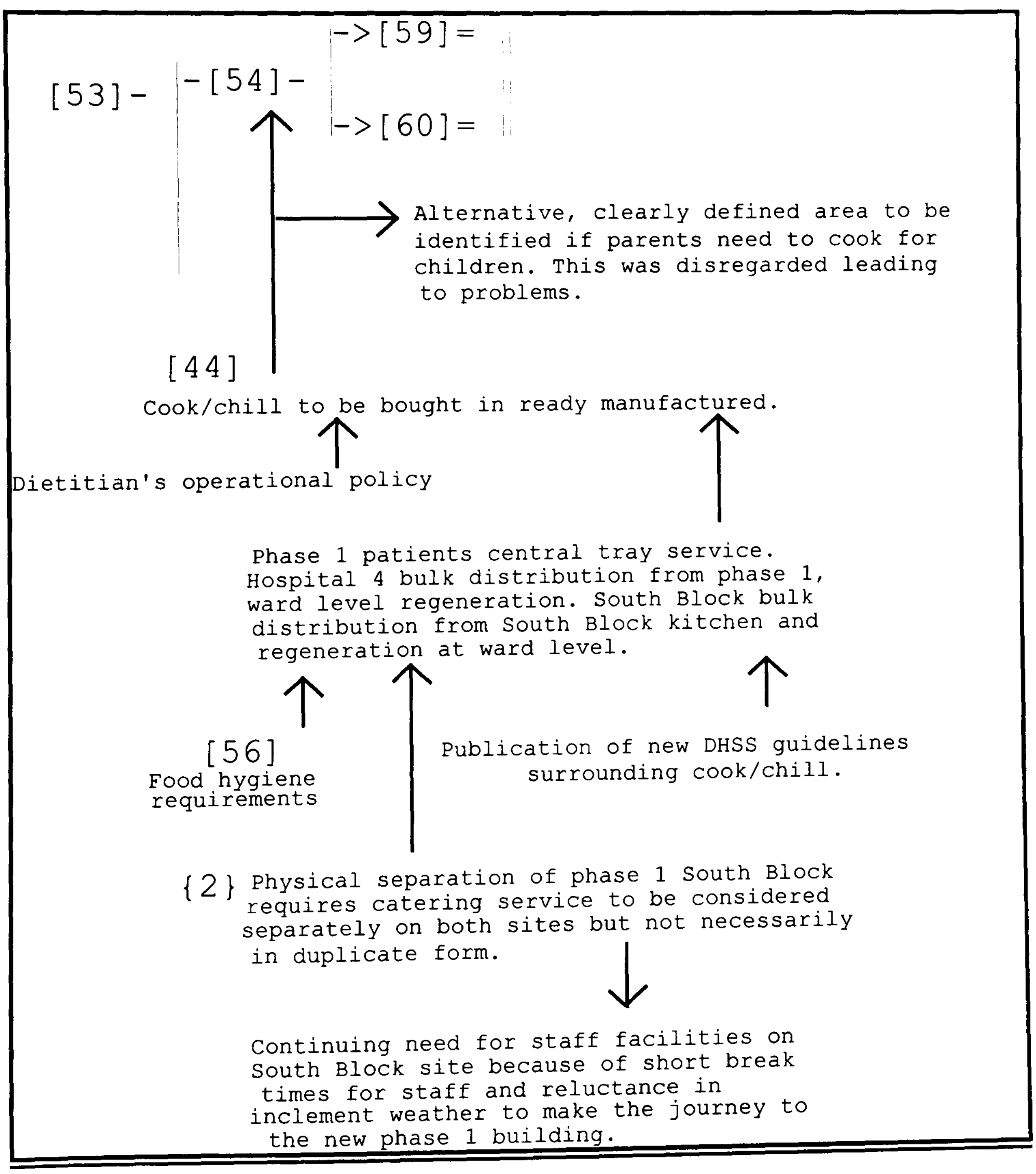


Figure 4.34 Environmental Influence Diagram for Project A, Operations 59 and 60

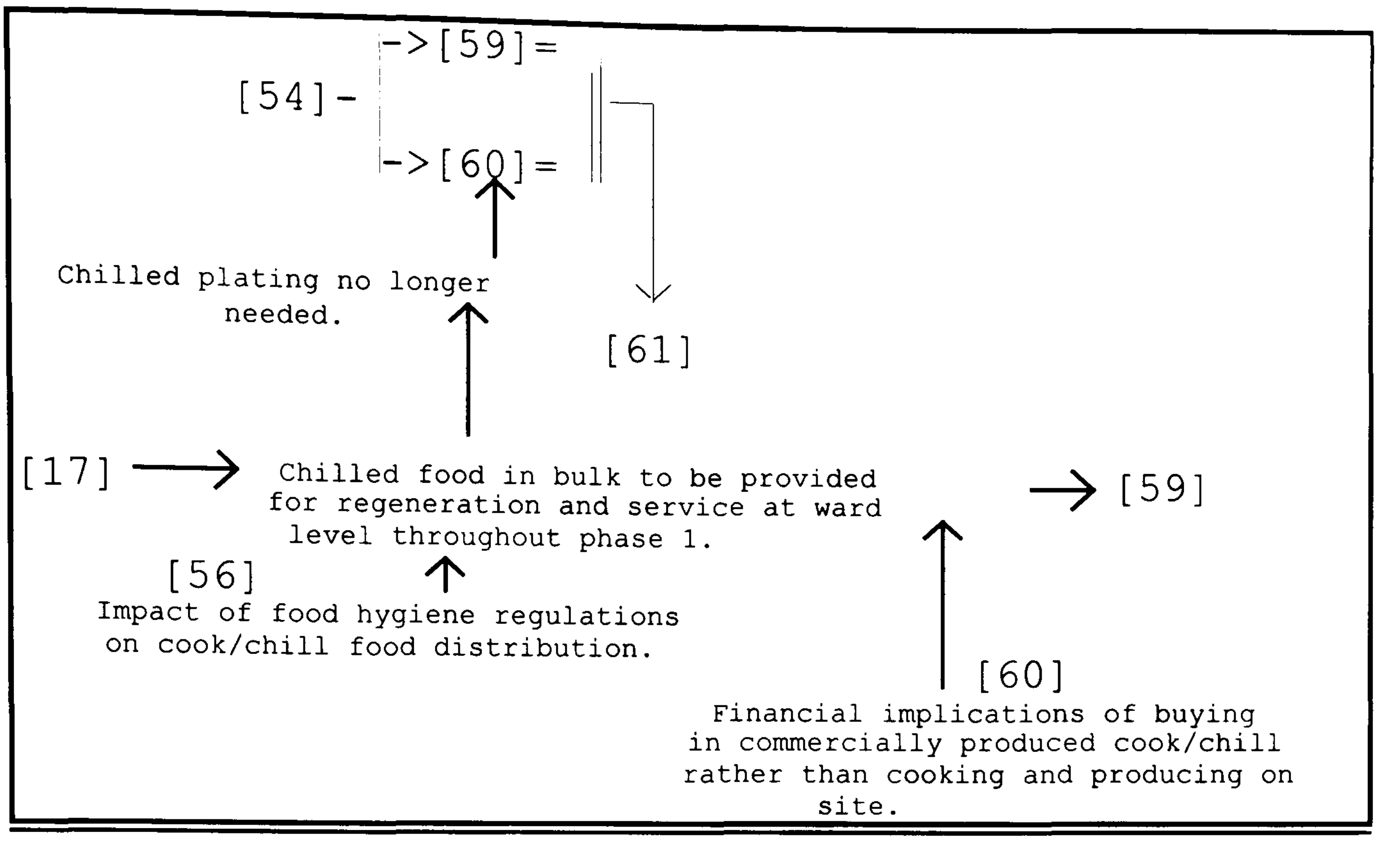


Figure 4.35 Environmental Influence Diagram for Project A, Operation 62

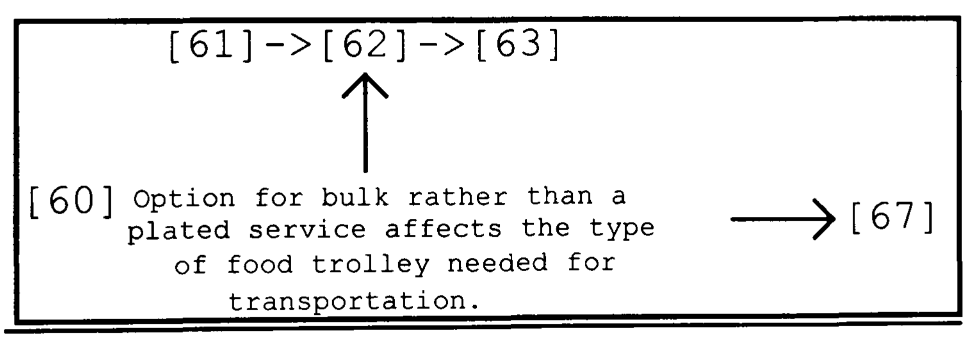


Figure 4.36 Environmental Influence Diagram for Project A, Operation 65

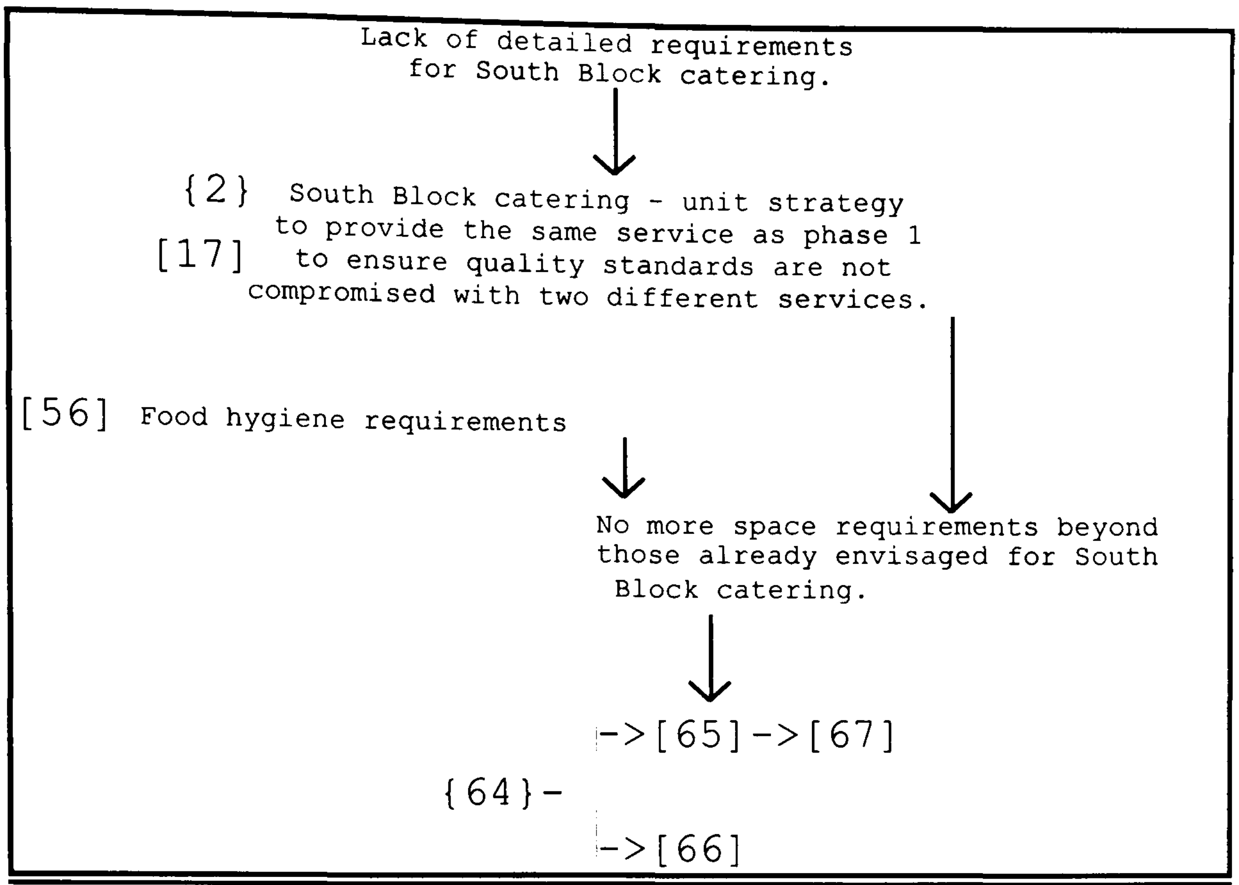
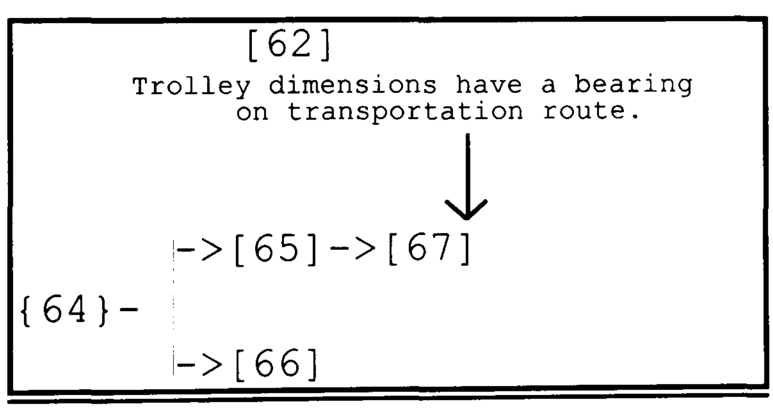


Figure 4.37 Environmental Influence Diagram for Project A, Operation 67



4.3 Retrospective Project B

4.3.1 Certainty/Uncertainty

Considerable uncertainty surrounding the go-ahead for the project could be attributed to lack of funding and lack of commitment at Authority level to actively seek a way out of the funding problem. The problem of space and equipment in the old kitchen had been the subject of various reviews during the previous ten years but the cost of making adequate changes to the working environment was extremely high and led to a delay in any firm proposal or decision being made.

