MODERN BUILDING SERVICES FOR LISTED HISTORIC BUILDINGS: PROBLEMS & RISK

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DECLARATION

I declare that the work undertaken in this thesis was carried out in accordance with the regulatic of Oxford Brookes University. The work is original except were indicated by a special reference the text and no part of the thesis has been submitted for any other degree.

Any views expressed in the thesis are those of the author and in no way represent those of Oxfc Brookes University.

This thesis has not been presented to any other university for examination in either the Uni Kingdom or overseas.

Signed: Justine Hillier Date: 8th May 2

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For My Grandmother

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ABSTRACT

The English Heritage Press Office has estimated that listed buildings represent a finite cultural resource of approximately 6% of England's building stock. Many of these listed buildings are historic. It is often necessary to find an appropriate use for them, in order to preserve them for future generations. Many, not threatened by obsolescence, require upgrading to comply with statutory regulations. Others are improved to provide the occupants with twenty-first century standards of environmental comfort, lighting and power, sanitation, security and communications systems.

The revitalisation or upgrading of property is commonly accepted as refurbishment. The study initially focused on the refurbishment of listed historic buildings - the enquiry was then narrowed to investigate the integration of modern building services into listed historic buildings. This element of the refurbishment process was identified as an area that frequently constitutes a considerable proportion of the contract sum. A naturalistic form of enquiry was used to elicit information that would contribute to the body of knowledge on this area of building conservation work.

Refurbishment characteristics pertaining to the process of integrating modern building services into listed historic buildings were identified and rated for frequency of occurrence and degree of difficulty. An evaluation of perceptions and attitudes to adverse events, that posed risk in the process, was also undertaken. Practitioners from the Construction Industry then described both success and problem factors encountered in this element of building conservation. Having built up a picture of the process, based on the experiences of the constituent members of the project team, three individual projects were studied to gain further insight into the project and what might be considered as 'repetitive essentials'. To facilitate analysis the elicited data was assigned to the most appropriate choice from eight different project categories. These categories were employed as a way of recording the data throughout all stages in the research enquiry. The study concludes by outlining a model, based on these project categories, which could be developed to provide a common project framework. A key function of such a project framework would be to promote understanding through improved communication and integrated teamwork. The study concludes by recommending areas worthy of further research relating to the project framework, the project team and risk in listed historic buildings.

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CHAPTER 1

The Study Begins

1.0 INTRODUCTION

A personal interest in historic buildings was awakened when research was undertaken to investigate the impact of visitors on the built heritage (Nichols, 1993). Its aim was to explore issues relating to sustainability, maintenance and refurbishment in the built heritage, a finite cultural resource estimated to be approximately 6% of the building stock, in England in 1996 (The English Heritage Press Office, 1996). Investigation into the refurbishment of listed historic buildings now continues and this chapter outlines the aim of the research and its objectives.

1.1 THE RESEARCH AIM

The aim of this research was to explore the process of the refurbishment of listed historic buildings. The research question was defined as follows:

'What are the characteristics of the process of refurbishing listed historic buildings and what flows from them?'

Throughout the enquiry, data was sought that illustrated this construction activity and contributed to the existing body of knowledge pertaining to building conservation.

1.1.1 The Research Objectives

Once the enquiry had provided a preliminary knowledge, for this aspect of building conservation, the field was narrowed. Focus turned to an individual element in the refurbishment process that was highlighted, as problematic, by practitioners in the Construction Industry.

Within this context, the objectives of the study were to investigate the following:

- The frequency of occurrence and degree of difficulty of identified refurbishment characteristics.
- Practitioners' perceptions and attitudes to events or activities that posed risk in this element of the project.
- Factors that contributed to the successful outcome of the project and factors that threatened that success.

1.1.2 Generation Of Propositions

As noted in par.1.1 the nature of the enquiry was exploratory. Propositions suggested throughout this thesis are essentially *'indicators'* intended to contribute to the understanding of the process. Some propositions raised questions that pointed to further in-depth investigation and these are detailed in the concluding chapter [par.11.6] as 'Areas Worthy Of Further Research'.

1.2 PARAMETERS & ASSUMPTIONS

The parameters of the individual study topics and, also, assumptions made by the researcher are detailed in individual chapters. By way of a brief overview, the study invited opinions from practitioners who had experience in building conservation work. In the study, respondents had all had acted as project managers in this capacity. In order to gain a holistic perspective, respondents were selected from the constituent disciplines that make up the project team. For the purpose of this study they were deemed to be architects, main contractors, mechanical & electrical contractors, quantity surveyors, building surveyors, building services consultants and structural engineers.

The scope of projects was limited to historic buildings that are listed [Grade I, Grade II* and Grade II] and had been refurbished a *maximum* of five years prior to the research study.

1.3 RESEARCH CONTRIBUTION

It was intended from the onset that the research enquiry should not limit its focus to the academic and theoretical but that it should provide a practical perspective as well. Within the last decade, the Construction Industry has focused on improving its working practices (Latham, 1994; Egan, 1998; 2002). Much of the value of this thesis lies in the illustrative quality of the data. It provides a pool of information that contributes to the understanding of the process and also serves as a basis for a suggested framework to integrate the team and the process.

1.4 THESIS FORMAT

The thesis follows the sequence taken by the path of enquiry. Chapter by chapter, the investigation is related just as it as it unfolded in the course of the study. The content of these chapters is now briefly summarised.

<u>Chapter 2</u>

As provenance for the study this chapter provides a brief overview of building conservation, legislation protecting listed historic buildings, the refurbishment of buildings and conservation risk. In summation the interrelationship between building conservation, refurbishment and risk is identified. The information was provided through a literature search.

Chapter 3

Having provided a background to the study topic, an investigation to find an appropriate research methodology was undertaken. This chapter discusses the approaches that were considered and the criteria upon which the final research strategy was based.

Chapter 4

In this chapter the empirical findings of the first part of the study are reported. The data provides the basis for isolating an element of the refurbishment process to be investigated in greater depth. This element was identified as the integration of modern building services into listed historic buildings.

Chapter 5

Through information yielded from reviewing literature the following are described: the need for modern building services in listed historic buildings; examples of modern building services; relevant consents and difficulties in obtaining approvals; design and workmanship: good and bad practice. The chapter concludes by discussing the interrelationship between conservation, refurbishment, risk and modern building services.

Chapter 6

The integration of modern building services into listed historic buildings is investigated in respect of the frequency of occurrence and degree of difficulty of the characteristics encountered when executing the works. The data is reviewed and propositions are suggested.

Chapter 7

Having rated identified characteristics of the process of integrating modern building services into listed historic buildings for degree of difficulty and frequency of occurrence, the investigation now continues by enquiring into practitioners' perceptions of the risk that certain adverse events might be encountered in the process. The data is reviewed and propositions are suggested.

Chapter 8

To investigate the subject area, further, factors that contribute to success, and problems that can threaten the success of the project process and its outcome, are elicited from practitioners, through interview. The findings are discussed and propositions are suggested.

Chapter 9

Individual case studies are reviewed and evaluated. What emanates from this stage of the enquiry is discussed within the same analytical framework employed in the questionnaire survey and interview. In conclusion, it is proposed that the data in the case studies reaffirmed the data in the questionnaires and interviews. It is proposed that these findings, relating to the project process, are capable of being regarded as repetitive essentials.

Chapter 10

Issues relating to the multidisciplinary team and the work stages are outlined. Failures that can occur in the current project process are tabulated. A conceptual model for a project framework, to aid practitioners the in the task of integrating modern building services into listed historic buildings, is outlined based on the findings of the research. Its application and benefit are discussed.

Chapter 11

This chapter brings the report to a conclusion. It comments on the research strategy and summarises propositions from the research enquiry. Recommendations relating to the process of integrating modern building services into listed historic buildings are suggested. Areas worthy of further research are also identified.

Appendices

Much of the data, generated by this investigation, is of an illustrative nature. The data has been arrayed in appendices for use as a reference when reading this thesis and, also, as a descriptive and informative account of various aspects of the process, in its own right.

Appendix I contains a blank sample of the questionnaire OBU/J/2 that practitioners were asked to complete relating to the refurbishment characteristics when integrating modern building services into listed historic buildings.

Appendix II contains the computed data and associated comments from processing the completed questionnaires relating to the frequency of occurrence and degree of difficulty of the refurbishment characteristics.

Appendix III contains the data from the processed questionnaires relating to risk.

Appendix IV contains the data relating to success and problems encountered in the process.

Appendix V contains the case study narratives.

Appendix VI illustrates the study programme in tabular format.

Appendix VII contains papers written by the author and presented at conferences.

1.5 SUMMARY

The research aim and its objectives have been outlined in this chapter. The format of the thesis and a brief summary of the contents of each chapter have been included to give the reader a preliminary view of how the research enquiry unfolded and how it has been reported. With this outline in place, the fuller picture will now be revealed.

CHAPTER 2

Refurbishing Listed Historic Buildings: A Background

2.0 INTRODUCTION

This chapter is intended to provide an introduction to the refurbishment of listed historic buildings, as a means of sustaining the cultural heritage of the built environment.

To provide provenance for the research initiative, literature relating to building conservation and its current day ethos, were undertaken. Furthermore, the following were also reviewed: legislative control imposed by Government in order to control interventions to buildings that form the built heritage; the principles underpinning the task of building conservation and, as a means to this end, the characteristics of the process of refurbishing buildings and associated risks. In summation the interrelationship between building conservation, refurbishment and risk is discussed.

2.1 A BRIEF OVERVIEW OF BUILDING CONSERVATION PHILOSOPHY

Historic man-made structures that form the built environment, today, have all probably undergone 'conservation' since their original construction, in one way or another. However, for the purpose of this study, the history of the conservation of historic buildings has only been considered from the latter part of the nineteenth century. At this time there was a radical reform in accepted thinking about the treatment of historic buildings. It culminated in a turning point in the practices employed when caring for the built heritage. A new rationale replaced the old approach to building conservation and this has, essentially, remained the guiding principle in conservation practice, today.