A number of decisions made on behalf of the catering department over the last decade had affected its operational effectiveness and, whilst remedial action was always taken immediately if possible, progress regarding long term solutions was always slow due to difficulties in co-ordinating various managers and service users. Despite the fact that senior managers had given a tremendous amount of verbal support, desperately needed practical assistance had not been forthcoming.

Capital planning is worked out on a five year rolling programme. The Regional Health Authority were committed to fund a permanent catering department planned for in phase 3 (mid 1990s) but would not fund an interim scheme. There were no moneys in the District Health Authority's capital programme to fund such an interim scheme. Any moneys for a proposed new development of catering facilities would had to have come from some form of income generation.

There were very few options for siting the catering department. Ideally, it would have been best to build on the site designated for the permanent department but this would have precluded the construction of phase 3, which was the planned location for the new catering department. Most of the unaccounted for space on the site had already been designated for other builds. The project was very much an unknown quantity: nothing like it had been attempted before so no-one was sure that it was right because there was nothing else to compare it to.

From the time of the option appraisal, after a decision about the solution had been made, doubts about funding re-surfaced when it became clear that funding would depend on the successful sale of a health centre. Immediately after the Authority District General Manager gave formal approval for the purchase of the new temporary catering facility to go ahead, he resigned. Doubts over the project arose again when a new temporary District General Manager was appointed, but he did not hold the project back.

In July, when the order for the new system built catering department had been placed, the Catering Services Manager was in no doubt that the project would continue as planned. However, from the point of view of the catering staff, their doubts only disappeared when they saw the foundations being laid at the beginning of September 1990. At the end of September, everyone felt completely assured when the sectional building arrived for erection.

4.3.2 Conflict

There was very little conflict experienced during the project. A number of snagging problems arose when the department had been built and became apparent on occupation and commissioning. During the defects liability period there were four main problems which did cause some conflict between the system build kitchen company and the District Health Authority.

The first of these problems concerned calculations for the required electrical capacity of the catering department. During commissioning it became apparent that the calculated electrical capacity was incorrect and this problem had to be rectified immediately. There was some conflict over this matter as neither the Health Authority or the system build kitchen company was willing to accept responsibility for the mistake. The matter was brought to a satisfactory conclusion when the system build kitchen company agreed that excess finances incurred in rectifying the electrical problem would be borne by them.

The second problem was the Artex ceiling finish which was not of an acceptable standard. A permanent solution was effected to cracks in the Artex when the system build kitchen company fitted a suspended ceiling to the structural ceiling.

The third problem was due to poor ventilation in the pot wash and servery areas. The pot wash area was affected by excessive steam build up when the pot wash was in use. The result of this was that the ceiling cover trims had begun to buckle and the excessive condensation was causing unsafe/unhygienic floors and walls. The Health Authority was concerned that the creeping of this moisture through the cladding joints would cause deterioration of the building's roof structure. On this premise, the Health Authority concluded that lack of adequate ventilation to prevent this problem was a matter of design and that since the system build kitchen company was responsible for design and construction then this was a legitimate defect requiring attention.

Similarly, the problem of the servery fans was placed with the system build kitchen company. The noise level which was created when the fan was used was such that normal speech was drowned out. At serving times, when maximum ventilation was required the fan could not be used.

The system build kitchen company believed the first of these problems to be caused by a lack of intake air rather than a lack of extraction so the problem was solved by increasing air flow through the lobby and into the pot wash area to decrease the effects of condensation to an acceptable level. As regards the noisy fan, the system build kitchen company replaced it with a less noisy one before the end of the Defects Liability period.

The fourth area of concern was with regard to the water softening mechanism on the gas combination ovens. The subcontractor supplying this specialised equipment had to carry out extensive repairs and replace the ovens twice, with subsequent changes in the warranty period before a solution was reached. The continual recurrence of this problem prompted the Health Authority Senior Engineer to request a detailed report from the sub-contractor as to why so many problems had been experienced and what efforts had been made to rectify them.

Local residents objected to the kitchen proposals on the grounds of smell but the local council still approved the plans.

Some of the purchase price was held back after opening ensuring that full payment to the system build kitchen company was only made once all defects and snagging problems had been rectified.

4.3.3 Technical Complexity

4.3.3.1 *Spatial*

The new catering facility had to be located in such a position on the hospital site that future developments would remain unaffected. This was not a simple task, since much of the space on the site had been designated for new build projects. The agreed location for the new catering department displaced some of the main entrance car parking area but this problem was unavoidable.

The complexity of the site restricted space available for building. On one side was a main road; on one side was a private dwelling; on one side was an oxygen store and on the fourth side was hospital car-parking space. However, this was the only available area on which to build. The catering department had to be built so that it was not too close to the dwelling and it would not cause obstruction to the main road and dwelling beyond that. It could not be too close to the oxygen store and it was to have a minimum impact on loss of car-parking space. The client's requirement and the system design were not wholly compatible. What the client drew up as a draft plan would not fit with the system units : the structure would have extended too far if the catering department had been allocated the space that had initially been anticipated. The final design provided a facility consisting of 453 square metres of accommodation contained within a building composed of seven modules 12m by 3m and seven modules 9.6m by 3m. The ceiling height of the complex was 2.7m. The whole department also had to be turned around 45 degrees to what was originally planned. The site chosen for the catering facility meant that there was to be no physical link with it and the rest of the hospital development. However, these restrictions were understood from the start.

The combination of restricted site and modular unit meant that space had to be thought out extremely carefully and this led to complexities in the interior.

4.3.3.2 *Structural*

The department had to be built according to the necessary building, fire and food hygiene regulations. The nature of the facility also meant that the structure would have to be capable of supporting heavy duty catering equipment. Although a temporary facility, the building would have to support wear and tear of up to 10 years normal usage. The building was of a sectional nature finished with colour coated steel panels with a felted flat roof and with connection to all main services.

Erection utilised the methods of modular construction, making use of pre-engineered, factory fitted building blocks. Once delivered to the site the units were off-loaded by crane on to prepared foundations then final fitting out and equipping of the catering department proceeded.

4.3.3.3 *Services*

All main services were relatively easy to install. The new department was built close to the main hospital complex. Drains ran on the site underneath the department so this facilitated drainage plans.

4.3.4 Aesthetic Complexity

The local council laid down various stipulations regarding height, noise and smells, which were to have no adverse effect with regard to local dwelling. The site also had to be planned with a degree of landscaping at one end. Other than that, the external appearances were to conform to the wishes of the catering staff. Internally, catering staff were very much involved in deciding on staff restaurant colour scheme and furnishings.

4.3.5 Functional Complexity

Due to the site constraints discussed earlier, every available inch of space had to be made use of inside but the building still had to provide all the requirements of a self-contained catering department with a good linear work flow for a total of 50 staff. Quite lengthy considerations were involved in detailing the functional attributes of the catering department. The quality of services had to be substantially improved. Adequate access was necessary for delivery vehicles and access and egress of food distribution equipment had to be considered. Access for staff and for restaurant customers had to be considered. All of these access points had to be at different locations around the premises.

Inside, there had to be a linear work flow and the inside environment had to meet all the necessary legislative requirements, e.g. the separation of raw and cooked foods. Hand wash facilities were necessary, as were facilities for staff changing and showering. Access was required for portering staff for collection/return of food and equipment without access to the main body of the kitchen. Facilities for the disabled were also required. For example, a ramp was built to facilitate disabled access to the restaurant and inside the restaurant a disabled toilet was provided. Fire exits had to concord with statutory regulations.

Operational consideration had to be given to the range of items of prime cooking equipment to facilitate provision of a multi-choice menu every day of the year but not have equipment standing idle and taking up valuable space. Production area space was at a premium but at peak periods staff had to be able to work safely. Equipment needed to be mobile so adjustments could be made in production techniques/methods. The cleaning team would need access to areas which are traditionally difficult to keep clean. The impact of general maintenance and engineering repair work to equipment had to be minimised as food service needed to be maintained every day. It was envisaged that food could not be prepared safely with engineers and maintenance staff in the kitchen, therefore, a service gantry was provided at the back of equipment.

When kitchen re-development became a priority at the end of the 1980s several schemes existed for replacing the old catering department. These schemes featured different catering systems and building types. However, as soon as an option was chosen the detailed design and operational planning work showed little deviation from original planning intentions.