2.1.1 Historic Buildings: A Definition

Feilden (1994) defines a historic building as follows:

"A building that gives us a sense of wonder and makes us want to know more about the people and culture that produced it. It has architectural, aesthetic, historic, documentary, archaeological, economic, social and even political and spiritual or symbolic values; but the first impact is always emotional, for it is a symbol of our cultural identity and continuity - a part of our heritage. If it has survived the hazards of 100 years of usefulness, it has a good claim to being called historic."

2.1.2 The Origin Of Contemporary Conservation Ethics

In 1865, The Royal Institute Of British Architects [RIBA] published a Handbook of Conservation of Ancient Monuments and Remains. It advised restorers that it was their duty to *'destroy any additions or alterations, be they clearly modern, that conceal the ancient work'*. An architect of the day, J.J. Stevenson, who was appalled by this approach, described the publication as a *'handbook for the destruction of old buildings'* (Denslagen, 1994). The Victorian urge to rebuild and alter historic buildings, in line with this doctrine, was spreading from churches to country houses. John Ruskin was bitterly opposed to this approach to the restoration of historic buildings, a feeling he expressed in The Seven Lamps of Architecture [The Lamp of Memory] by saying, " *The thing is a lie from beginning to end.* " (Ruskin, 1880)

A contemporary and friend of Ruskin, William Morris, was also deeply alarmed by the then ethic, guiding the conservation of historic buildings. According to Delafons (1997) prompted by the horror of seeing Burford church being demolished for restoration, Morris set up The Society For The Protection Of Ancient Buildings [SPAB] in 1877. This newly formed society embraced the views of both Ruskin and Morris. Its beliefs were founded in the principle that the historic building should be considered as a whole, including its alterations and additions. This was in strong contrast to earlier philosophy and, as such, the anti-restoration movement was born.

2.1.2.1 SPAB Manifesto 1887 & The International Charter For The Conservation And Restoration Of Monuments And Sites, 1964[1]

William Morris drafted a manifesto for the SPAB. Its two leading principles were in essence: approach to building conservation was not to be limited to any specific styles but based on critical evaluation of the building stock and that fakes should be avoided - *conservative repair and to stave off decay, by daily care* (Jokilehto, 1996).

In 1964, The International Council On Monuments and Sites, a nongovernmental body of professionals concerned with conservation, with separate committees in 60 countries, [ICOMOS] set down an international code of practice for conservation. It was approved by the 2nd International Congress of Architects and Technicians of Historic Monuments, which met in Venice, on May 25th -31st, 1964. This code of practice, known as The International Charter For The Conservation And Restoration Of Monuments And Sites, 1964 [The Venice Charter, 1964] made a declaration of principles. This provides a document of ethics that is still forefront in

[1] Commonly referred to as 'The Venice Charter, 1994'.

conservation, today (Pickard, 1996). As can be noted, by reference to Article 9 and Article 11, the principles laid down by Morris, in the SPAB manifesto, were reinforced in this Charter.
In brief, Article 9 and Article 11 state the following aims:

- Article 9 - Preserve and reveal the historic and aesthetic value for the historic building: have respect for the original; stop where conjecture begins and ensure that any extra work must bear a contemporary stamp.
- Article 11 - Valid contributions from all periods must be respected and a unity of style is not the aim of restoration.

2.1.3 Current Day Conservation Principles

The Venice Charter (1964) is not a legally binding document but its principles are widely adopted in the current day and this is, possibly, set to grow.

"As more conservation officers are employed and undertake specialist training in conservative repair techniques, knowledge of and recourse to the charter may become more widespread." (Pickard, 1996)

In short, there are three overriding principles governing interventions to historic buildings, today.

- Minimum Intervention
- Reversibility
- Honest Repair

Sharpe (1999) states the following duty of care should be afforded to the historic building, on the part of contractors.

"It is essential that all forms of adaptation, treatment or change are capable of reversal to their original state. Where alterations and structural adaptation cannot be avoided, they need to be kept to a minimum. In addition, interference to existing elements and all new work must be distinguishable from the original in a manner that enables the historic development of the building to be positively identified by visual examination, without reasonable doubt or ambiguity."

2.1.4 Factors Affecting The Approach To Conserving The Listed Historic Building

In addition to employing the aforementioned three conservation principles in building conservation work, the question that must be asked of every act of conservation is,

"How is this work meaningful and right for this and future generations?" (Warren, 1996)

This is a matter for conservation ethics [par.2.1.2.1 refers] and these will provide the basis for defining acceptable changes and losses to the original nature of the building '*since it is neither practicable or sensible to insist upon the total preservation of all that is contained within the historic environment*' (Baker, 1983).

The quality of decisions and choices, however, will also be influenced by the following factors:

i. Perception The interpretation of data against the practitioner's/client's bank of previous knowledge, experience and his or her individual persona (Strike, 1994; Warren, 1996).

ii. Understanding The clarity of understanding held by the project team, statutory bodies and the client, regarding the special importance of the building and its landscape (Clark, 2001).

iii. Viability An appreciation of the relationship between good conservation and commercialism to ensure any decision is founded within a viable economic and financial framework (Redman, 1995).

iv. Judgement The uncertainty of private judgement relating to '*what to us may be without merit may well prove to be of considerable value to posterity*' and the threat to sound judgement due to '*the confusion between antiquity and merit*' (Fawcett, 1976).

2.2 STATUTE: LEGISLATION TO PROTECT HISTORIC BUILDINGS

A listing procedure to protect buildings considered '*to possess architectural and/or historical significance*' came into being after the Second World War, under the Town and Country Planning Act, 1947. Towards the end of the twentieth century there were in the region of 450,000 listed buildings in England (The Heritage Monitor, 1999). A listed building is any building that is included for the time being in the lists, and any object or structure within the curtilage of the building that was erected prior to 1 July 1948 (Ross, 1991).

Listed buildings are identified in three categories:

Grade I - Buildings to be considered of exceptional interest } estimated in 1994
Grade II*- Important buildings of more than special interest } to be 5.5% of listed buildings.

Grade II - Buildings of special interest, which warrant every effort to preserve them.

2.2.1 Listed Building Control

Before any intervention is made to a listed building guidance should be sought, from the local authority, to ascertain if approval is needed in respect of the proposed works. If so, it will entail going through the process of obtaining listed building consent. The current provision relating to listed buildings is set out in the Planning [Listed Buildings and Conservation Areas] Act 1990. Section 7 of the 1990 Act states,

"No person shall execute or cause to be executed any works for the demolition of a building or for its alteration or extension in any manner which could affect its character as a building of special architectural interest, unless the works are authorised."

To provide guidance to local authorities, when considering listed building consent applications, the Government issues Planning Policy Guidance Notes [PPG's]. In September 1994, the Department of the Environment & the Department of National Heritage issued PPG 15 'Planning And The Historic Environment'. It provides a full statement of government policies in relation to the upkeep and repair of historic buildings as well as directives relating to repair, urgent works, repairs notices, compulsory acquisition of listed buildings in need of repair and general considerations.

Some critics of the legislative framework have argued that listing buildings impedes their regeneration. This argument has been balanced by the assertion that the aim of legislation is not to prevent change but to manage it so that the vast majority of historic buildings can be sympathetically adapted for new uses and where necessary to meet modern demands [SAVE (1998) Catalytic Conversions].

2.2.1.1 <u>Application For Listed Building Consent</u>

In order to obtain consent to alter or extend a listed historic building an applicant should:

- identify the building, including relation by plan
- set out the work proposed, accompanied by plans and drawings showing what this comprises
- include any other particulars required by the authority.

Any decision made by the local planning authority will not be based on keeping it at all costs, but in ensuring that its life is guaranteed and lengthened in a way that will not destroy architectural merit and historic interest (Ross, 1991).

Planning permission, if needed, may be granted but listed building consent refused. Without both the development cannot proceed. However, an applicant may appeal to the Secretary of State against this decision on specific grounds.

2.3 THE CONSERVATION OF HISTORIC BUILDINGS

Feilden (1994) defines conservation as follows:

"The action to prevent decay. It embraces all acts that prolong the life of our cultural and natural heritage, the object being to present to those who use and look at historic buildings with wonder, the artistic and human messages that such buildings possess".

The ethics that underpin contemporary building conservation philosophy and the legislative framework that protects the built heritage have been briefly reviewed. Nonetheless, even given this guidance, building conservation work requires high levels of sound, sensitive and informed judgment, in conjunction with specialist expertise.

Earl (1996) states,

"The conservation of buildings is not a mechanical activity controlled by hard and fast formulae which, correctly applied, will produce demonstrably correct solutions."

The nature of historic buildings has been explored through the work of Chitty (1987) commissioned by English Heritage [the Government's statutory adviser on the conservation of historic buildings and ancient monuments in England]. Chitty identified the life cycle of historic buildings as seven stages. These were essentially, as follows:

(1) Design and construction

(2) Alterations and changes due to taste and use

(3) Abandonment of the building

(4) Advanced decay and dilapidation

(5) Visual or picturesque ruin

(6) Attempts to arrest the process of decay

(7) Preservation and possibly reconstruction

Strike (1994) suggests that using Chitty's categories, to define the stage in the historic building's life cycle, could be beneficial when devising the conservation strategy – different life cycle stages lending themselves to some approaches more than others.

Earl (1996) observes that decisions faced by the practitioner in conservation work '*raise philosophical questions at every turn.......and that all solutions must be defensible*'. Subscribing to the argument of Strike (1994) identifying the stage, in the life cycle of the listed historic building, could make a valuable contribution when devising defensible solutions.

2.3.1 Guidelines For Practitioners Working In Historic Building Conservation

Brereton (1995) advises,

"The basic principles and objectives which are relevant to an individual case should be established at the outset and, then, should be applied to generate solutions to particular problems and specific methods of repair. Perhaps the most important of all are the attitudes of building owners and the practitioners involve."