Figure 4.38 Environmental Influence Diagram for Project B, Operation 1

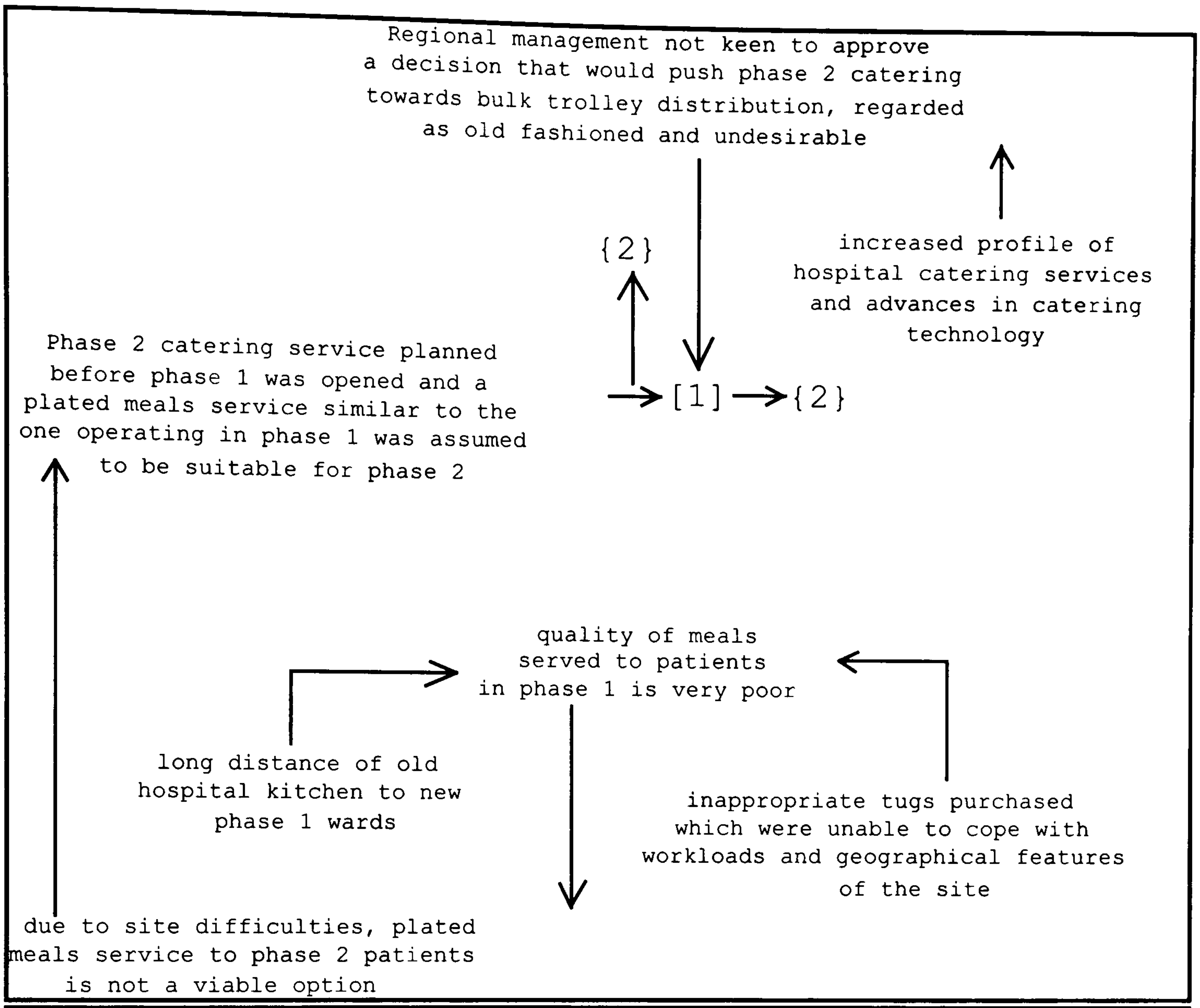


Figure 4.39 Environmental Influence Diagram for Project B, Operation 2

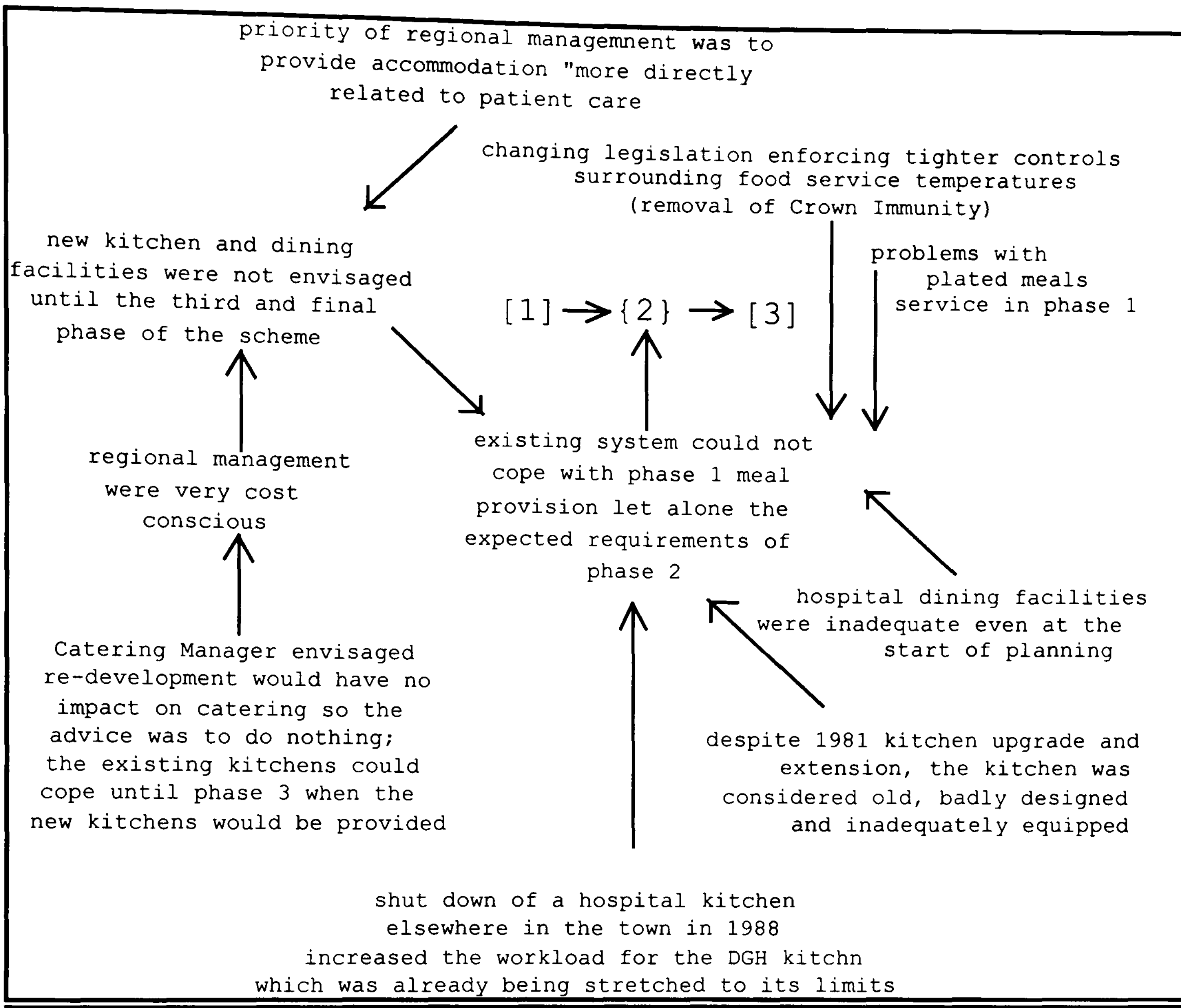


Figure 4.40 Environmental Influence Diagram for Project B, Operation 3

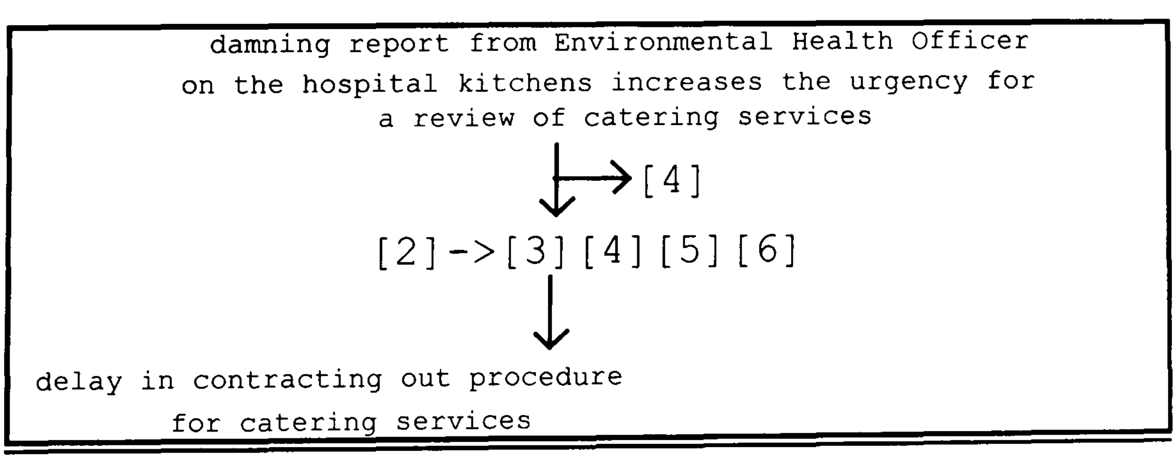


Figure 4.41 Environmental Influence Diagram for Project B, Operation 4

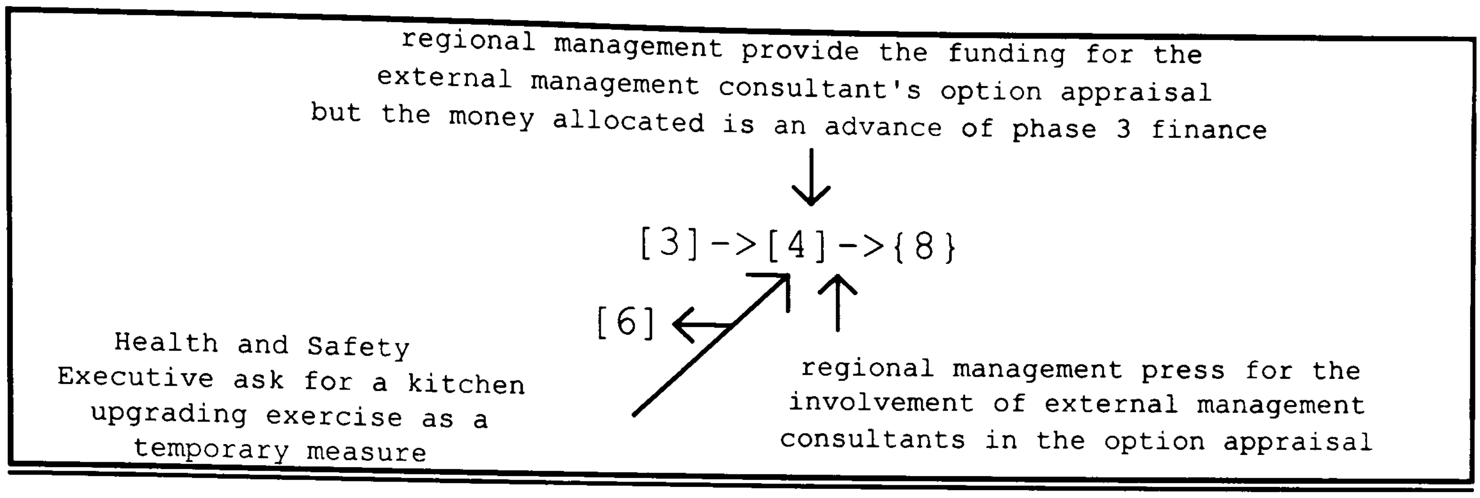


Figure 4.42 Environmental Influence Diagram for Project B, Operation 5

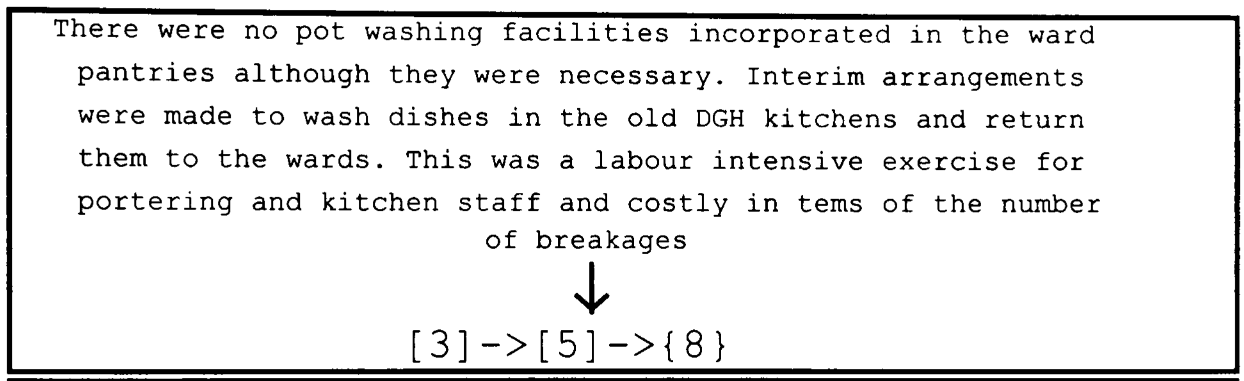


Figure 4.43 Environmental Influence Diagram for Project B, Operation 6

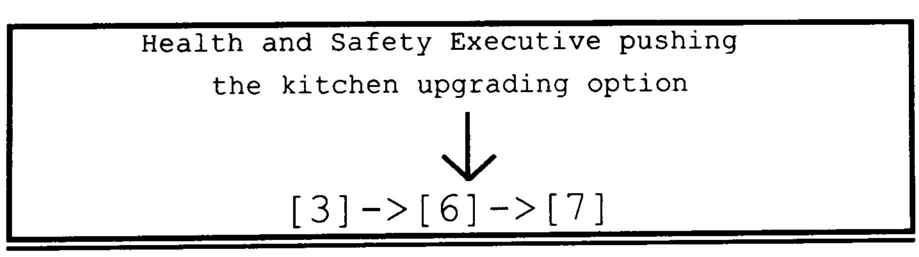


Figure 4.44 Environmental Influence Diagram for Project B, Operation 8

difficulties in gaining access to carry out upgrading work

cost of upgrading work not seen to to be cost effective, providing a cosmetic rather than a more thorough solution

[4][5][7]->{8}->[9][10]

further visit by EHO to DGH kitchens indicates that a kitchen upgrade would not be a satisfactory solution to catering difficulties and that, in fact, more floor area is essential

upgrading exercise compounded by the need for alternative catering arrangements to be put into operation during kitchen closure

Figure 4.45 Environmental Influence Diagram for Project B, Operation 9

Uncertainty over exact location of the temporary catering department. Much of the DGH site was designated for new build through the region

{8}->[9]->[11]

Figure 4.46 Environmental Influence Diagram for Project B, Operation 13

Cook/chill option seen as being politically too sensitive. The district had already shut down a hospital kitchen in another town and had closed another hospital kitchen about 1 mile away from the DGH. The introduction of a cook/chill service would have caused further staff cuts; a situation which the district wanted to avoid.

[12]->{13}->[14][15]

The environment of the system build kitchen appeared to be much more suitable than the closed environment of the portacabin type structures. The district were concerned about improving the working environment of catering staff. Option provided the best solution to immediate and long term problems, giving a degree of flexibility in food production and service without affecting catering costs.

Figure 4.47 Environmental Influence Diagram for Project B, Operation 14

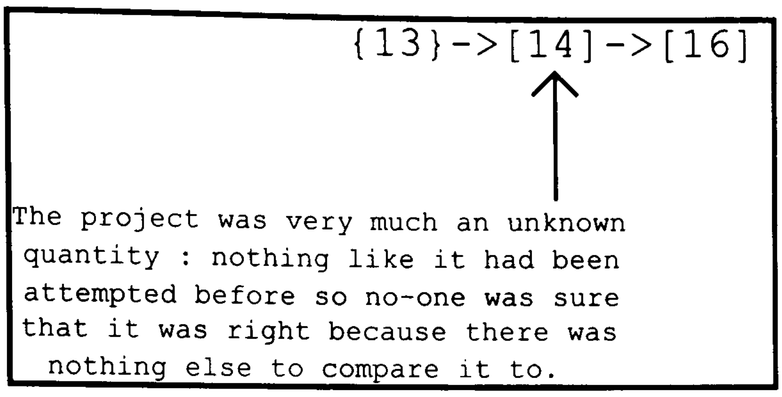


Figure 4.48 Environmental Influence Diagram for Project B, Operation 15

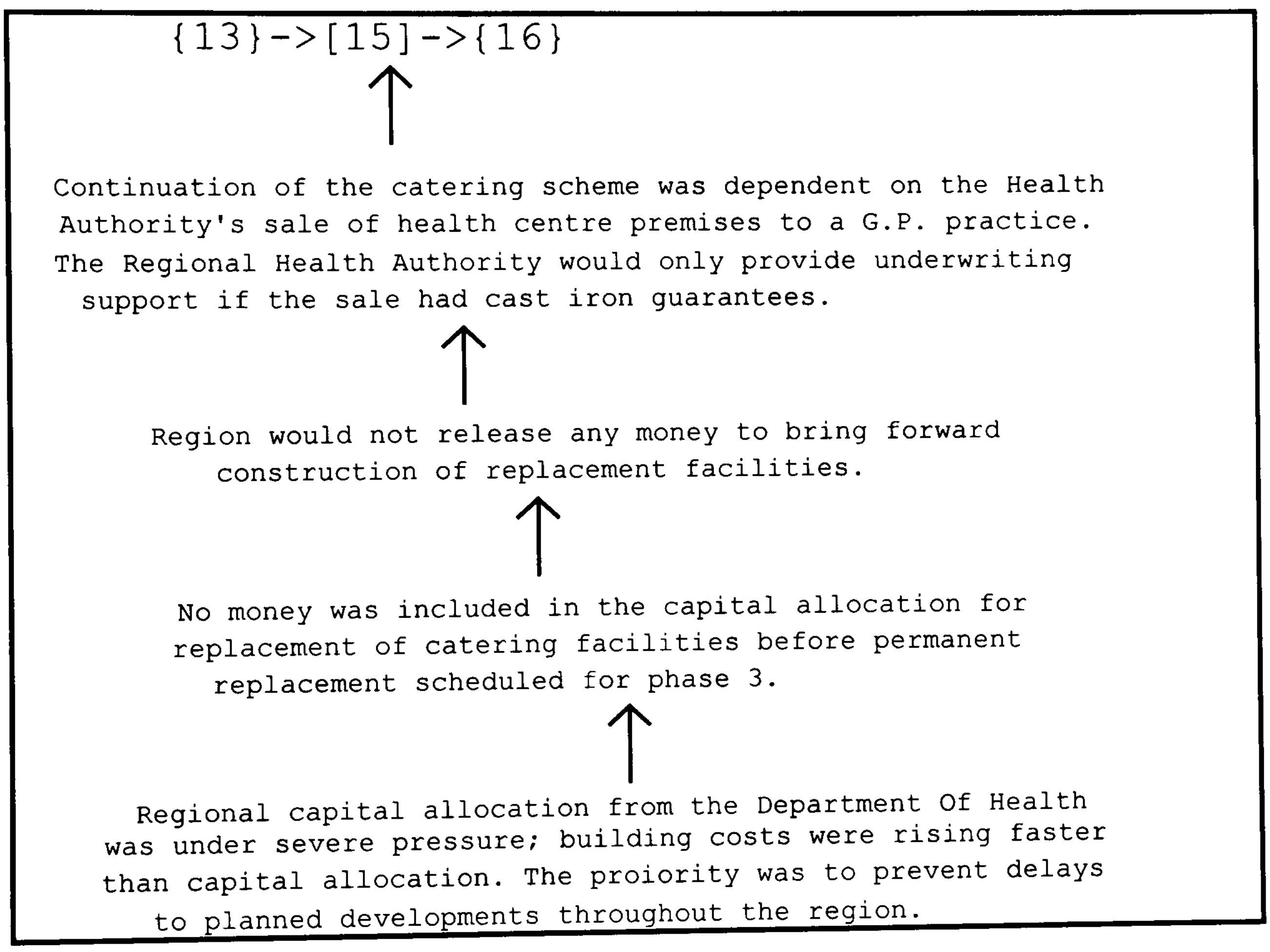


Figure 4.49 Environmental Influence Diagram for Project B, Operation 16

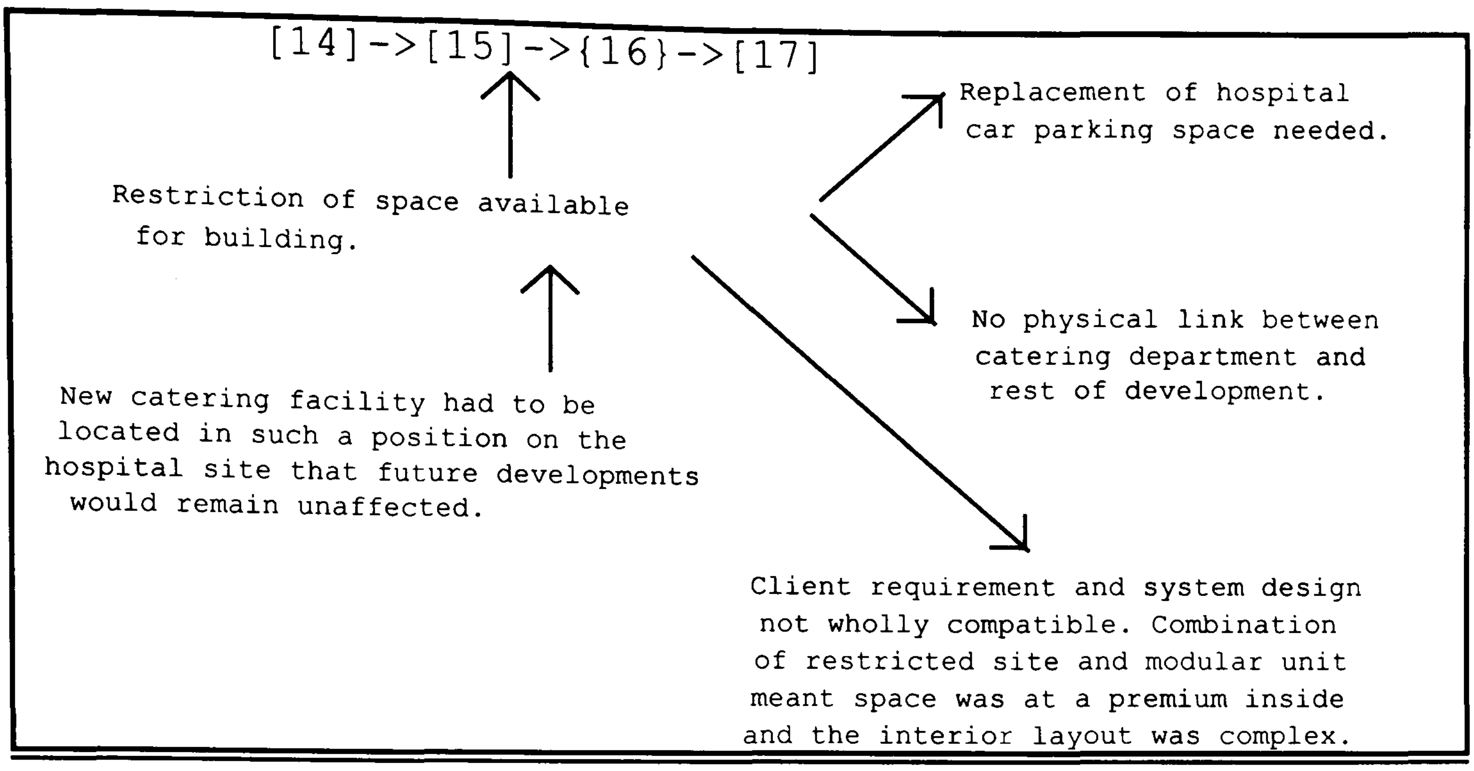


Figure 4.50 Environmental Influence Diagram for Project B, Operation 17

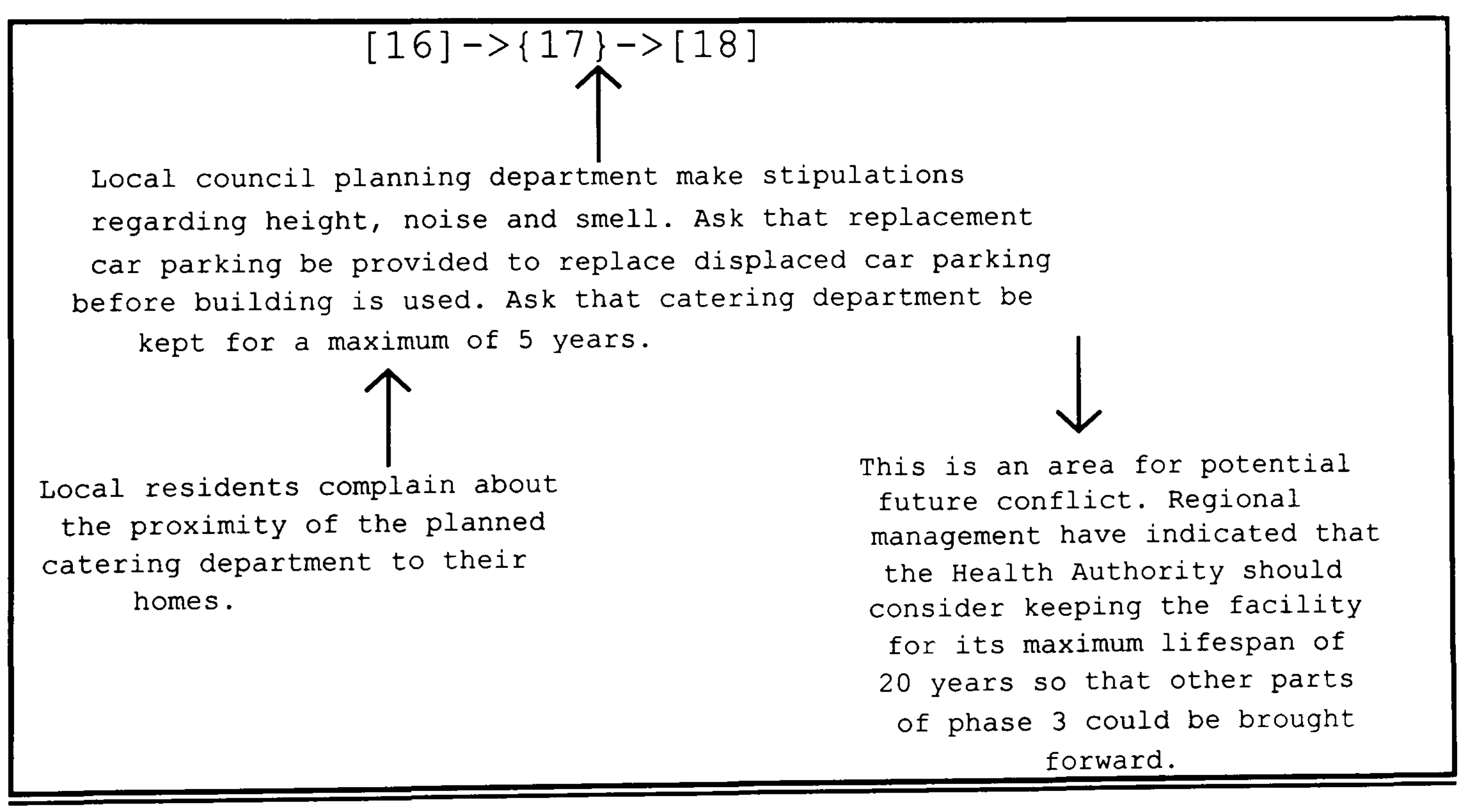
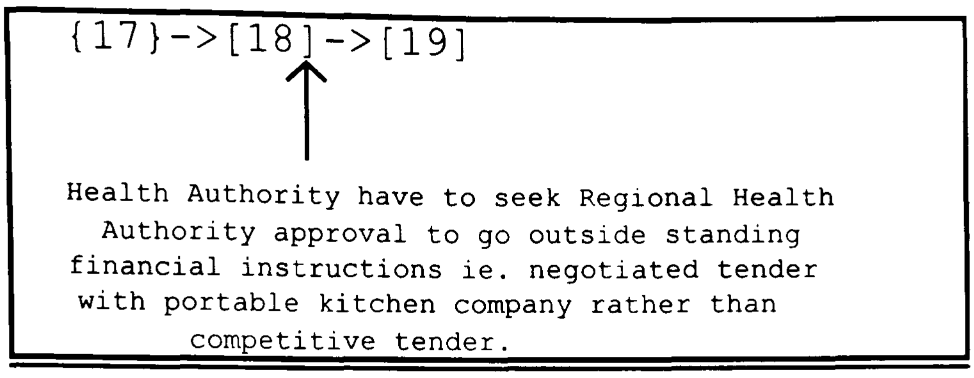


Figure 4.51 Environmental Influence Diagram for Project B, Operation 18



APPENDIX 5

3R Chart Responsibility Distributions for all Projects

5.1 Longitudinal Project C

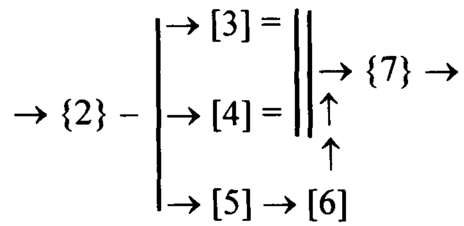
Table 5.1 3R Chart Responsibility Distributions : Stage 1 Inception

Longitudinal Project C Stage 1 : Inception [1] → {2} – Decision {} Operation [ ] Sequential → Reciprocal || 1972	Professional Planning Committee	Regional Hospital Board
1. Identification of food services in re-development plan	*	⊕ →
2. Food service to be based on cook/freeze, trayed meals	⇒ → ↑	*

Key	Operating system	* Operating	+ Co-operating	→ Consulting	⇒ Input	> Receiving
	Control system	= Resourcing	⊕ Monitoring	↓ Supervising		
	Managing system	↔ Co-ordinating	O Directing	↑ Recommending	✓ Approving	

Table 5.2 3R Chart Responsibility Distributions : Stage 2 Feasibility

Longitudinal Project C Stage 2 : Feasibility



Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1981

	Professional Planning Committee	Project Team	Regional Hospital Board	Divisional Nursing Officer	Building And Supplies Administrator	Area/Board Catering Adviser	Community Medicine Specialist	CSA Building Division Senior Planning Officer	CSA Building Division Catering Adviser 1	Project Architect
2. Food service to be based on cook/freeze, trayed meals	⇒ → ↑		*							
3. Determination of life expectancy for mid 1970s refurbishment		+ →			↔ ⇒ O	→	⊕	→	→	*
4. Analysis of effect of existing catering accommodation on site development		+ →			↔ ⇒ O	→	⊕	→	→	*
5. Catering policy outlined for phase 1 and future kitchen				→	↔ ⇒ O	→	⊕	→	*	
6. Schedule for kitchen and dining accommodation drawn up					↔ O	→	⊕		* ⇒	
7. Existing accommodation to be used for food production and staff dining		* ✓			⇒ ↑					▸