Furthermore, the quality of decisions relating to historic building conservation will be influenced by individual perceptions and judgement [par.2.1.4 refers]. To compound the issues relating to attitude, perception and judgement Baker (1983) argues, *"Professional codes of conduct necessarily leave large grey areas undefined."*

To aid the practitioner in the quest to achieve building conservation objectives, the BSI [British Standards Institution] produced a draft BSI Guide To The Care Of Historic Buildings, Document 91/15479, in 1991. In 1998, the same institution published British Standard 7913:1998 'The Principles Of The Conservation Of Historic Buildings'. BS 7913:1998 identifies '*the immediate and obvious objective of building conservation*' as a way to secure '*the preservation of the nation's building stock and, in particular, its historic buildings and fine architecture, in the long term interest of society*'. It provides a fundamental reference for the building conservation project team and gives a common context to any discipline-related or client-related decisions regarding conservation, renovation and repair of historic buildings.

2.4 THE REFURBISHMENT OF LISTED HISTORIC BUILDINGS

This chapter, so far, has briefly considered the principles of building conservation, the legislative framework within which it operates and makes reference to general guidance on building conservation practice. A discussion will now ensue about the process of conservation that goes beyond that of routine maintenance and repair. The challenge to the practitioner to make defensible decisions relating to conserving the building was mentioned in par.2.3. Setting aside their value in terms of culture and history, historic buildings are identified by Earl (1996) as '*useful resources capable of serving a modern purpose*'. Buildings, he maintains, fall into decline as a result of economic forces and operational obsolescence and not because they are incapable of being repaired. Economic forces have now entered the 'building conservation picture'. This factor, in conjunction with the guidance offered through the use of Chitty's model, might well highlight *refurbishment* as the most viable and defensible approach to conserving the listed historic building in life cycle stages (2) (3) and possibly (4) [par.2.3 refers].

2.4.1 Refurbishment - A Definition

The CIRIA [Construction Industry Research and Information Association] Report 133 'A Guide To The Management Of Building Refurbishment' provides a definition of refurbishment as follows:

"Construction work to an existing building to update or change the facilities it provides. It goes beyond mere maintenance and repair, though it may well include opportunist work of this nature."

Watt & Swallow (1996) expand on this definition by stating that refurbishment is the process of overhauling the building '*bringing it up to the requirements of the client*'.

Report 133 (1994) identifies reasons that clients choose to refurbish their buildings are unacceptable deterioration in the building's performance, the need for improved facilities, or a business decision influenced by the market.

2.4.2 Conservation Versus Refurbishment

Conservation, with respect to listed historic buildings, is a measure to preserve and protect their architectural, historic and cultural merit for future generations. Listed historic buildings are a finite resource within the built heritage and, as such, precious and irreplaceable. Owners of listed historic buildings are not at liberty to allow them to fall into irrevocable disrepair and, therefore, intervention will be necessary at some stage in the life of the building. Any construction activity, in respect of this, must comply with statutory legislation [par.2.2.1 refers] respect conservation principles [par.2.1.3 refers] and focus on the needs to protect the building.

Refurbishment [as defined in par.2.4.1] is, in essence, a major intervention in the life of an existing building [involving construction activities] undertaken to satisfy the client's needs. The project brief will reflect desired outcomes and providing the scheme proposals are approved, with respect to statutory legislation regarding listed buildings [and any other Acts relevant to the projected use of the building concerning planning, building regulations, fire precautions, safety etc.] then the client can choose to go ahead.

In summation, it can be said that both building conservation and refurbishment entail construction work to an existing building. Refurbishment, in buildings that are not listed can principally focus on the client's needs whilst the principal focus in building conservation will be to protect the building, albeit in a financially and economically viable way [ref.2.1.4 (iii)]. In order to conserve a listed historic building, refurbishment may be the chosen solution [par.2.4

refers]. If so, this approach will necessitate the successful marriage of conservation objectives and the client's needs.

It must be noted that BS 7913:1998 [par.2.3.1 refers] refrains from defining refurbishment due to it being a 'general term' having 'no precise or technical meaning in building conservation'.

In view of this, it can be added that refurbishment is a generic term. The approach employed when refurbishing an existing building will be in response to its present condition and projected use. In the case of refurbishing a listed historic building, this response will additionally be governed by the principles of conservation.

2.4.2.1 <u>Refurbishment In The Field Of Building Conservation</u>

Article 5 of the Venice Charter, 1964, states as a guiding principle,

"The conservation of monuments is always facilitated by making use of them for some socially useful purpose. Such use is therefore desirable but it must not change the layout or decoration of the building. It is within these limits that modifications demanded by a change of function should be envisaged and may be permitted."

Not all refurbishment, of course, entails a change of use but the limits this principle imposes still hold. Pickard (1996) highlights assessment of the original quality of the building as fundamental before engaging in the design for new work or adaptation. Clearly costs, too, will be a determining factor to the extent and nature of the conservation and refurbishment undertaken in the historic building. Fitch (1994) cites a survey by the Advisory Council on Historic Preservation, [Washington DC] which shows that, generally, the determining factors in the overall cost of adaptive re-use are in the architectural and mechanical work. Albeit an American study, it provides an indication that demolition costs for works, inside the building, and structural costs are generally a minor proportion of the budget sum. In summary, 'adaptive re-use', facilitated by refurbishment, can be a viable economic proposition [ref: par 2.3] to save a building.

2.4.3 Managing The Refurbishment Process

According to the CIRIA Report 133 (1994) from inception, the refurbishment project should adopt a management strategy. The document states,

"The project manager, in collaboration with the client representative must develop a strategy for defining all the responsibilities within the project and the earlier this is done in the life of the project the more effective it will be."

As part of the development of the management strategy, the project manager must take into account certain considerations, peculiar to the nature of the work, in addition to the basic objectives of cost, time and quality (CIRIA, Report 133). These can be divided into three specific categories *viz.*

- The continuing existence of the building or other fixed asset throughout the duration of the project which may require:
    - measures to minimise disruption to the operation of the building
    - taking account of hindrance to construction work due to occupancy
    - additional safety awareness and protection measures.
- Uncertainty due to:
    - unclear or evolving client requirements
    - the continuing discovery of the building's physical condition during the work

  <u>or</u>
    - the interaction of the aforementioned two.

In addition to this, in the case of listed historic buildings:

- Achieving conservation objectives to protect the building's
    - architectural merit
    - historic significance
    - cultural messages.

Young & Egbu (1993) undertook research into the difficulty and frequency of refurbishment characteristics experienced, by project managers, in the course of the refurbishment process. The study was not restricted to any specific type of building or refurbishment project and, as such, data relating to the refurbishment of listed historic buildings contributed to the computed results. Cost control, dust control, pricing of the works, variations on the works, noise control and site security were rated as being difficult. Variation/ change to the order of the works and keeping the site tidy were ranked as characteristics encountered very frequently.

In addition, they investigated which management skills project managers perceived to be important. Managing time and communication received high weighting. Amongst managers' education training needs for refurbishment the most highly rated were:

1. Forecasting and planning
2. Analysis of project risk/uncertainty
3. Use of computer technology

In the words of Young & Egbu (1993) *"This clearly suggests that refurbishment work is risky, uncertain and difficult to forecast and plan."*

2.5 RISK IN HISTORIC BUILDING CONSERVATION REFURBISHMENT

Refurbishment work has been identified as 'risky' [par 2.4.3]. Research has shown that conservation refurbishment projects hold special elements of risk.

"There will be uncertainty in terms of specification, extent, duration or cost all of which pose risk. In addition, there are further specific layers of risk associated with conservation projects." (Reyers & Mansfield, 2001)

These have been reported under the following headings:

- <u>Consultants</u>: dependence of practitioners and contractors, availability of experience, communication and legal relationships.
- <u>Involvement of external bodies:</u> the imposition of expensive mandatory requirements, protracted negotiations and opening up works.
- <u>Health & Safety</u>: safety issues relating to the increased use of temporary works and safe access requirements.
- <u>Design constraints:</u> restricted components and material choice, minimum quality thresholds and combinations of alternative design solutions.

In an earlier study, Reyers & Mansfield (2000) found two elements of risk that were perceived to be significant and frequent. Both involved externalities: clients and the statutory approval process. Further analysis of the risks, relating to cost, indicated most practitioners believed conservation projects were less predictable in terms of confidence limits of out-turn costs, had more tendency to go over budget and contingency allocations/ provisional sums were generally greater. Extension of time was more likely on higher value projects. Reyers & Mansfield (2001) propose that risks can be grouped in clusters, their grouping and subsequent management influenced by the respective practitioner's background and training.

CIRIA Report 133(1994) claims attitudes towards allocation of risk between the parties vary in refurbishment projects, e.g. larger clients often prefer to manage the risks and pay the cost as necessary rather than offload them, whereas, smaller clients and property developers accept that the client may ultimately have to take the risk but often try to place it with the contractor.

Thus, it can be concluded that building conservation refurbishment work holds specific elements of risk. Research in the field indicates that the practitioner's perception of risk will be influenced by experience and training. Furthermore attitudes towards the allocation of risk in refurbishment projects may vary.

2.6 BUILDING CONSERVATION, REFURBISHMENT AND RISK: OBJECTIVES & INTERRELATIONSHIP

The key objective in the case of (i) the conservation of listed historic buildings, (ii) refurbishment and (iii) risk management is described in par.2.6.1 and the interrelationship of these objectives outlined in par 2.6.2.

2.6.1 Key Objectives

i. The *key objective* in conserving a listed historic building will be to preserve for posterity the architectural, historical and cultural value of the building in line with conservation ethics, in a commercially viable way. Appropriate resources [financial, time, human, organisational and material] are essential. The scope for the treatment of the historic building will be constrained by legislative control. Depending on the nature and extent of the intervention, before works to listed historic buildings can commence, listed building consent [par.2.2.1 refers] will be required in addition to building regulation approval and/or planning permission and any other statutory consents, as necessary.

ii. The *key objective* in refurbishing a building will be to satisfy the needs of the client, within the parameters of cost, time, quality and functionality. If the building is listed, conservation [legal and philosophical] constraints decrease the latitude that can be exercised in the decision-making process relating to:

    a. design, construction and management solutions
    b. demolition or other interventions, to parts of the building [par. 2.2.1 refers].