Table 5.3 3R Chart Responsibility Distributions : Stage 3 Sketch Design

Longitudinal Project C Stage 3 : Sketch Design

→ {7} → [8] → [9] → [10] – (→ [11] = / → [12] =) || → {13} →

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1984-1986

	Core Group	Project Team	Capital Planning Officer	Regional Hospital Board Finance Department	Regional Hospital Board Director Physical Resources	Planning And Development Administrator	Senior Planning And Development Assistant	Assistant Planning And Development Officer	Building And Supplies Administrator	Hospital Administrator	Area/Board Catering Adviser	Community Medicine Specialist	CSA Building Division Catering Adviser 1	Project Architect
7. Existing accommodation to be used for food production and staff dining		* ✓							↑ ⇒					→
8. Area of site ear-marked for possible future kitchen		+ →				O								* ⇒
9. Updating previous catering policy		*				O ⇒							→ ⇒	→
10. Review of previous catering policy	*	+ ↓					↔ ⇒ O				→		⇒ →	
11. Investigating incorporation of cook/chill into phase 1 ward units	↓	⊕ ⇒			→		↔ O =				* ⇒		›	
12. Costing of ward based cook/chill regeneration options	↓	⊕		*			O ↔				⇒ ›		› →	
13. Regeneration policy for phase 1 accommodation	↑	* ⇒	O				↔ ⊕ ⇒	→		→		›		

Table 5.4 3R Chart Responsibility Distributions : Stage 4 Detail Design

Longitudinal Project C Stage 4 : Detail Design

{13} → [14] → {15} –

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1986-1989

	Core Group	Project Team	Project Manager	Capital Planning Officer	Regional Hospital Board Director Physical Resources	Senior Planning And Development Assistant	Assistant Planning And Development Officer	Hospital Administrator	Finance Officer	Area/Board Catering Adviser	Domestic Services Officer	Community Medicine Specialist
13. Regeneration policy for phase 1 accommodation	↑	• ⇒		O		⇒ ↔ ⊕	→	→				→
14. Analysis of catering staff requirements		↓				↔			→	• ⇒	›	
15. Urgent review of catering services needed			⇒ ↑		• ⇒					→		

Table 5.5 3R Chart Responsibility Distributions : Stage a2 Feasibility

Longitudinal Project C Stage a2 : Feasibility

```
            | → [16] –  |
→ {15} –    |           | → [19] → {20} →
            | → [17] –  | ↑
                 → → [18]
```

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1989-1990

	SHHD/Scottish NHS Management Executive	Project Team	Project Manager	Commissioning Engineer	Regional Hospital Board	Regional Hospital Board Director Physical Resources	Area/Board Catering Adviser	Unit Catering Manager	CSA Building Division Catering Adviser I	Project Architect	Mechanical And Electrical Engineers
15. Urgent review of catering services needed			↑ ⇒			• ⇒	→				
16. Investigating feasibility of cook/chill alternatives			• ⇒ ↔	→		⇒ o	→			→	→
17. Draft schedule of accommodation based on bulk distribution from a new kitchen			↔ ⊕ ⇒					→ ⇒	•	→	
18. Appraisal of bulk and plated meal distribution systems			• ⊕ ↔			⇒ →		› ⇒			
19. Funding arrangements	→		⇒		•	⇒					
20. New build kitchen to supply conventionally cooked meals		•	⇒ ↑			↑					

Table 5.6 3R Chart Responsibility Distributions : Stage a3 Sketch Design

Longitudinal Project C Stage a3 : Sketch Design

→ {20} → [21] → [22] → {23} –

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1990

	Project Team	Project Manager	Regional Hospital Board Director Physical Resources	Area/Board Catering Adviser	Unit Catering Manager	Hospital Catering Manager	CSA Building Catering Adviser 1	CSA Building Division Catering Adviser 2	City Environment Development Officer	Project Architect
20. New build kitchen to supply conventionally cooked meals	•	↑ ⇒	↑							
21. Production of accommodation schedules for bulk and plated meals		↓ ↔					• ⇒	⇒ →		
22. Incorporation of bulk and plated meals schedules for combination service		↔ O		→	→	→	⇒ →	⇒ →	→	•
23. Approval of drawings for new kitchen scheme	•	⇒ ↑ ✓	✓							

Table 5.7 3R Chart Responsibility Distributions : Stage a4 Detail Design

Longitudinal Project C Stage a4 : Detail Design

→ {23} – | → [24] – ‖ → [26] → [27] → {28} →
→ {23} – | → [25] – ‖

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1990-1991

	Scottish NHS Management Executive Officer 1	Scottish NHS Management Executive Officer 2	SHHD/Scottish NHS Management Executive	Cost Control Group	Project Team	Design Team	Commissioning Team	Project Manager	Regional Hospital Board Director Finance/Treasurer	Regional Hospital Board Director Physical Resources	Physical Planning Officer	Management Accountant Area Services	Unit Catering Manager	Hospital Catering Manager	CSA Building Division Regional Director	CSA Building Division Officer	CSA Building Division Catering Adviser 1	Project Architect	Quantity Surveyors
23. Approval of drawings for new kitchen scheme					*			⇒ ↑ ✓	>	✓	>								
24. Detailing equipment lists								O ↔				>	⇒ →	⇒ →			* ⇒		
25 Revision of kitchen accommodation schedules						+ →		↔ O					⇒ →	⇒ →				*	
26. Preparation of FCL				⊕			*	O ↔										⇒	+ ⇒ →
27. Re-examination of new kitchen option appraisal	→							⇒ →		* ↔					›	›			
28. Formal approval of AIP and FCL for new kitchen		✓	*					→ ⇒		↔ ↑									

Table 5.8 3R Chart Responsibility Distributions : Stage 5 Tender

Longitudinal Project C Stage 5 : Tender

→ {28} → [29] → {30} →

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1991

	Scottish NHS Management Executive Officer 2	SHHD/Scottish NHS Management Executive	Design Team	Project Manager	Regional Hospital Board Chairman	Regional Hospital Board Director Finance/Treasurer	Regional Hospital Board Director Physical Resources	Physical Planning Officer	Architect Partner	Quantity Surveyors	Phase 1 Contractor	General Manager Phase 1 Contractors
28. Formal approval of AIP and FCL for new kitchen	✓	•		⇒ →		>	↔ ↑	>				
29. Tender negotiations			+ →	⇒ → ↓			⇒ ↔ ⊕ O		→	⇒ •	+ →	
30. Tender acceptance	→			⇒ →	•	↔				→		+

Table 5.9 3R Chart Responsibility Distributions : Stage 6 Construction

Longitudinal Project C Stage 6 : Construction

{30} → [31] → [32] → [33] → [34] → [35] → {36}

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1991-1992

	Scottish NHS Management Executive Officer 2	SHHD/Scottish NHS Management Executive	Commissioning Team	Project Manager	Commissioning Team Administrator	Commissioning Engineer	Regional Hospital Board	Regional Hospital Board Chairman	Regional Hospital Board Director Finance/Treasurer	Regional Hospital Board Director Physical Resources	Unit Catering Manager	Hospital Catering Manager	CSA Building Division Catering Adviser 1	CSA Assistant Director Procurement Supplies Division	External Consultant Architect	Project Architect	Architect	Quantity Surveyors	Phase 1 Contractor	General Manager Phase 1 Contractors
30. Tender acceptance	→			⇒ →				•	↔	o ⊕ ↑								⇒		+
31. Savings exercise to offset excess departmental costs			• ⇒	↔ ↓ ⊕					→										›	
32. Approval of revised tender cost	→	•		↓ ⇒					↔ ↑											
33. Sealed windows for kitchen area						↔					→						• ⇒			
34. Review of catering equipment needs					o ↔						→	→ ⇒	• ⇒	→ ↓		⇒ →				
35. Change kitchen wall covering				• ⇒ ↔ ↓							→		→		→					
36. Practical completion				↑ o			•											⇒ →	→ ⇒	

Table 5.10 3R Chart Responsibility Distributions : Stage 7 Commissioning

Longitudinal Project C Stage 7 : Commissioning

→ {36} → [37]

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1992-1993

	Commissioning Team	Project Manager	Commissioning Engineer	Client Clerk Of Works	Regional Hospital Board	Hospital Divisional Facilities Manager	Unit Catering Manager	Hospital Catering Manager	Catering Users	Project Architect	Architect	Quantity Surveyors	Structural Engineers	Mechanical And Electrical Engineers Client Clerk Of Works	Phase 1 Contractor	Sub-contractor 1	Sub-contractor 2	Sub-contractor 3
36. Practical completion		↑ O			•					→ ⇒		⇒ →			⇒ →			
37. Snagging	→	⊕ ↔	↓	+		→	→	→	→	→ ⇒	+	⇒ +	⇒	+	⇒ •	+	+	+

5.2 Retrospective Project A

Table 5.11 3R Chart Responsibility Distributions Stage 1 : Inception

Retrospective Project A Stage 1 : Inception [1] → {2}→ Decision {} Operation [ ] Sequential → Reciprocal || 1968	Joint Planning Committe	Project Team
1. Identification of the requirements of food services	→	*
2. Catering system to be based on system of freezing prepared meals	✓	* ⇒

Key

Operating system	* Operating	+ Co-operating	→ Consulting	⇒ Input	> Receiving
Control system	= Resourcing	⊕ Monitoring	↓ Supervising		
Managing system	↔ Co-ordinating	O Directing	↑ Recommending	✓ Approving	

Table 5.12 3R Chart Responsibility Distributions : Stage 2 Feasibility

Retrospective Project A Stage 2 : Feasibility → {2} → [3] → {4} → Decision {} Operation [ ] Sequential → Reciprocal || **1968-1972**	Joint Planning Committee	Project Steering Group	Project Team	Project Manager
2. Catering system to be based on system of freezing prepared meals	✓		* ⇒	
3. Investigation of phasing options on food services planning		→	⇒ →	*
4. Food services, including staff catering, included as a phase 1 priority		* → ✓	→	⇒ ↔ ↑

Table 5.13 3R Chart Responsibility Distributions : Stage 3 Sketch Design

Retrospective Project A Stage 3 : Sketch Design

→ {4} → [5] →[6] → {7} –

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1972-1976

	Project Steering Group	Project Team	Project Manager	Planning Officer	Catering User Representative	Dietetic User Representative	Engineering Services Officer	Architect
4. Food services, including staff catering, included as a phase 1 priority	* → ✓	→	⇒ ↔ ↑					
5. Outline sketch plan of catering department for phase 1			⇒ ⊕		⇒ →			* ↔
6. Sketch plan viewing of catering department			⊕	↔ ↓	*	→	→ ⇒	→ ✓
7. Review of catering accommodation schedules	*	✓	⇒ ↑		→ ↑			

Table 5.14 3R Chart Responsibility Distributions : Stage a2 Feasibility

Retrospective Project A Stage a2 : Feasibility

→ [8] =

→ {7} – → {10} →

→ [9] =

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1978-1979

	Project Steering Group	Project Team	Project Manager	Planning Officer	Nurse Planning Officer	Catering User Representative	Architect
7. Review of catering accommodation schedules	*	✓	↑⇒			→↑	→ ✓
8. Updating schedules of catering accommodation			⊕	↔↓	→	* ⇒	→
9. Formulation of phase 1 catering operational policy			* O ↔			⇒ →	
10. Revise phase 1 kitchen and dining room outline sketch scheme		* ✓ →	→↑			→	→

Table 5.15 3R Chart Responsibility Distributions : Stage a3 Sketch Scheme

Retrospective Project A Stage a3 : Sketch Scheme

```
                                   ┌→ [14] –┐
→ {10} → [11] → [12] → [13] –┤         ├ → {16} →
                                   └→ [15] –┘
```

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1979-1984

	Hospital Planning Committee	Project Team	Project Manager	Catering User Representative	Architect	Mechanical And Electrical Engineers
10. Revise phase 1 kitchen and dining room outline sketch scheme		✓ *→	→↑	→	→	
11. Incorporation of changes into new scheme			⇒ ↔	→	*	
12. Consideration of steam supply to kitchen equipment			*	→ ⇒		
13. Determination of staffing requirements for catering system			*	⇒ →		
14. Revision of catering office accommodation			↔O	⇒*	+	
15. Checking equipment dimensions in vegetable preparation area			*	⇒ →	+	
16. Commence detailed design work on phase 1 catering layout	✓	✓	*		→	→

Table 5.16 3R Chart Responsibility Distributions : Stage 4 Detail Design

Retrospective Project A Stage 4 : Detail Design

→ {16} → [17] → | → [18] – | → [19] – | → [20] – | → | → [21] – | → [22] – | →

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1985-1986

1985-1986	Joint Planning Committee	Hospital Planning Committee	Project Team	Design Team	Project Manager	Planning Officer	Catering User Representative	Health Authority Chief Executive	Health Authority General Manager	Architect	Mechanical And Electrical Engineers	Catering Manager Health Authority 1
16. Commence detailed design work on phase 1 catering layout		✓	✓	↑	*					→	→	
17. Provisional changes in policy and accommodation for cook/chill system		✓	+	+	⊕O	↓	*		+	+	+⇒	
18. Investigation of feasibility of cook/chill option		+			→ ⇒		→	→+	*↔			+ →
19. Catering equipment manufacturers prepare phase 1 kitchen equipment scheme					⇒ →		→+			↓ →	*	
20. Amendment of cold/freezer room temperatures						*⇒	→					
21. Design changes to catering office accommodation and catering staff accommodation					⇒⊕ ↔	⇒ ↔↓	→			* ⇒	+	
22. Revision of catering policy for Hospital 4 to a conventional service	✓	✓			+		*⇒					

Table 5.17 3R Chart Responsibility Distributions : Stage 4 Detail Design

Retrospective Project A Stage 4 : Detail Design

→ | → [23] – / → [24] – | →[25] – | → [26] – / → [27] – / → [28] – / → [29] – / → [30] – / → [31] – / → [32] – / → [33] – / → [34] – / → [35] – / → [36] – / → [37] – / → [38] – |

Decision {} Sequential →
Reciprocal || Operation [ ]