    This limits flexibility in terms of time, cost, quality and functionality.

iii. There is an element of uncertainty in any construction activity due to the nature of the process, the different approaches and attitudes of the individuals concerned and the characteristics of the site. Where there is uncertainty, there is a likelihood that unforeseen events will occur and these may adversely affect the project objectives and pose risk to desired project outcomes. Risk is managed through a process of identification and response. The *key objective* of risk management will be to eliminate risks, at best, and, where unavoidable, minimise the risks and allocate them to the party best suited to manage them. The finite resource of the built heritage [of which listed historic buildings form a proportion] is something that cannot be replaced once lost. Therefore, in addition to risk factors relating to cost, time, quality, and safety in construction activities, risk factors affecting architectural, historical and cultural value *need* to be addressed and managed.

2.6.2 The Interrelationship Between Building Conservation, Refurbishment & Risk

The conservation of a listed historic building is an activity undertaken to preserve its architectural, historical and cultural merit [par.2.3]. Refurbishment has been identified as a way of conserving the listed historic building and securing its future for posterity [par.2.4 refers]. Refurbishment is characterised by the fact that the construction work is carried out on an existing building. This feature of refurbishment frequently means there is a higher degree of uncertainty in the project than would be expected in new build. It is recognised that uncertainty in the construction process, and therefore the refurbishment of listed historic buildings, exposes the project objectives to risk [par.2.4.3]. Furthermore, specific elements of risk exist relating to the nature of building conservation work [par.2.5 refers]. Building conservation work must be commercially viable (Redman, 1995; Pickard, 1996) but reliable cost forecasts for this type of work are difficult to produce. A high frequency of exceeded budgets and late completions has been identified in 'conservation refurbishment' projects (Reyers & Mansfield, 2001). This evidence reflects their vulnerability to cost and time risk. In addition to time and cost requirements, satisfying the client's needs for the building, within overarching building conservation objectives, must be achieved. However, uncertainties relating to the building, itself, can also pose risk and impact on the realisation of the key objectives described in par. 2.6.1 (i) and (ii). The perception of and attitude to the project's risks [and how they form clusters with other risks] will be variable (Reyers & Mansfield, 2001) from practitioner to practitioner. This suggests how risks are allocated will have bearing on their management and thus influence the outcome of key objective par. 2.6.1(iii) and ultimately, the key objectives stated in par 2.6.1 (i) and par.2.6.1 (ii).

Building conservation and, as a possible means to this end, refurbishment can be characteristised by the nature of the work and the risk this involves. It is suggested further research into the characteristics and risks pertaining to the refurbishment of listed historic buildings, from the viewpoint of the multidisciplinary project team, will contribute to knowledge about the process and serve to deepen understanding of the nature of the work and its inherent difficulties.

2.7 SUMMARY

To provide a background to the refurbishment of listed historic buildings, building conservation philosophy, in terms of current day practice, has been briefly reviewed. The legislative framework protecting the listed historic building within which the refurbishment proposals must conform has been outlined. The process of refurbishment, its management and associated risks, have also been discussed. In summation, the chapter concludes by commenting on the interrelationship between conservation in buildings, refurbishment and risk.

All the topics mentioned in this chapter are, in themselves, extensive and highly specialist areas and yet, it is suggested that to consider one, in isolation, would diminish the understanding of the topic of refurbishing listed historic buildings. To this end, a methodology had to be identified which enabled a contribution to be made to this area of 'multi-activity' within the construction industry and answer the research question:

'What are the characteristics of the process of refurbishing listed historic buildings and what flows from them?' [par. 1.1 refers.]

The chosen methodology and its rationale will now be outlined in Chapter 3.

CHAPTER 3

The Rationale For The Research Methodology

3.0 INTRODUCTION

This chapter describes the rationale for the research strategy employed in the study topic. Essentially, the strategy was based on the premise '*the question should determine the methodology*' (Leedy, 1993). The chapter discusses the decided approach to investigation, in order to facilitate meaningful and valid analysis. The aim of the enquiry was to make a new contribution to the existing body of knowledge that could be both illuminating and useful [par.1.1 refers].

3.1 A DISCUSSION SURROUNDING CONCEPTS IN RESEARCH

Extensive philosophical debate into the characteristics of research and what it sets out to do is beyond the scope of this study. However, in order to support the reasoning behind the choice of research strategy for the enquiry, definition, historical perspective and approaches to investigation and analysis will now be outlined.

3.1.1 Research: A Current Day Definition

As a starting point, definitions of research were identified. According to Pirsig (1989)
"Definitions are the foundation of reason ...... You can't reason without them!"
The following are all definitions of 'research'.

- 'Systematic investigation to establish facts or principles to collect information on a subject' (Collins English Dictionary, Major Edition, 1992).
- 'Simply gathering information you need to answer a question, thereby helping to solve a problem' (Booth *et al.*, 1995).
- 'The general field of disciplined investigation, covering the humanities, the sciences, jurisprudence....' (Scriven, 1991).
- 'To derive conclusions from a body of disparate fact and discover that which was hitherto unknown' (Leedy, 1993).

From these definitions it is clear, in simplistic terms, that research is a process of systematic, disciplined information gathering to answer questions in order to discover something new and contribute to the existing knowledge base. Having established what research is, it is logical to then consider how it should best be carried out, to achieve the research aim and objectives of this investigation, drawing on past and present thinking.

3.1.2 A Brief Historical Perspective

In the quest to comprehend phenomena, throughout the ages, man has constructed theories through an intellectual process. The building blocks for these theories, however, have originated in a variety of sources, both the abstract and the observable. The debate surrounding what is valid theory has extended over the last two and a half thousand years. Plato (427-347 BC) and Aristotle (327-322 BC) made a clear distinction between the academic - knowledge founded in theory and the pragmatic - practical understanding in the form of opinions and belief.

By the eighteenth century, Immanuel Kant (1724-1804) was bringing together these schools of thought by proposing that reason and observations work together. His philosophy clearly recognised the thought processes of the enquirer or researcher and empirical study are inextricably linked when seeking to comprehend nature. He, or she, decides what data is collected, how it is interpreted and how such interpretation may, if appropriate, be used to generate law-like regularities. The question of validity of any proposition or interpretation had now entered the debate. To address this issue, recognised and acceptable conventions to carry out the process of a research enquiry were established and as such, methodologies were born.

Empirical research has had, until relatively recently, a preference for the quantitative approach [numerical measurement] to collecting data. Such information was commonly analysed to identify regularities that were then generalised to other situations. A qualitative approach [observation, through for example, survey, participation or case study] employed to generate a rounded, in-depth account of a group, organisation etc., started to gain wider use in the latter part of the twentieth century. Its usefulness as an efficient way of providing a well-illustrated account of a particular study topic, to give rise to relevant meanings has led to it being acknowledged as a viable strategy for enquiry, today. Furthermore, the significance of the 'whole cloth' paradigm [all aspects of reality are interrelated] was also gaining credence. Erlandson *et al.* (1993) quote Guba (1981) in stating,

"If one attempts to focus attention on certain portions of reality only, the whole falls apart as though the cloth had been cut with scissors."

In summary, what emanated from the enquiring and eminent minds of bygone centuries through to the wisdom of today was that the research strategy, for this investigation, necessitated a marriage between structured observation and creative, transparent and defendable reasoning. The study needed to be framed within a holistic context, interpretations were to demonstrate validity and this could be facilitated through utilising appropriate quantitative and qualitative data collection tools or instruments, in conjunction with relevant analytical techniques.

3.1.3 Endeavouring To Understand The Reality

'Science' according to Graziano & Raulin (1997) is the disciplined way in which questions are posed in order to understand natural events. Natural science, according to Smith (1998) makes assumptions and uses methods that tend to ignore the differences between studying things and people and frequently adopts the closed system. Social science investigates people in 'real-life' situations to draw attention to the issues and complexities involved, something which Robson (1994)) defines as 'real world' research. This study, although within the context of a highly technical subject area, sought to understand people in real-life situations. The degree of control and standardisation permitted in 'laboratory conditions' allows for the construction of a closed system to ascertain cause and effect. The complex nature of the activity of construction, its internal dynamic and external influences made the closed system model both impractical and unrealistic. The rationale, therefore, for the design of the research methodology was driven by the 'real world' ethos, the challenge in the words of Robson (1994) *"to say something sensible about a complex, relatively poorly controlled and generally 'messy' situation."*

3.1.4 The Role Of Value Judgements

The interaction of the researcher and what is being researched throws the question of objectivity into the research design, the so-called subject-object problem. Interpretivists (Emile Durkheim, 1858 -1917) claimed that subjective processes provided sources of explanation whilst the positivists, who advocated the deterministic rationale, claimed subjective values distort and there should be a fact- value distinction. The research aim, in this study, required principally the understanding of what Gill & Johnson (1998) call *verstehen* or how people make sense of their worlds and that any denial of the importance of human subjectivity, in itself, leads to the generation of a mere assembly of facts. (Erlandson *et al.*, 1993) note that Lincoln & Guba (1985) consider objectivity is largely an illusion but go on to say,

"The 'naturalistic' paradigm affirms the mutual influence that the researcher and respondents have on one another. However, nor are the dangers of reactivity ignored."

In this investigation, both the value of contribution made by the subjectivity of the researcher and respondents, on the one hand, and the potential for distortion of the facts in reactive responses, on the other, were to be recognised.