1985-1986

	Project Team	Design Team	Project Manager	Planning Officer	Catering User Representative	Group Engineer	Project Management Consultants	Architect	Surveyor	Mechanical And Electrical Engineers	Environmental Health Officer	Assistant Planning Environmental Health Officer	Food Service Consultants	Catering Equipment Manufacturer And Supplier 1
23. Re-assessment of phase 1 kitchen mixed cook/chill and conventional operational policy	+	+	O	↓	*					⇒+				
24. Environmental Health Officer assessment of plans for phase 1 and South Block catering			⇒⊕ → ↔		→						*			
25. Quotations sought from kitchen equipment suppliers for equipment layout			⇒		→ ⇒		O↔			*				
26. Incorporation of plant room to service cold rooms		→	→O	↓⊕ ⇒			↔	*		→				→
27. Policy and design relating to drainage of floor areas and equipment			⊕	↔↓	*	→	↔+	+→	+	→ ⇒		→		
28. Group marking of kitchen equipment items				*⇒						→				+
29. Client brief and catering equipment manufacturer's recommendations reviewed by food service consultant							O⇒						*	
30. Specification drawn up							O⇒						*	
31. Detailing of services feeds and connections			⊕						→	*⇒				
32. Review of food service consultant's report			*		→		↔ ⇒						→ ⇒	
33. Client advises on revised chilling requirements for service from phase 1 to Hospital 4			⇒		*⇒		↔			› +				

Table 5.18 3R Chart Responsibility Distributions : Stage 4 Detail Design

Retrospective Project A Stage 4 : Detail Design

→ | → [39] – | → [40] – | → [41] – | → [42] – | → {43}

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1985-1986

Retrospective Project A Stage 4 : Detail Design	Design Team	Project Manager	Planning Officer	Equipment Officer	Catering User Representative	Health Authority General Manager	Secretary To Board	Deputy	Group Engineer	Project Management Consultants	Architect	Surveyor	Mechanical And Electrical Engineers	Control Of Infection Officer	Environmental Health Officer	Food Service Consultants	Catering Manager Health Authority 1	Catering Equipment Manufacturer And Supplier 1
34. Finalisation of detailed drawings and specifications		→+	⊕			✓				↔	+	+→	•⇒			→		+ →
35. Services equipment specification			⊕→	⇒					→	↔			⇒•					
36. Finalisation of cook/chill layout		⇒•		↓						↔ ⇒			+					
37. Revision of recommendations for chilling equipment			⊕							↔		→	•⇒					
38. Revision of double doors between central wash up and kitchen in phase 1			⊕→	↓		→				⇒ ↔	•	→	→		→			
39. Natural light and ventilation system concerns in phase 1 kitchen	→		•↔			→ ⇒	>			⊕	→		+→					
40. Determination of type of service for phase 1 coffee shop	•		↔O			⇒ →				+								
41. Finalisation of equipment layout and equipment schedules				↓→	+	→				↔	→		•⇒					
42. Review of ward level dish washing policy	⊕→		O↔			•⇒								→				
43. Continue with evaluation of options for catering service	•		⇒ ✓					↑									>	

Table 5.19 3R Chart Responsibility Distributions : Stage 5 Tender

Retrospective Project A
Stage 5 : Tender

→ {43} – | → [44] – | → [45] – | → [46] – | →{47}

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1986-1987

	Hospital Planning Committee	Project Manager	Unit Commissioning Manager	Nurse Planning Officer	Catering User Representative	Health Authority General Manager	Deputy Secretary To Board	Director Of Planning And Administration	Unit General Manager	Treasurer	Finance Officer	Group Engineer	Project Management Consultants	Architect	Surveyor	Mechanical And Electrical Engineers	DHSS Catering Adviser 1	DHSS Catering Adviser 2	Catering Manager Health Authority 1	Director Support Services Health Authority 2	Catering Consultant Health Authority 2	Assistant General Manager Hospital X	Director Planning Operations Hospital Y	Capital Project Co-ordinator Hospital Y	Director Of Estates Management Hospital Y	General Manager Hospital Y	Assistant Treasurer Hospital Y	Catering Manager Hospital Y	Regional Catering Officer Regional Health Authority 3
43. Continue with evaluation of options for catering service	*	✓ ⇒					↑												>										
44. Collaborative cook/chill option		⊕↔		→	→	>	•O ⇒			→	→	→					→	→	+	+	+	→	+	↔ ⇒	+	→	+	+	→
45. Cost and functional implications of adding ward based dish washer		⊕	→↓										•																
46. Location and specification of dish washer and associated waste disposal unit in phase 1 kitchen		O⊕	↔↓		→ ✓								↔ ⇒	•	+	+													
47. Abortion of collaborative cook/chill option			>			•		>	→ ⇒	>								→↑											

Table 5.20 3R Chart Responsibility Distributions : Stage 6 Construction

Retrospective Project A Stage 6 : Construction

→ [48] =

→ {47} – → [50] → [51] → [52] → [53] –

→ [49] =

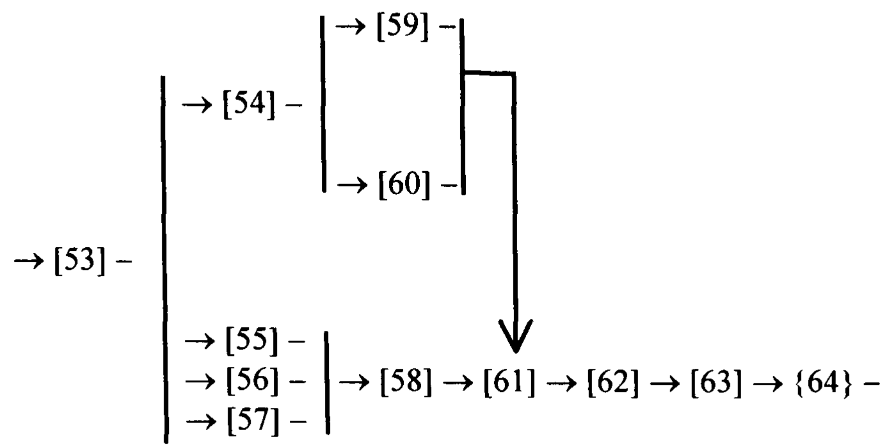
Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1987-1990

	Capital Planning Manager	Unit Commissioning Manager	Catering User Representative	Health Authority General Manager	Director Of Planning/Administration	Unit General Manager	Treasurer	Project Management Consultants	Architect	Surveyor	Mechanical And Electrical Engineers	Public Health Officer	DHSS Catering Adviser 2	DHSS Catering Adviser 1
47. Abortion of collaborative cook/chill option		>		*	>	→ ⇒		>						→ ↑
48. Savings being sought to offset cost of items of kitchen equipment missing from Bills of Quantities	*		→						↔ ⇒					
49. Revision of schedules of kitchen accommodation and equipment	⊕O ⇒		*						↔	+	+→	+		
50. Cost and contractual implications of revising kitchen accommodation and equipment schedule	⊕O ⇒		→						*↔	→				
51. Clearance of kitchen equipment supplier's drawings to confirm equipment being supplied under contract	⊕	+	+						*↔ →	→	+	→	>	
52. Transfer of dish washer from Hospital 1 North Block to phase 1 kitchen	*⇒ ↔						→		+	+		›		
53. Revision of phase 1 dining room seating	→		⇒ →						*→	+	+			

Table 5.21 3R Chart Responsibility Distributions : Stage 6 Construction

Retrospective Project A Stage 6 : Construction



Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1987-1990

	Commissioning Team	Commissioning Progress Group	Design Team	Capital Planning Manager	Unit Commissioning Manager	Deputy Unit Commissioning Manager	Equipment Officer	Catering User Representative	Domestic Services User Representative	Health Authority Chief Executive	Unit General Management	Unit General Manager	Resident Engineer	Project Management Consultants	Architect	Surveyor	Mechanical And Electrical Engineer	Assistant Planning Environmental Health Officer
54. Revision of catering operational policy	→	↑		⊕⇒				•⇒			✓			→				
55. Route of waste water from vending and servery beverage unit				⊕↔				→						⇒	+	+	•	
56. Impact of food hygiene regulations on cook/chill service					+			•										⇒ →
57. Alteration of positioning of chilled water dispenser							→						→	•			+	
58. Cook/chill system storage space requirements and temperatures				↔	⊕			•⇒										
59. Review of ward kitchen and day room facilities				⇒	O↓			•	→					→				
60. Revision of chilled plating area and belt in phase 1	⇒		•	↔O	⊕→	→↓		→				→		↓	›	+→	→	
61. Organisation of post contract works package		•		O⇒ →	↔					⊕				→			›	
62. Purchase of food service trolleys				⊕	↓O ⇒	•		›	→									
63. Updating catering equipment schedules				→	•↔ ⇒		›	→										
64. Completion of works to phase 1 catering				•	✓									↑ › ›	› ›	›	› ›	

Table 5.22 3R Chart Responsibility Distributions : Stage 7 Commissioning

Retrospective Project A Stage 7 : Commissioning

{64} – → [65] – [67]

{64} – → [66]

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1990-1991

	Capital Planning Manager	Unit Commissioning Manager	Assistant Planning Officer	Commissioning Nurse	Catering User Representative	Unit General Manager	Unit Estates Manager	Project Management Consultants	Architect	Surveyor	Mechanical And Electrical Engineers	Technical Officer Environmental Health Services	Joint Venture Contractor	Sub-contractor 1	Sub-contractor 2	Catering Equipment Manufacturer And Supplier 1
64. Completion of works to phase 1 catering	•	✓						→↑ ⇒	⇒ →	→	→ ⇒					
65. Catering policy for interim scheme	⇒ →	0↔ ↓			•	→										
66. Phase 1 snagging	✓ o											→	+	+	+	+
67. South Block Hospital 1 food trolley access and circulation route	⊕	⇒0	•	→	→		→									

5.3 Retrospective Project B

Table 5.23 3R Chart Responsibility Distributions : Stage 1 Inception

Retrospective Project B Stage 1 : Inception

[1] → {2} →

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1989

	RHA Capital Equipment Management Team	RHA Work Study Department	RHA Assistant Manager Capital Developments	Phase 2 Commissioning Team	RHA Project Leader Capital Management Team	RHA Capital Equipment Manager	DHA General Manager	DHA Treasurer	DHA Health Services Manager	DHA Deputy Health Services Manager	DGH General Services Manager	DHA Catering Services Manager
1. Switch to bulk service for phase 2 meal distribution	= → ✓	*	+	↑ O ↔	+ ↓	→	→	>		⊕	+	→
2. Urgent review of catering services to new district general hospital needed					⇒		*		↑ →		→	→

Key

Operating system	* Operating	+ Co-operating	→ Consulting	⇒ Input	> Receiving
Control system	= Resourcing	⊕ Monitoring	↓ Supervising		
Managing system	↔ Co-ordinating	O Directing	↑ Recommending	✓ Approving	

Table 5.24 3R Chart Responsibility Distributions : Stage 2 Feasibility

Retrospective Project B Stage 2 : Feasibility

→ {2} – [3] – |→ [4] – | → [5] – | → [6] – | → {8} –, with [7] ↑ {8}

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1989

1989	RHA Management Services Department	RHA Assistant Manager Capital Developments	RHA Capital Equipment Manager	RHA Phase 2 Commissioning Officer	DHA Phase 2 Commissioning Team	DHA Nursing Adviser/Planning Co-ordinator	DHA General Manager	DHA Health Services Manager	DHA Deputy Health Services Manager	DHA Assistant Health Services Manager	DGH General Services Manager	DHA Estates Manager	DHA Building Manager	DGH Operational Works Manager	DHA Catering Services Manager	DHA Domestic Services Manager	DGH Catering Sub-Committee	DHA Consultant Microbiologist	PKC Sales Director	Regional Director Public Health	Regional Environmental Health Adviser	Senior Environmental Health Officer	External Management Consultants	EMC Assignment Manager	EMC Food Service Consultant	Catering Equipment Supplier 1	Catering Equipment Supplier 2
2. Urgent review of catering services to new district general hospital needed			⇒				•	→↑			→				→												
3. Review of catering services	→	→	→	→		+	→	⊕→ ↔	→ ⇒	→	+	+		→	• ⇒		→	→				→					
4. Appraisal of options for short term solutions to catering problems		↑	+			+	→	O ⊕			→ ⇒	+			→					>				↓ ↔	•		
5. Identification of problems with phase 2 ward pantries					→						⊕				• ⇒	+ →											
6. Development of kitchen extension as a solution to short term problems								✓			⊕	O↔	+ ↓		• ⇒			→				→				→	→
7. Options for food production during kitchen closure for extension works											↓ ↔				• ⇒				→					+	⇒ →		
8. Abandon kitchen extension scheme		→	>					•			↔ ⇒ →	⇒		+	⇒					>	→		⇒		↑		

Table 5.25 3R Chart Responsibility Distributions : Stage 3 Sketch Design

Retrospective Project B Stage 3 : Sketch Design

→ {8} – | → [9] – / → [10] – | → [11] → [12] → {13} –

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1989-1990

1989-1990	RHA Regional Management Executive Team	RHA Director Corporate Planning	RHA Assistant Manager Capital Developments	RHA Capital Equipment Manager	DHA Nursing Adviser/Planning Co-ordinator	DHA General Manager	DHA Treasurer	DHA Health Services Manager	DGH General Services Manager	DHA Estates Manager	DHA Building Manager	DGH Operational Works Manager	DHA Catering Services Manager	PKC - Sales Director	Regional Director Public Health	Regional Environmental Health Adviser	Deputy Director Estates Management HA X	Catering Manager Hospital X	External Management Consultants	EMC Assignment Manager	EMC Food Service Consultant	EMC Accounting And Finance Consultant	Sectional Building Manufacturer Sub-Contractor
8. Abandon kitchen extension scheme			→	>				•	↔ → ⇒	⇒		+	⇒		>	→			⇒		↑		
9. Outline scheme for temporary kitchen drawn up									⊕ ⇒ ↔				⇒ →	• ⇒					⇒		→		
10. Option appraisal for long term solutions to catering problems	= ✓	→	↑		+	O	+	⊕ ⇒	↓ ↔	→	+ →		⇒ →						⇒	•		+ →	
11. Outline of two additional temporary kitchen schemes									↓→ ⇒ ↔				→	⇒							→		•
12. Review of all three temporary schemes					+	O	+	⊕ →	• ↔ ⇒	+	+		⇒ →	+		→	→	→	→			+	
13. Option 1 chosen as best solution						•		✓	⇒ ✓				↑ ⇒						→				⇒

Table 5.26 3R Chart Responsibility Distributions : Stage 4 Detail Design

Retrospective Project B Stage 4 : Detail Design

→ {13} – | → [14] – | → [16] → {17} →
→ {13} – | → [15] – |

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1990

	RHA Regional Management Executive Team	RHA Director Corporate Planning	RHA Manager Capital Developments	RHA Assistant Manager Capital Developments	DHA Nursing Adviser/Planning Co-ordinator	DHA General Manager	DHA Treasurer	DHA Health Services Manager	DHA Director General Support Services	DGH General Services Manager	DHA Director Estates	DHA Assistant Director Estates And Building	DHA Catering Services Manager	DHA Supplies Manager	Portable Kitchen Company	PKC - Client Liaison	District Council Planning Department	Regional Environmental Health Adviser	Senior Environmental Health Officer	Health Authority Divisional Fire Officer	District Fire Officer	Fire Prevention Officer	External Management Consultants
13. Option 1 chosen as best solution						•		✓		⇒ ✓			↑ ⇒		⇒								→
14. Option 1 worked up in detail						⇒				↔ ↓			⇒ →			•							⇒
15. Securing funding for temporary kitchen facility	→	→		→	+	⇒	+	• ↔		+ ⇒													
16. Revisions to option 1 scheme			✓			⊕	+		o ⇒		+ ↔ ⇒	↓	→	+	• →	+		→	→	→	→	→	
17. Approval of planning application											⇒	↑					•						

Table 5.27 3R Chart Responsibility Distributions : Stage 5 Tender

Retrospective Project B Stage 5 : Tender

→ {17} → [18] → [19] → {20}–

Decision	{}
Operation	[ ]
Sequential	→
Reciprocal	||

1990	RHA Director Corporate Planning	DHA Chairperson	DHA General Manager	DHA Director Estates	DHA Assistant Director Estates And Building	DHA Senior Engineer	Portable Kitchen Company	PKC - Client Liaison	District Council Planning Department
17. Approval of planning application				⇒	↑				•
18. Tender arrangements	→			• ⇒ ↔				→	
19. Arrangement of sub-contractor tendering				⇒	↓	•			
20. Acceptance of main tender	✓	•	↑	⇒ ⊕ ↔			+		

Table 5.28 3R Chart Responsibility Distributions : Stage 6 Construction

Retrospective Project B Stage 6 : Construction

→ {20} → [21] – | → [22] – / → [23] – | → [24] → [25] → [26] –

Decision {} Sequential →
Operation [ ] Reciprocal ||

1990

	RHA Director Corporate Planning	DHA Chairperson	DHA General Manager	DHA Director General Support Services	DHA Director Estates	DHA Deputy Director Estates And General Services	DHA Assistant Director Estates And Building	DHA Catering Services Manager	DHA Domestic Services Manager	DGH Catering Staff	DGH Portering Staff	DGH Senior Engineer	DGH Unit Engineer	Portable Kitchen Company	PKC - Client Liaison	PKC - Sales Director	PKC - Project Manager	District Fire Officer	Building Works Sub-Contractor	Sectional Building Manufacturer	Telecommunications Sub-Contractor	Gas Services Sub-Contractor	Water Services Sub-Contractor
20. Acceptance of main tender	✓	*	↑		⊕ ↔ ⇒									+									
21. Organisation of orders for services installation works							↓ →+					* ⇒											
22. Groundworks							⊕ ⇒										↓ ↔		*				
23. Determination of interior finishings/wall coverings							⊕ ⇒	*									→ +						
24. Review of catering service to wards				→				* ⇒	→	→													
25. Delivery and erection of sectional building units							⊕ ⇒										↓⇒ ↔			*			
26. Services installation							⊕ ⇒					→		*			↓⇒ ↔				+	+	+

Table 5.29 3R Chart Responsibility Distributions : Stage 6 Construction

Retrospective Project B Stage 6 : Construction

→ [26] – |→ [27] –|→ [28] –|→ [29] –| → [30] → [31] → [32] → [33]

Decision {} Sequential →
Operation [ ] Reciprocal ||

1990

	RHA Director Corporate Planning	DHA Chairperson	DHA General Manager	DHA Director General Support Services	DHA Director Estates	DHA Deputy Director Estates And General Service:	DHA Assistant Director Estates And Building	DHA Catering Services Manager	DHA Domestic Services Manager	DGH Catering Staff	DGH Portering Staff	DGH Senior Engineer	DGH Unit Engineer	Portable Kitchen Company	PKC - Client Liaison	PKC - Sales Director	PKC - Project Manager	District Fire Officer	Building Works Sub-Contractor	Sectional Building Manufacturer	Telecommunications Sub-Contractor	Gas Services Sub-Contractor	Water Services Sub-Contractor
26. Services installation							⊕ ⇒					→		*			↓⇒ ↔				+	+	+
27. Arrangement of official handover and kitchen open days				⇒ →		+		+ ⇒ →						⇒	+	* ↔	+						
28. Revision of fire equipment for dining area						↓						* ⇒						→					
29. Organisation of staff demonstration and commissioning				⊕				⇒ →								+	*						
30. Inspection of works prior to handover							⇒					* ⇒ ↓	+ →				+						
31. Electrical testing												↓ ⇒		*			⇒ ↔						
32. Transfer of catering equipment from old to new premises						⊕		⇒ →			*	↓ ⇒	+	+			↔						
33. Practical completion				✓		*								⇒ →									

Table 5.30 3R Chart Responsibility Distributions : Stage 7 Commissioning

Retrospective Project B Stage 7 : Commissioning

→ [33] – | → [34] – | → {36}
 | → [35] – |

Decision {}
Operation [ ]
Sequential →
Reciprocal ||

1990-1992

	DHA Director General Support Services	DHA Deputy Director Estates And General Services	DHA Catering Services Manager	DHA Senior Engineer	DGH Unit Engineer	Portable Kitchen Company	PKC - Client Liaison	PKC - Project Co-ordinator	PKC - Project Manager	Gas Services Sub-Contractor
33. Practical completion	✓	*				→ ⇒				
34. Variations	⊕	↔ ⇒ →				* →			→ ↓	
35. Snagging	⊕	↔ ⇒ →	→	+	+	* ⇒	→ +	→ +	↓ ⇒	→ +
36. Final completion	✓	* ⇒				→ +				

APPENDIX 6

Questions Used for User Group Evaluation of Food Service System Functioning at Retrospective Project B

NEW MAIN KITCHEN AND STORES

(1) What is your job title?

(2) Briefly, list the main activities you do in the catering department.

(3) Here is a list of general areas in a catering department. Number these places according to how much time you spend working in them. For example, if you work mainly in the pot/dish wash area, then label this box with a number 1. If you spend some other time in the preparation and cooking areas then label this with a number 2. Areas that you spend very little time working in number with a 0.

[ ] Pot/dish wash area.
[ ] Staff restaurant.
[ ] Preparation and cooking areas.
[ ] Main stores.
[ ] Trolley unloading and cleaning area.
[ ] Offices.
[ ] Meal plating and trolley loading area.

(4) Has your overall satisfaction with the new catering department premises changed since you started working in it?

Less satisfied	Satisfaction has not changed	More satisfied
[ ]	[ ]	[ ]

(5) Did you work in the old kitchen immediately before transferring to the new catering department?

No [ ] Yes [ ]

(6) If you answered, NO to question (5), can you tell me approximately how long you have been working in the new catering department?

(7) Do you consider the role of the catering department to be important to the patient's health and welfare?

Very Unimportant	Fairly Unimportant	Neither Important nor Unimportant	Fairly Important	Very Important
[ ]	[ ]	[ ]	[ ]	[ ]

(8) Do you think the system of patient meal service works,

All of the time	Most of the time	Half the time	Some of the time	Never
[ ]	[ ]	[ ]	[ ]	[ ]

(9) In your opinion, are there any problems in the design of the catering department which hinder your work?

Yes [ ] No [ ] Don't know [ ]

(10) If you answered YES, to question (9), please explain what the problems are and how they affect your work.

(11) Only tick ONE of the statements to complete the following sentence,
Based on your knowledge and work in the catering department would say that.

[ ] It requires major changes in operation to satisfy functional requirements.
[ ] Minor adaptations or modest additions to the building structure and/or equipment is essential to provide an adequate functional standard.
[ ] It provides a good total environment for functions for which it is used.
[ ] Minor adaptation to its operation is essential to provide an adequate functional standard.
[ ] It requires major equipment and/or building changes to satisfy functional requirements.

(12) Below are some statements. Please CIRCLE the answer which best matches your opinion of the catering department. For example:

The decoration of the catering department is...

Too bright Just right Too dark

(a) Space in the catering department is...

Inadequate Satisfactory Ample

(b) Physical relationships between spaces, equipment and different work areas enables me to do my work in the catering department...

Easily Adequately With difficulty

(c) The physical relationship and location of the catering department to the rest of the hospital is...

Bad Satisfactory Good

(d) The general shape and layout of the catering department affects work flow

Positively Not at all Negatively

(e) Equipment in the catering department is located in such a way that I can operate it...

With difficulty Adequately Easily

(f) Doors, windows and cupboards in the catering department are positioned...

Conveniently Inconveniently

(g) Cooking smells in the catering department are...

Intolerable Tolerable Not noticeable

(h) The temperature in the catering department is...

Mostly too cold Mostly about right Mostly too hot

(i) The ventilation of the catering department is...

Good Satisfactory Bad

(j) Lighting in the catering department is...

Bad Satisfactory Good

(k) Natural light from the windows in the catering department is...

Sufficient Insufficient

(l) Noise in the catering department is...

Intolerable Tolerable Not noticeable

(m) The general design and layout of the catering department makes work activities...

Flexible Rigid

(n) The general design and layout of the catering department makes it possible to achieve food hygiene standards...

With difficulty Satisfactorily Easily

(13) What aspects do you LIKE MOST about the catering department? If none, write NONE.

(14) What aspects do you DISLIKE MOST about the catering department. If none, write NONE.

(15) What changes would you like to make to the design or operation of the catering department to improve the method of patient meal production and delivery?

(16) If you were here at the time the new catering department was being planned and built, were you involved with any decisions relating to the design or operation of the catering department and food services?

Yes	No	Don't know	Wasn't here
[ ]	[ ]	[ ]	[ ]

(17) If you would like to make any additional comments about the new catering department and the service it provides to patients, please add them here.

TRANSPORTATION AND DISTRIBUTION

(1) How much of your working day is spent delivering meals to patients and returning trolleys to the main kitchen?

Less than a quarter	A quarter	A half	Three quarters	All
[ ]	[ ]	[ ]	[ ]	[ ]

(2) Which mealtimes are you involved in food transportation?
(You may tick MORE than one of these.)

Breakfast	Lunch	Supper
[ ]	[ ]	[ ]

(3) Which wards do you deliver meals to? Please list them below.

(4) On average, how long does it take to transport the food trolley from the kitchen to a ward?

(5) If you answered Yes to question (4), is there a ward which always seems to take longer to deliver to?

Yes [ ] No [ ] Don't know [ ]

Which ward is it? ______________________________

(6) Is there any particular ward which is difficult to transport food to?

No [ ] Yes [ ] Don't know [ ]

If Yes, which ward is it? ______________________________

(7) When delivering meals to wards o you have to follow a specific route?

Yes [ ] No [ ] Don't know [ ]

(8) What kind of vehicle do you use to transport the food trolleys?

(9) In your opinion, is the vehicle well suited and able to cope with transporting the food trolleys around the hospital site to the wards?

No [ ] Yes [ ] Don't know [ ]

(10) If you have ever experienced any difficulties transporting food trolleys around the site, please tell me about them below.

(11) Does the nature of the site at Hospital Case Study B create problems for food transportation?

No [ ] Yes [ ] Don't know [ ]

(12) If you answered YES, to question (11), tick from the following list the factors which YOU THINK cause problems and please add any others which you can think of.

[ ] Distance of kitchen to wards.
[ ] Some of the wards are situated downhill from the main kitchen.

[ ] There is no physical link between the main kitchen and wards so meal transportation can be influenced by the weather.

Please list any other factors below.

(13) With respect to the location of the new catering department to the rest of the hospital, do you think that it was sited in... (Only tick ONE of the following to complete the sentence.)

[ ] The most ideal place for transportation of patient meals around the hospital site.

[ ] The worst possible place for transportation of patient meals around the hospital site.

[ ] A place which is generally satisfactory for transportation of patient meals around the hospital site.

(14) With respect to transportation of food trolleys, would you describe access to and from the catering department as,

Very bad	Bad	Satisfactory	Good	Very good
[ ]	[ ]	[ ]	[ ]	[ ]

(15) Is the space for loading the food trolleys at the main kitchen,

Ample	Satisfactory	Inadequate
[ ]	[ ]	[ ]

(16) Is the space for unloading of dirty trolleys at the main kitchen,

Inadequate	Satisfactory	Ample
[ ]	[ ]	[ ]

(17) Are the food trolleys easy to manoeuvre in and out of the main kitchen?

Yes [ ] No [ ] Don't know [ ]

(18) If you answered No to question (17), can you describe what the problems are?