3.1.5 Frameworks And Perspectives

In order to generate questions that led to reliable explanations, a framework of assumptions outlining the existing perspective of the study topic, needed to be established. From this paradigm, the search for new facts through measurement and observation could proceed in a holistic way. Erlandson *et al.* (1993) state,

"The naturalistic paradigm assumes that there are multiple realities and because all parts of the reality are interrelated, an understanding of the whole can begin with an a holistic investigation of any portion of it....by looking holistically at even a corner of the cloth we can usually predict with great accuracy the nature of the entire cloth."

Kuhn (1970) talks about the evolving nature of explanations through the discovery of anomaly within the paradigm - in essence, the additive adjustment of theory. This investigation did not seek to adjust theory as might be appropriate in a natural science research strategy. Former work was, however, to be used as a platform or base for the research design. Comparisons were to be made with others' findings in order to add depth to current thinking. Furthermore, the study sought to discover explanations within the context of the 'messy real-life situation,' from a holistic standpoint, to contribute to clarification and meaning as well as providing anchorage for any 'new' facts revealed.

3.1.6 Confirmation And Generation Of Propositions

Before embarking on the research design, it had to be decided how it was intended to construct meaning and contribute to the understanding of the topic under investigation. It had to be decided whether to:

(a) begin from a hypothetical starting point where the research strategy set out to test propositions through a deductive process.

<u>Or</u>, by contrast,

(b) employ an inductive approach requiring observation and the subsequent identification of patterns and trends to generate meaningful propositions.

The complexity of the construction activity being investigated and the processes involved in its undertaking, favoured the naturalistic paradigm and a research activity that was essentially driven by observation and inductive reasoning. It was recognised that, in this study, such a pathway of unfolding enquiry might also necessitate the inductive-deductive approach (Graziano & Raulin, 1997) when constructing convincing and plausible explanations along the way.

3.2 RESEARCH DESIGN: DISCOVERY AND JUSTIFICATION

This chapter has briefly discussed the pathway to valid explanations for the study topic. Data collection, the relevance of context both in the physical situation and existing paradigms, modes of reasoning, the contribution of the researcher's subjectivity in design, implementation and explanations have all entered the discussion. In view of these considerations and mindful of the premise made by Leedy (1993) *'the question should determine the methodology'* the approach to dovetailing what (Smith, 1998) calls the context of discovery [the study area and how it should be studied] with the context of justification [interpretation and explanation of any evidence gleaned] in a valid and relevant way, will now be discussed.

3.2.1 The Research Question And Aim And Objective Of This Study

The first and encompassing question of this research study was '*What are the characteristics of the process of refurbishing listed historic buildings and what flows from them?*'

The broad aim of the research methodology was to identify these factors from a holistic and multidisciplinary perspective, the main objective being to reveal layers or different facets of reality relating to this construction activity.

3.2.2 Research Strategy

Having identified the research question, the various components of the research strategy to satisfy an answer, were outlined. Darke (1995) suggests in searching for the appropriate methodologies it is best to look for a middle ground, the essential requirement being open to new ideas and explanations. Robson (1994) also advocates an open-minded exploration of the most suitable strategy and best methods for the task in hand.

The following describes the approach that was employed in this research strategy. It subscribed to the wisdom of Darke and Robson.

1. The nature of the problem and the context of the enquiry employed an exploratory approach, to follow an unfolding path of enquiry.

2. As a base line and springboard for the enquiry, previous studies and their findings (Summers & Fellows, 1987; Young & Egbu, 1993) were used. This approach afforded the benefit of continuum and complemented the existing body of knowledge. Locke *et al.* (1998) note that *'increments of knowledge are won through a 'step by step' process - small bits of insight have to be woven together into a structure'.*

3. A combined strategy using both quantitative and qualitative techniques was utilised. This entailed the use of simple counting techniques employed along side anecdotal evidence. Data was presented in order to provide a fuller picture, another layer or different facet depending on where the research journey had led. (Oliver, 1997)

4. Methodological pluralism [i.e the use of questionnaire, interview and case study] identified different aspects of the problem by providing different types of complementary data. The benefit of this multi-method approach is cited by Gill & Johnson (1997) *'as a way of overcoming the bias inherent in a single method approach'.*

   With respect to (3) and (4) the researcher should consider compatibility when utilising different methods and modes of analysis. In essence, according to Mason (1997) the research methodology should be designed so that different methods:

   - address the same parts of the intellectual puzzle or approach the puzzle from diverse angles
   - provide measurements to be knitted together in order to make some meaningful interpretation
   - support generalisations so that they could be most meaningfully and usefully integrated.

   In view of this, different modes of data collection in the study [and subsequent data interpretation] were chosen to be compatible with one another.

5. Evaluation research is gaining momentum as a form of assessment for policy, practice or service. Enquiry into the 'real world' is essentially some sort of evaluation according to Robson (1994). This study adopted the approach taken in an illuminative evaluation as categorised by House (1978) that focused on qualitative methods, inductive analysis and naturalistic enquiry. Rather than adopting a prescriptive evaluation approach, the following evaluation principles underpinned the research strategy.

   1. Usefulness
   2. Practicality and cost-effectiveness
   3. Fair and ethical approach

4. Technical skill and sensitivity

3.2.3 Findings, Interpretations And Judgements

The research design intended to address the following criteria. These were central to data generation and its analysis and interpretation in the study.

3.2.3.1 Trustworthiness And Reliability

In any enquiry the data must be trustworthy and reliable. Adopting the multi-method approach, as outlined in (3) and (4) par.3.2.2, was to build a fuller picture, to provide credence to any generated data through a process of 'triangulation'. Triangulation according to Gill & Johnson (1997) is *'the use of different methods in the same study to collect data so as to check the validity of things'.*

The research process was designed to be clear, systematic and well documented so that the auditor could come to a judgement about the trustworthiness and reliability of the study, within the context of the combined methodologies.

3.2.3.2 Bias

Graziano & Raulin (1997) identify a threat to the research process called the 'Subject and Experimenter' effect. In a nutshell, this points out problems such as verbally reinforcing some responses and not others to support the researcher's expectations or incorrectly recording responses. Graziano & Raulin (1997) cite Barber & Silver (1968) in saying it is difficult to demonstrate clearly that they do occur but it is important for the researcher to control for experimenter expectancy effects. Conversely, the useful input of the researcher is also recognised. Robson (1994) states,

"A pre-existing knowledge and experience base about the situation and the people involved will be useful in design, carrying out investigation and analysis of useful, appropriate studies."

To this end, any interpretation in the study was mindful of the potentially distorting influence of the researcher's expectations but, on the other hand, also aware of the beneficial contribution of the researcher's pre-existing knowledge. Overall, the methodology was aimed in essence, to demonstrate that the research process was adequate and the findings flowed from the data, something that Robson (1994) calls 'confirmability' [the corresponding concept to objectivity in qualitative research

3.2.3.3 Internal Validity

Where in the study propositions were made, the question of internal validity was addressed. Recognised techniques such as prolonged involvement and peer debriefing were employed to support any propositions or conclusions. According to Lincoln and Guba (1985) these demonstrate that the subject of enquiry was accurately identified and described.

3.2.3.4 External Validity

Graziano & Raulin (1997) propose that appropriate subject selection enhances external validity. Robson (1994) identifies the concept of transferability and cites Kennedy (1976) as describing 'first decision span' and 'second decision span'. This is concerned with applying the findings about one situation, or case, to a second one that is considered sufficiently similar to the first to warrant that generalisation.

Purposive sampling was employed and the data was evaluated to search for factors that could apply from one project to another. Where it was deemed applicable to generalise the results of the study to other populations, or contexts, the question was asked as to whether the findings told the truth when they were situated outside the study.

3.2.3.5 Construct Validity

When interpreting the data to find the best explanation of what the findings reveal, a factor that must be considered is the so-called nature - nurture problem. Graziano & Raulin (1997) ask the question,

"Is it the innate characteristics of the discrete situation or is it external environments that have shaped the data concerned?"

By adopting the multi-method approach, as a research strategy, it was intended to identify the most plausible interpretation, whilst pointing out that, hitherto unexplored externalities, may have also impacted on the findings. Jick (1979) states,

"It is a delicate exercise to decide whether or not results have converged. Should all components of a multi-method be weighted equally? There are no formal tests to discriminate methods to judge their applicability."

Nevertheless, in Jick's judgement various methods taken together produce convergent findings, and this belief has been subscribed to in the PhD Study.

3.2.3.6 Content Validity

This facet of validity addresses the problem of how accurately the questions elicit the information that is sought. Two questions that were to be considered were whether the research instrument measured what it was supposed to measure and whether the sample was adequate to represent the trait or behaviour being measured. The design of any research instrument relies on the subjective and best judgement of the researcher, the quality of what Patton (1982) calls 'face validity'. An instrument that has high value in terms of face validity, according to Patton (1982) is the questionnaire and this was employed as a method for collecting data in this study.

3.2.4 Criteria For The Research Framework

Zelditch (1962) suggests information adequacy and efficiency are the criteria by which to judge the appropriateness of the researcher's choice of method. The following criteria underpinned the choice of research instruments and respective modes of analysis.

3.2.4.1 Implementation

The design of the research framework only selected methods that were sensible to employ. Although this chapter has already identified the need to apply the multi-method approach and the need for openness to new ideas, only techniques were used which were capable of being carried out effectively. In the context of this study they have been identified as questionnaire, interview and case study.

3.2.4.2 Interpretation

With respect to interpretation, there were two factors. Firstly, that it was possible to collect the necessary data to answer the particular facet of the overall research question. Due to the many facets of the construction activity, some of which are sensitive or confidential, only information that was reasonably available and sufficient for meaningful analysis was sought. Secondly, each chapter was to make a clear distinction between arraying the data and interpreting the data.

3.2.4.3 Contribution: Credible, Reliable And Useful

In designing the research strategy, the questions posed, the populations targeted and the projects investigated were all selected to ensure that the identification of any patterns, trends or generation of any propositions were driven by the rationale that they fulfilled the criteria of being credible, useful and reliable.

3.2.4.4 Ethical

Oliver (1997) points out,

"Research always intrudes into the privacy of both individuals and organisations - even if people agree with the significance of the research, potential respondents are likely to balance the perceived value of the research with its personal effect on them."

In view of this, permission was sought before any respondent engaged in the study. He, or she, was also to be in full understanding of the nature of the enquiry, how the elicited data was to be utilised and, where requested, appropriate anonymity and confidentiality were assured.

3.2.4.5 Economical

Cost-effectiveness is a criterion for evaluation research [par.3.2.2, Point 5 refers]. In this study, the financial implications of the various modes of information gathering and the selection of samples involved were considered. The optimal solution with respect to sample size and type, geographical distribution, time frame and research instrument was based on generating sufficient useful data for the least financial outlay.

3.2.4.6 Outline Of The Research Framework

The study followed the line of a naturalistic form of enquiry. It comprised of three major components. The first, as the starting point, consisted of a pilot study employing the interview to elicit information. Secondly, a main questionnaire survey [with interview] was conducted from a holistic multidisciplinary perspective. The case study approach provided the research methodology, for the third component of the research framework, and was focused on emerging patterns and trends.

3.3 SUMMARY

Theoretical principles and pragmatic factors have been outlined, as criteria, for the development of the research strategy in this study topic. The research framework was designed to adopt a multi-method and holistic approach. Methods of data collection and analysis of the findings will be discussed in fuller detail, in subsequent chapters.

CHAPTER 4

The Unfolding Path Of Enquiry Begins

4.0 INTRODUCTION

This chapter describes the first stage in identifying empirical data. An inductive approach to the enquiry set out to recognise characteristics, relating to the refurbishment of historic buildings, as a platform for further investigation. In the words of Erlandson *et al.* (1993) *"Once the study has begun, the design of a naturalistic study begins to emerge."*

4.1 METHODOLOGY

Gill & Johnson (1997) describe the objectives of an inductive enquiry as constructed explanations and theories of what has been observed. Locke *et al.* (1998) categorise this kind of study as 'interpretive research' where the investigator *'builds an extensive collection of "thick description", i.e. detailed records, concerning context, people, actions and perceptions of participants'.*

A commonly used method to obtain information for the 'thick description' is the interview and this has been employed in the pilot study.

Cohen & Manion (1982) define the research interview as follows:

"A two-person conversation initiated by the interviewer for the specific purpose of obtaining research-relevant information, and focused by him/her on content, specified by research objectives of systematic description, prediction or explanation."

They cite a major advantage of this type of research technique as the scope it affords for 'greater depth' over other methods of data collection. They also highlight a weakness – the interviewer may tend towards subjectivity and bias when using this approach to data collection. Locke *et al.* (1998) point out that trustworthiness of data is a vital issue. In view of this, measures were taken to reduce bias and to preserve validity when eliciting data.

These are as follows:

- The interviewee led the discussion within the predetermined framework set by the interviewer. The role of the interviewer, in the interview, was constrained to seeking clarification in responses. This allowed probing, objectively, into the points raised by the interviewee. It has to be noted that bias could not be entirely eliminated due to the interpersonal nature of the research enquiry. Cohen & Manion (1982) refer to the work of Kitwood (1977) who, in essence, states that bias itself and its impact on the quality of information gathered in the interview *'are predicates applicable to the theories within which the phenomena are explained'*. In other words, inherent subjectivity makes a contribution to the wider picture.

- The comfort of the interviewee was paramount. In order to promote this, participants in the study were given:
    - pertinent information about the study
    - an explanation of how the data would be used
    - assurances of anonymity and confidentiality.
- Questions were designed to reduce the likelihood that an interviewee's response was distorted or reactive.
- Questions were framed using 'common vocabulary'. (Erlandson *et al.,* 1993) state that interviews require verbal interaction, and that terminology and nuance need to be as clear and mutually understood as possible. They cite the explanation of Patton (1980)

"Using words that make sense to the interviewee, words that reflect the respondents world view, will improve the quality of the data obtained during the interview."

4.2 DATA COLLECTION AND FINDINGS

The data was collected using a three-tiered approach to elicit information.

STAGE 1

The exploratory interview: This took the format of a nondirective interview. This is characterised by minimal direction or control exhibited by the interviewer and in which the respondent has freedom to express his or her opinions. The value of this technique is its potential to establish information relating to the deeper attitudes and perceptions of the person being interviewed, in such a way, as to leave them free from interviewer bias (Cohen & Manion, 1982).

STAGE 2

The pilot questionnaire: This personal questionnaire was designed to:

- test aspects of the questionnaire approach to conducting a survey, as part of a pretest for the main questionnaire
- elicit information using a different and more structured format.

STAGE 3

The focused interview: Merton & Kendall (1946) define the focused interview as follows:

"An interview guide that identifies the major areas of enquiry which determine the relevant data to be obtained in the interview."

A major benefit of this approach to data collection, according to Merton & Kendall (1946) is that it retains good qualities of the nondirective technique but is economical and precise enough to elicit significant data.

The distinctive feature of the focused interview is the prior analysis by the researcher of the situation. In Stage 3 of the enquiry, therefore, information gleaned in Stage 1 and Stage 2 was utilised in framing the interview.

At each stage the collected data was recorded, evaluated and then fed forward into the next stage of the pilot study enquiry. Through this developmental process the collated information was used to form the basis of the main questionnaire [Appendix I] designed to identify the nature of refurbishment characteristics in listed historic buildings and perceptions and attitudes to related risks.

4.2.1 Stage 1: Exploratory Interviews

As a preliminary and exploratory investigation, three architects were interviewed. The participants in the pilot study were selected purposively. Experience, as a lead consultant and project manager in refurbishing listed historic buildings, was the criterion for selection.

Purposive and directed sampling according to Erlandson *et al.* (1993) *'increases the range of data exposed and maximises the researcher to identify emerging themes that take adequate account of contextual conditions and cultural norms'*.

4.2.1.1 Data Collection

Interviewees described their role as practitioners as follows: estate manager, housing association architect and building conservation specialist. Each practitioner was merely asked to talk about his experience, in heritage refurbishment, highlighting what, in his opinion, were significant issues in this type of work with listed historic buildings.

4.2.1.2 Findings

A content analysis of each interview was undertaken. Interviewees identified factors, based on their professional experience, which they considered were particularly relevant to the refurbishment process in listed historic buildings. All identified selection of the work force, organisation and planning and a high standard of accurate and appropriate specification, as essential for the success of a project. The element of the unknown in refurbishment projects was also highlighted as making this a challenging and specialised activity, experience and skill being crucial to ensure completion of the work, within time, budget and to the required quality.

In order to provide a framework, for comparison with future data, the factors were assigned to relevant categories in two separate sections.

These sections were defined as:

- *Listed Historic Building Refurbishment Characteristics*
- *Problems In Listed Historic Building Refurbishment Exposing The Project To Risk*

The following tables list the comments and observations made by interviewees.

Table 4.2.1(a) **Listed Historic Building Refurbishment Characteristics (Exploratory Interview)**

<u>**Characteristics Category**</u>	<u>**Listed Historic Building Refurbishment Characteristics**</u>
Programme	Allowance should be made for frequent interruptions throughout progress of the works. Recording details of the building during refurbishment may disrupt the construction programme. Awareness of procurement periods is critical.
Skills **Working Methods** **Working Hours**	Contractors and consultants must have appropriate experience. Specialist craft skills must be readily available. Hot work is frequently prohibited. Use of construction plant and equipment is often limited. The type and design of temporary works are generally restricted. Conservation principles e.g. minimum intervention and the reversibility are overriding considerations. Location and occupancy are often influencing factors.
Liaison and Communication	Positive interaction between consultants and contractors is essential, promoting a good working relationship. A high level of supervision is most important. A clear order of command, defining boundaries and responsibilities should be established. Prompt decisions should be made throughout the refurbishment process. The contract documentation should contain adequate information.
Health and Safety	Significant Health and Safety considerations are: noise, dust, hazardous materials [e.g. asbestos] and occupancy.
Budget and Financial Matters	Cost control is difficult. Competitive tendering can generate a conflict between building conservation and cost. The client owner must be able to show high level of financial commitment.
Statutory Control	Requirements by different statutory bodies may be in conflict.
Site and Materials	Space is frequently a problem. Unknown in the construction of the building and a lack of as built drawings are the general case. Appropriate use of materials and techniques is essential. High cost, one-off items are often required. Knowledge of suitable substitutes, delivery periods and supply sources is crucial.
Contract	User-friendly contract documents and form of contract are important.

Table 4.2.1(b) **Problems in Listed Historic Building Refurbishment Exposing The Project To Risk (Exploratory Interview)**

Risk Category	Source of Risk	Management of Risk
Programme Risk	Unknown factors in the building's construction. Procurement periods for specialised components and materials.	Nondestructive investigative survey and/or additional time allowance. Awareness of lead-in times and timely ordering.
Technological Risk	Incomplete and inappropriate specification and drawings.	Experienced and trained practitioners must write specifications. High degree of interaction between all members of building team throughout the duration of project.
Conservation Risk	Inexperienced contractor. Inexperienced consultant. Inexperienced tradesman/women. Inadequate funding.	Appropriate selection of trained professionals and trades. Adequate specification, supervision and financial resources.
Environmental/ Health and Safety Risk	Demolition. Discovery of asbestos. Occupied buildings.	Risk assessment undertaken and risk management strategy implemented. Adequate preparation in the design phase.
Budget/Financial Risk	Unforeseen circumstances. Inadequate time allocated to preparation prior to the contract being let.	Appropriate form of contract. Careful cost monitoring.

4.2.1.3 Discussion

This preliminary investigation clearly highlighted the fact that refurbishing listed historic buildings is a highly complicated process due to the nature of the building and unknown in its construction. The standard of professional and technical expertise must be of the right calibre, the management of the process should be a fully integrated one and the cultivation of positive working relationships, and the provision of adequate supervision is crucial. None of the points raised by any of the interviewees was at variance with another.