(19) Does the layout and design of the corridors inside the hospital make food transportation...

Easy	Neither Easy nor Difficult	Difficult
[ ]	[ ]	[ ]

(20) Are there any problem areas inside the hospital which make transportation of the food trolleys difficult?

Don't know [ ] Yes [ ] Don't know [ ]

If you answered YES, to question (20), please tell me what they are.

(21) When transporting food vertically between floors, are the lifts in the hospital able to cope with this job,

Poorly	Satisfactorily	Easily
[ ]	[ ]	[ ]

(22) Are there any changes you would like to make to the transportation and distribution system to deliver patient meals more effectively?

(23) Do you think the way that food is transported and distributed affects the quality of the food in the trolley?

No [ ]   Yes [ ]   Don't know [ ]

(24) If you would like to make any additional comments on the transportation and distribution of patient meals, please add them below.

VIEWS OF IN-PATIENTS ON FOOD SERVICE

SEX : Male [ ] Female [ ]
AGE : Under 18 [ ] 18-30 [ ] 1-50 [ ] 51-65 [ ] Over 65 [ ]

(1) Which ward are you on?

(2) Are you eating a special diet?

No [ ] Yes [ ] Don't know [ ]

If you are on a special diet tell us what it is (e.g. diabetic.)

(3) If you are on a special diet have you had any problems in getting the food you need?

Yes [ ] No [ ] Don't know [ ]

(4) How long will you be in hospital for this stay?

less than 2 days	2-6 days	7-15 days	over 15 days
[ ]	[ ]	[ ]	[ ]

(5) How do you feel about the courtesy and cheerfulness of the people serving your food and drinks?

Very satisfied [ ]
Moderately satisfied [ ]
Neither satisfied nor dissatisfied [ ]
Moderately dissatisfied [ ]
Very dissatisfied [ ]

(6) Is there a menu card available for you to choose your meals?

Never or almost never	Sometimes	Always or almost always
[ ]	[ ]	[ ]

(7) Does the menu include the type of meals you enjoy?

Always	Mostly	Half the time	Rarely	Never
[ ]	[ ]	[ ]	[ ]	[ ]

(8) Is the choice on the menu card...?

Too big	About right	Too small
[ ]	[ ]	[ ]

(9) Is there help available for you to fill in the menu card if you need it?

Always or almost always	Sometimes	Never or almost never	Help not needed
[ ]	[ ]	[ ]	[ ]

(10) Do you receive all the food items which you order?

Never or almost never	Sometimes	Always or almost always
[ ]	[ ]	[ ]

(11) If your food items are not always correct, what is wrong?
(YOU MAY TICK MORE THAN ONE OF THESE.)

Food items added	Food items missing	Food items changed
[ ]	[ ]	[ ]

(12) Were your meals served promptly and without delays between courses?

Always	Mostly	Half the time	Rarely	Never
[ ]	[ ]	[ ]	[ ]	[ ]

(13) Are you generally happy with the times meals are served?

Breakfast:	Too early [ ]	About right [.....]	Too late [ ]
Lunch:	Too early [ ]	About right [.....]	Too late [ ]
Supper:	Too early [ ]	About right [.....]	Too late [ ]

(14) Are trays, crockery and cutlery always available and clean?

Never	Rarely	Half the time	Mostly	Always
[ ]	[ ]	[ ]	[ ]	[ ]

(15) Do you have enough spoons, forks, knives, napkins, plates and condiments?

Always or almost always	Sometimes	Never or almost never
[ ]	[ ]	[ ]

(16) If any of these are ever missing (i.e. knives, forks etc.) which ones are they?

(17) Please list any comments you have on food choice, food service and timing of meals.

(18) Does the food look attractive and appetising when served?

Never	Rarely	Half the time	Mostly	Always
[ ]	[ ]	[ ]	[ ]	[ ]

(19) Are the size of the food portions for you...?

Too large	Just about right	Too small
[ ]	[ ]	[ ]

(20) Do you have enough time to finish your meals without rushing?

Yes [ ] No [ ] Don't know [ ]

(21) How much of your food have you been eating in hospital?

None	Some	Most	All
[ ]	[ ]	[ ]	[ ]

(22) If you have not been eating ALL your food please tell us why?

(23) If you required assistance with your meals did you receive it?

Always	Mostly	Half the time	Rarely	Never	Assistance not required
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

(24) Is the food generally served at the temperature you like?

Too hot	About right	Too cold
[ ]	[ ]	[ ]

(25) What is you overall opinion of ALL the meals and drinks you have had in this hospital?

Very good	Good	Neither good nor bad	Bad	Very bad
[ ]	[ ]	[ ]	[ ]	[ ]

(26) Were you able to talk with someone from the catering department about your food if you needed to?

No [ ] Yes [ ] Don't know [ ]

(27) Did you add to, or replace, your meals at this hospital with items of food other than those on the hospital menu (APART FROM THE USUAL FRUIT AND SWEETS)?

Yes [ ] No [ ] Don't know [ ]

(28) If you answered Yes, to question (27), indicate where you obtained the food item(s) from. (YOU MAY TICK MORE THAN ONE ANSWER.)

Vending machine	[ ]	Relative or friend	[ ]
Fellow patient	[ ]	Nurse	[ ]
Dietitian	[ ]	Hospital restaurant	[ ]
Hospital shop	[ ]	Other (specify)	______________

(29) If you answered YES, to question (27), please tell us what these food items were.

(30) How do you rate the drinks that are served at meals and at other times?

Very bad	Bad	Neither bad nor good	Good	Very good
[ ]	[ ]	[ ]	[ ]	[ ]

(31) How IMPORTANT to you is the food served during your stay in hospital?

Very Important	Fairly Important	Neither Important nor unimportant	Fairly Unimportant	Very Unimportant
[ ]	[ ]	[ ]	[ ]	[ ]

(32) To sum up, if you were asked by your friends what sort of meals you had in this hospital, how would describe them?

The best possible standards	Good	Adequate	Rather institutional	Best Forgotten
[ ]	[ ]	[ ]	[ ]	[ ]

(33) Have you any further suggestions or comments on catering arrangements or quality of meals and drinks?

Are there any changes which you would like to see made in the hospital catering?

WARD KITCHENS

(1) How much of your working time do you spend in the ward kitchen?

less than a quarter	a quarter	a half	three quarters	all
[ ]	[ ]	[ ]	[ ]	[ ]

(2) Which ward or wards do you work on? Please list them below in the order in which you most frequently work in them. For example, if you work in wards B2 and B4 and work most frequently in B2, then write.... B2, B4. If you work on the wards with the same frequency then when you have made the list write "same amount of time".
Answer the rest of the questions according to the ward kitchen that you spend most time in.

(3) If you work in several different ward kitchens, are they generally the same design and layout?

No [ ] Yes [ ] Don't know [ ]

(4) How long have you worked in the new ward kitchens as a domestic assistant?

(5) Has your overall satisfaction of the ward kitchen changed since you started working in it?

Less satisfied	Satisfaction has not changed	More satisfied
[ ]	[ ]	[ ]

(6) What work activities do you carry out in the ward kitchen?
Please list as many as you can think of below.

(7) In your opinion are there any problems in the design of the ward kitchen which hinder your work?

Yes [ ] No [ ] Don't know [ ]

(8) If you answered Yes, to question (7), please explain what the problems are and how they affect your work.

(9) Only tick one of the statements to complete the following sentence,

Based on your knowledge and use of the ward kitchen would you say that,

[ ] It requires major changes in operation to satisfy functional requirements.
[ ] Minor adaptations or modest additions to the building structure and/or equipment is essential to provide an adequate functional standard.
[ ] It provides a good total environment for functions for which it is used.
[ ] Minor adaptation to its operation is essential to provide an adequate functional standard.
[ ] It requires major equipment and/or building changes to satisfy functional requirements.

(10) Below are some statements. Please CIRCLE the answer which best matches your opinion of the ward kitchen.

For example: The decoration of the ward kitchen is...

Too bright Just right Too dark

(a) Space in the ward kitchen is...

Inadequate | Satisfactory | Ample

(b) Physical relationships between spaces, equipment and different work areas enables me to do my work in the ward kitchen...

Easily | Adequately | With difficulty

(c) The physical relationship of the ward kitchen to the ward is...
(Think of distances and location.)

Bad | Satisfactory | Good

(d) The physical relationship of the ward kitchen to the rest of the hospital is...
(Think of distances and location, especially with respect to the main kitchen.)

Good | Satisfactory | Bad

(e) The general shape and layout of the ward kitchen affects work flow

Positively | Not at all | Negatively

(f) Equipment is located in the ward kitchen in such a way that I can operate it...

With difficulty | Adequately | Easily

(g) Doors, windows and cupboards in the ward kitchen are positioned...

Conveniently | Inconveniently

(h) The temperature of the ward kitchen is...

Mostly too cold | Mostly about right | Mostly too hot

(i) Ventilation of the ward kitchen is...

Bad | Satisfactory | Good

(j) Lighting in the ward kitchen is...

Good | Satisfactory | Bad

(k) Natural light from the windows in the ward kitchen is...

Sufficient | Insufficient

(l) The ward kitchen can be cleaned...

With difficulty | Satisfactorily | Easily

(m) The general design and layout of the ward kitchen makes work activities...

Flexible | Rigid

(n) The general design and layout of the ward kitchen makes it possible to achieve food hygiene standards...

With difficulty Satisfactorily Easily

(11) What aspects do LIKE MOST about the ward kitchen? if none, write NONE.

(12) What aspects do you DISLIKE MOST about the ward kitchen? If none, write NONE.

(13) In your opinion, what is the purpose of the ward kitchen?

(14) If you would like to make any additional comments about the ward kitchen. please add them here.

APPENDIX 7

Broad Brush Appraisal of Retrospective Project B

Aspects	What was supposed to happen	What actually happens	Does it work	Explanations
Description of service				
Functional size	450 in-patients variable staff and visitors number	450 in-patients variable	Yes Yes, but -	Seating capacity is regularly reached and many visitors to the premises have no other reason to be on site.
Type of service	Traditional plated bulk	Traditional plated bulk	Yes	
Purchasing	Via contracts, written and telephone orders	As planned with extremely tight controls	Yes – very well	
Manipulation (preparation or pre-preparation)	Prepared from basic raw ingredients except use of prepared vegetables	As planned	Yes	
Cooking	Various methods	As planned	Yes	
Preservation (hot-holding, chilling or freezing)	None	As planned	Yes	Improves quality and reduces risks
Reheat/rethermalisation	None	As planned	Yes	
Distribution	Plated and bulk via heated/chilled conveyor	As planned	Yes	Some obstacles encountered – gradients/pavements /lifts

Aspects	What was supposed to happen	What actually happens	Does it work	Explanations
Design solution				
Location within hospital/travel distances	Central - all areas within 100 yards	As planned	Yes	Delivery completed within 6 minutes
Departmental relationships	Quality groups	As planned	Yes and no	Some ward staff are reluctant to participate/change
Accessibility - catering staff	Easy access by all	As planned	Yes	
Accessibility - dietetic staff	Direct access	Limited access	No	Dietetics department is part of another Directorate and dietitians workload leaves little available time
Accessibility - portering staff	Direct access	As planned	Yes	
Layout of department	Good linear workflow	As planned	Yes	
Travel distances in department	Minimal	As planned	Yes	
Communications within department	Specified network	As planned	Yes	Various meetings, walking the job and staff appraisals
Work flow	Good/safe/hygienic	As planned	Yes	
Facilities for staff - rest room	Requested but no space available	As planned	No	Relaxation area is required but not available
Facilities for staff : offices	3 available	As planned	Yes	Space limited
Facilities for staff - WCs	2 staff, 2 customers inc. 1 disabled	As planned	Yes	
Facilities for staff - baths/showers	1 male and 1 female shower	As planned	Yes	But little privacy

Aspects	What was supposed to happen	What actually happens	Does it work	Explanations
Space				
Space provision	Sufficient but tight	As planned	Yes	But requires good management
Shape	Rectangular in all areas	As planned	Yes	
Equipment location	Fixed on perimeter prime cooking/mobile central	As planned	Yes	
Stores location	By goods inward, adjacent to kitchen perimeter	As planned	Yes	
Refrigeration/freezing stores location	By goods inward	As planned	Yes	
Equipment store location	By central wash up area and by preparation areas	As planned	Yes	
Position of - doors	On each side of building	As planned	Yes	
Position of - windows	4 feet from floor	As planned	Yes	Good natural light
Position of - equipment	Central	As planned	Yes	
Position of - cupboards	None	As planned	Yes	
Position of - offices	Perimeter of building	As planned	Yes	
Position of - staff rest room	None	As planned	Yes	
Position of - WCs	In changing rooms and adjacent to restaurant	As planned	Yes	
Position of - baths/showers	In changing rooms	As planned	Yes	

Aspects	What was supposed to happen	What actually happens	Does it work	Explanations
Environmental conditions				
Smell	Minimal	As planned	Yes	
Heating	Controlled from within	Not always controlled, electric wall heaters incorrect	No	Centrally controlled for efficiency and electric heaters result in dry atmosphere
Ventilation	Controllable	As planned	No	Not totally efficient causing heat retention and damp via condensation in some areas
Lighting				
Windows	All around perimeter	As planned	Yes	
Noise	Minimal	High level	No	Extractor fans very noisy
Ease of cleaning	As easy as possible	As planned	Yes	
Legislative standards				
Fire escape signs	To meet legislation	As planned	Yes	
Fire fighting equipment	To meet legislation	As planned	Yes	
Alarms	To meet legislation and local requirements	As planned	Yes	Connected to switchboards
Food hygiene	To meet Food Safety Act	As planned	Yes	