4.2.2 Stage 2: Pilot Questionnaire

Based on the findings of the exploratory interviews, a more structured approach to the enquiry was then devised. A pilot questionnaire was designed to gather information relating to specific heritage projects. The questionnaire was carried out 'person to person' in order that additional notes could be made. As part of the pretest exercise it was deemed an opportunity to:

- identify and correct flaws
- improve ways of wording questions
- rectify ambiguities and omissions
- make observations relating to the respondent, in terms of questionnaire fatigue.

4.2.2.1 Data Collection

Three professionals were again chosen purposively. As the findings, in the exploratory interviews, highlighted interrelationships as being critical elements in the successful outcome to historic building refurbishment, respondents were chosen who could answer questions from a holistic standpoint. All of the three respondents had acted as project managers in both the design and the construction phase.

4.2.2.2 Findings

Of those questioned, two had worked on Grade I listed buildings and all three on Grade II*. All had worked for private clients and either the National Trust, English Heritage or Local Authorities. Various types of buildings, size, and construction types were cited by all respondents. None of these variables was described as being more or less influential on the successful outcome of the project. The lack of information about the building in forms such as original or as built drawings was reaffirmed. Contract, programme, budget, working relationships, supervision and skills were once again highlighted as key areas.

The following tables categorise the essential findings of this second stage of the study using the framework devised in Stage I of the Pilot Study

Table 4.2.2(a) **Listed Historic Building Refurbishment Characteristics (Pilot Questionnaire)**

Characteristics Category	Listed Historic Building Refurbishment Characteristics
Programme	Construction periods are generally not long enough.
Skills **Working Methods** **Working Hours**	Appropriately trained craftsmen/women and consultants are in short supply. Methods and hours of working are influenced by the location of the site.
Liaison and Communication	A cohesive team is required with experience and expertise. Trust is essential between the contractor and consultants. The architect or practitioner, acting as agent to the client, should visit the site very frequently.
Health and Safety	No comments.
Budget and Financial Matters	Unrealistic budgets are commonplace for the scope and nature of the work.
Statutory Control	Conflict can occur between stipulated fire safety measures and local authority building conservation requirements.
Site and Materials	Lack of space. Replacement materials can be difficult to obtain. Original or as built drawings are rare.
Contract	Preliminaries can be onerous. Contract selection is crucial.

Table 4.2.2(b) **Problems in Listed Historic Building Refurbishment Exposing The Project To Risk (Pilot Questionnaire)**

Risk Category	Source of Risk	Management of Risk
Programme Risk	Construction programmes are too short.	Architect to visit site daily, facilitating swift identification of problems followed by prompt workable decisions in order to rectify the situation. Design the construction programme to be slow speed.
Technological Risk	No as built drawings. Lack of appropriate technical understanding by consultants and craftsmen/women.	Match the project team to the nature of the work. Have a strategy in place to identify problems early.
Conservation Risk	Abortive or destructive work.	Close and regular supervision. Correct pace of programme, preferably slow. Experienced workforce.
Environmental/Health and Safety Risk	No comments.	No comments.
Budget/Financial Risk	Unrealistic budgets. Construction programmes that are too short can have high cost implications in terms of disruption, delay, and extension of time.	Advise the client, with respect to realistic expectations in relation to cost and time.

4.2.2.3 Discussion

The questionnaire presented no discernible problems as a method for data collection. Essentially, the findings in Stage 2 corroborated and expanded on the findings in Stage 1. Although the approach to gathering information was more structured, nothing was identified in the content analysis that pointed to either a particular building type or a specific relationship between individual refurbishment characteristics. Participants found it difficult to restrict their responses to one project in order to illustrate or clarify a point. More information under the section headings and categories was, however, gleaned. [Table 4.2.2(a) and Table 4.2.2(b) refer.]

In view of this, it was decided to narrow the field, to an element in the listed historic building refurbishment process, which was frequently problematic. This was the rationale behind the focused interviews with building conservation specialists in the next stage, Stage 3.

4.2.3 Stage 3: Focused Interview With Building Conservation Specialists

All interviewees in Stage 1 and Stage 2 had identified cohesive teamwork and interactive working relationships contributing to success when refurbishing listed historic buildings. Project managers, who had been involved in both the design and construction phase, had provided valuable insight into the refurbishment process. To gain a more holistic perspective, other disciplines would now be interviewed. Budget and financial matters were cited as being frequently problematic and also matters relating to skills, technical solutions and statutory legislation.

In light of this, through purposive sampling, four practitioners who specialised in building conservation work were selected: a quantity surveyor, a conservator, an environmental designer and a fire protection officer.

4.2.3.1 Data Collection

An interview guide based on the findings in Stage 1 and 2 was devised. An open-ended approach to questioning was chosen in order that the interviewer could go into more depth and clear up any misunderstandings, should the need arise.

Cohen & Manion (1982) identify the benefits of such an approach as follows:

- they enable the interviewer to test the limits of a respondent's knowledge
- they encourage co-operation and establish rapport

- they allow the interviewer to make a truer assessment of what the respondent really believes
- they can also result in unexpected or unanticipated answers which may suggest *'...hitherto unthought of relationships'.*

The questions were of the type, delineated by Patton (1980) as *'experience/behaviour questions aimed at eliciting experiences of behaviours, actions and activities'.* Interviewees were asked to discuss, with reference to refurbishment in listed historic buildings what, in their opinion, were:

- the key criteria for good quality work
- the main reasons for problems arising throughout such schemes
- risk factors that could threaten the successful outcome to the project.

The practitioners were also asked to recommend strategies, where possible, to:

- safeguard the fabric of listed historic buildings
- provide effective solutions to reduce problems in the refurbishment process.

4.2.3.2 Findings

The analysis of each of the interviews followed the same procedure. Data was categorised, as previously, under the two sections and these are tabled in 4.2.3(a) and 4.2.3(b).

Table 4.2.3(a) **Listed Historic Building Refurbishment Characteristics (Focused Interview)**

CharacteristicsCategory	Listed Historic Building Refurbishment Characteristics
Programme	Preferences must be decided early on. Often insufficient time is allowed for planning and programming the works. Work that is scheduled out of sequence leads to abortive work and may cause damage to the structure and fabric of the building.
Skills **Working Methods** **Working Hours**	Appropriate selection of the workforce is essential, ideally with early involvement by all members of the project team. Practitioners must work well together recognising and respecting the objectives of each other.
Liaison and Communication	Records of the building, relating to its building engineering services installations, have been poorly documented in the past, leading to 'educated guesswork'. Frequently there are different interpretations of what is required, by individual practitioners, thus driving the need for an integrative approach early on.
Health and Safety	No comment.
Budget and Financial Matters	Cost overruns are common. Retrofit and upgrade of building engineering services is usually a high cost element of the refurbishment work.
Statutory Control	A compromise is often necessary between legal requirements and conservation objectives, especially in public buildings.
Site and Materials	The way old buildings are put together is frequently misunderstood. In historic buildings, when introducing or replacing building engineering services, lack of interstitial space, structural constraints, the requirement for minimum intervention and minimal aesthetic disruption are major considerations.
Contract	Onerous contract conditions generally lead to poor working relationships. Lack of familiarity with standard forms of contract is a common problem. A clear and full specification is essential.

Table 4.2.3(b) **Problems in Listed Historic Building Refurbishment Exposing The Project To Risk (Focused Interview)**

Risk Category	Source of Risk	Management of Risk
Programme Risk	Client requires work to be completed very quickly.	Allot enough time to fully prepare an integrated construction programme. Ensure communication pathways are workable and clearly defined. Decisions must be made and implemented promptly.
Technological Risk	Poor solution due to conflict between building conservation policy and building services engineering objectives.	Clearly define the end-use of the building and using an integrated holistic approach, prioritise and work towards optimal solutions considering all objectives.
Conservation Risk	Building engineering services' design is often prioritised in favour of building contents and/or building occupants rather than the building.	Clearly define the end-use of the building and using an integrated, holistic approach, prioritise and work towards optimal solutions considering all objectives.
Environmental/ Health and Safety Risk	Inappropriate internal environments: humidity, temperature and light.	Clearly define the end-use of the building and using an integrated, holistic approach, prioritise and work towards optimal solutions considering all objectives.
Budget/Financial Risk	Unforeseen problems with a knock-on and/or cost implications.	Deal with all problems in a holistic rather than an isolated way.

4.2.3.3 <u>Discussion</u>

The findings in Stage 3, once again, afforded confirmation of the premise that effective interdisciplinary teamwork underpins the successful outcome in the refurbishment of listed historic buildings.

Unknown factors in the building's construction often lead to interruptions in the construction programme, with a consequential impact on time and cost. Introducing or upgrading building engineering services, to provide modern day standards of accommodation in listed historic buildings, was identified as being frequently high-cost and problematic. Thus, an element of the refurbishment process which impacted on the whole project, but was narrow enough to facilitate further in-depth investigation, was identified.

4.3 SUMMARY

Ten practitioners from within the Construction Industry, with experience of building refurbishment in the built heritage, had contributed to this first stage of the enquiry. The integration of modern building engineering services, to bring historic buildings up to current day standards, was identified as frequently being high-cost and problematic. The survey revealed that nature of the work demanded a highly skilled team brought together from the early stages in the project, willing to work together to embrace the challenges of meeting historic building conservation objectives, whilst keeping the job within the client's requirements for time, cost and quality. Furthermore, many of the problems encountered in refurbishing listed historic buildings arise out of uncertainty, which expose the project to risk.

In view of this, the next stage of the investigation would seek to elicit the following information:

- The nature of refurbishment characteristics encountered when integrating modern building services into listed historic buildings.
- An appraisal of the risk attitudes held by professionals, in construction, when undertaking this type of work and an identification of the risk management techniques they used in practice.

CHAPTER 5

The Integration Of Modern Building Services Into Listed Historic Buildings: A Review

5.0 INTRODUCTION

The integration of modern building services into listed historic buildings was identified as *'an element of the refurbishment process which impacts on the whole project, but is narrow enough to facilitate further in-depth investigation'* in the pilot study [par 4.2.3.3]. This study revealed that the upgrade or replacement of building services is an activity in the refurbishment of listed historic buildings that is frequently a costly element of the works and poses 'conservation risk' [Table 4.2.3(a) and Table 4.2.3(b) refer]. The need for building conservation work to be commercially viable was identified in Chapter 2 [par.2.1.4]. Mindful of this, the installation, replacement or upgrade of building services is essential to provide the modern day standards of accommodation required by clients and, facilitates the continued usefulness of the building and hence, its survival in the future. As provenance for the next stage of the unfolding path of enquiry, the integration of modern building services into listed historic buildings is now reviewed.

5.1 THE NEED FOR MODERN BUILDING SERVICES IN LISTED HISTORIC BUILDINGS

Buildings constructed prior to the late nineteenth and early twentieth century were not designed and constructed with the facilities of modern day building services (Watt & Swallow, 1996). Over the last century, in response to the changing needs and lifestyles of their occupants, building services have since been introduced into many of these historic buildings. Skingley (2002) points out that building services are transitory compared to the building itself; their life expectancy is only 15 to 20 years[1], whilst the historic building may survive from 300 to 500 years, upwards. Park (1991) suggests that mechanical systems must be 'reversible' in view of their short lifetime, in relation to the building itself [i.e. their later removal will not damage the building]. The need for the installation, renewal or upgrade of modern building services, as part

[1] The actual life span of the building services installation will depend on workability, maintenance, obsolescence and fashion.

of the conservation and refurbishment process will now be outlined. This outline acknowledges conservation as meaning:

"The action to secure the survival or preservation of buildings, cultural artefacts, natural resources, energy or any other thing of acknowledged value for the future. Where buildings or artefacts are involved, such actions should avoid loss of authenticity or essential qualities."
(BS 7913:1998)

This definition of conservation subscribes to the following points:

a) The survival of a listed historic building is not solely founded in the state of repair of its structure and fabric but in its practicality and efficiency, in the current day (Simpson, 1996). The facilities, afforded by modern building services, substantially contribute to realising the criteria of practicality and efficiency and, hence, conservation of the building.

b) Unless updated and adequately maintained, mechanical and electrical services are vulnerable to defects that pose risk to the listed historic building, e.g. electrical faults leading to major fires or leaks leading to water damage and dry rot (Lawson-Smith, 1995; Inskip & Cannel, 1991). Substandard building services prejudice the condition of the building and undermine its architectural, historical and cultural features - their sensitive repair, renewal or upgrade is essential and central to the aim of conservation.

c) Many historic listed buildings can only be conserved if a profitable new use can be found for them (Beckmann, 1995). Many are located in prime commercial and residential locations with great appeal to the business world (Highfield, 1987). Redman (1995) declares the use of listed historic buildings for business purposes is often the only way the building's future can be secured. This new use, according to Fitch (1992) will require the insertion of mechanical and electrical systems aimed at the client's requirements for increased comfort, amenity and safety. The integration of modern building services into listed historic buildings, therefore, is a necessary component of what Redman (1995) terms *'commercial'* conservation.

In summary, it can be argued that the renewal, upgrade or introduction of building services, in accordance with the overarching objectives of preserving the building's architectural, historical and cultural merit, is fundamental to securing the future of the listed historic building.

5.2 EXAMPLES OF MODERN BUILDING SERVICES INSTALLED IN LISTED HISTORIC BUILDINGS

"People's expectations of heating, lighting, transportation and electrical services in the buildings are much higher now than in the past." (CIBSE, 2002)

To satisfy these expectations will necessitate a combination of some, or all, of the following building services.

5.2.1 Mechanical Systems

In relation to historic buildings, Park (1991) states,

"No set formula exists for what type of mechanical system is best for a specific building." Fundamental principles are outlined for the types of mechanical systems that are likely to be required for listed historic buildings. Examples of some systems are briefly described and their benefits and disadvantages are noted.

5.2.1.1 <u>Heating Systems</u>

According to Feilden (1994)

"The choice of heating must be a three-cornered compromise between the needs of the occupants and avoiding damaging conditions for both the contents and the building itself." The system should be designed to be sympathetic to the architectural and historical amenity, cause minimal disruption to the fabric of the building during installation and be economical in use (Lawson Smith, 1998).

"In practice," Lawson-Smith states, *"simple heating installations controlled by a humidistat with an appropriate control strategy to provide good continuous control of relative humidity are needed."*

Improper heating and its functioning, in the building, lead to deposition of dust and dirt with pattern staining; condensation and mould growth; shrinking, warping and cracking of wood; deterioration in painted surfaces; the failure of adhesives causing veneers to lift and blooming of polished surfaces (Feilden, 1994); crumbling of structural timber '*breshness*'[1] (Fidler, 1987).

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[1] A term, which appears to have been invented by the Building Research Establishment, used to describe the 'cooking' of timberwork by excessive heating. Breshness has been identified in the ceiling of The House Of Lords in the Palace Of Westminster and was recognised by the Central Electricity Generating Board in domestic dwellings heated by storage heaters (Fidler, 1987. p.13).

N.B. The Central Electricity Generating Board generated and transmitted all public electricity supplies in England and Wales until 1990.

The choice of space heating system will be influenced by the construction of the building (Feilden, 1994). The use of gas as an energy source will not always be suitable (Lawson-Smith, 1998). Where heating systems already exist, defects to chimney stacks, flues, fireplaces and radiators should be remedied (Watt & Swallow, 1996). Heaters that exhibit inflexible control [electric night storage heaters] or have potential to cause a fire [oil-filled radiators] or produce water vapour [flueless gas and oil heaters] should be avoided.

Wet systems using a network of pipes to deliver hot water to hydronic radiators have the advantage that they are generally easy to install. Boilers should be located within the building where load imposed by the plant will not prejudice the structural integrity of the building. Basements often provide a satisfactory location [see Figure 5.5, p.63]. The choice of radiators, and their positioning, should be should be sensitive to the historic interior [see Figure 5.6, p.63]. The cost of BWIC [Builders Work In Connection] rises considerably if special holes need to be drilled through thick masonry to accommodate pipe runs. This factor makes piped systems uneconomical in certain situations. A further disadvantage is the risk of hidden leaks in walls, or burst pipes, if boilers fail (Park, 1991).

Floor systems can provide an acceptable option if the flooring needs to be replaced. In other circumstances the cost of this system may be excessive. These systems should not be installed in areas where the flooring [e.g. intricate marble] has historic value (Feilden, 1994).

5.2.1.2 Air Conditioning

The design and installation of air conditioning is difficult. Improper air conditioning, and its functioning, can create aesthetic drawback and be detrimental to internal environments if the building is not understood. In the case of the latter, the build up of (i) positive pressure increases the danger of interstitial condensation and (ii) negative pressure enhances the risk of humid climates and condensation (Feilden, 1994).

Integrating large ducts into the historic building is a significant problem. Voids and spaces may be found within the building [old lift wells, redundant chimneys, staircases, dumb waiters, basements etc.] to accommodate them. [Examples of good practice, regarding the siting of service routes, are illustrated in Figure 5.7 and Figure 5.8, p.63.] Where this option does not exist, ducts are sometimes treated as sculptural forms. Alternatively, the need for long duct runs can be eliminated if local plant rooms are employed.

5.2.1.3 Ventilation

Where natural ventilation is inadequate, the building will need to be ventilated by artificial means. This may be developed along side space heating systems or in areas within the building where the number of air changes falls below statutory requirements. The siting of equipment and ducting is problematic and poorly thought-out ventilation systems can pose similar problems to those identified in par.5.2.1.2. Noise generated from the operation of plant may also have a detrimental impact on the acoustic environment of the historic building.

In circumstances where earlier ventilation systems exist, within the building, benefit may be gained by incorporating them within the new. Furthermore, this can satisfy the criterion of preserving the history of the building and its building services [see Figure 5.11, p.64].

5.2.1.4 Overview Of Heating, Ventilation or Air Conditioning (HVAC) Systems

"Modern standards of climatic control developed for new construction may not be achievable or desirable for historic buildings. In each case, the lowest level of intervention needed to successfully accomplish the job should be selected." (Park, 1991)

Park (1991) identifies the advantages and disadvantages of different systems *viz.*

- Water Systems

Advantage: Piping is generally easier to install than ductwork.

Disadvantage: Hidden leaks and burst pipes leading to water damage.

- Central Air Systems

Advantage: Ducted systems offer a high level of interior climatic control.

Disadvantage: Damage to the building as a result of installing a ducted system without adequate space. Systems can generate noise and require routine and regular balancing.

- Combined Air And Water Systems

Advantage: Flexibility of installation - greater piping runs and shorter ducted spaces. Air handlers can fit into small spaces.

Disadvantage: Undetected leaks; noise from air handlers.

- Use Of Non-Systems Components

[e.g. portable air conditioning units, fans, dehumidifiers, portable radiant heaters.]

Advantage: Acceptable levels for the internal environment may be achieved without the need for an entire system.

Disadvantage: Spot heating, cooling and fluctuations in humidity. May only provide a temporary solution.

5.2.1.5 Hot And Cold Water Supply

Water supply systems have been introduced into most historic buildings, over the last century, as an essential part of 'modernisation'. Cold water supply has advanced from hand pumped well or spring water to the use of piped systems to service the building. Existing water supply systems, in historic listed buildings in need of conservation, are commonly subject to the following defects: leaking joints, corrosion and prohibited lead pipework. Hot water systems may have been poorly designed with long dead-legs and water storage tanks are often over sized, lack lids, insulation or corrosion protection (Lawson-Smith, 1995). These faults may be remedied by complete renewal or upgrade of the hot and cold water systems. Such work, however, can be problematic in terms of finding acceptable routes for pipework and the siting of appliances and equipment. New systems must not only be functional and economic but designed to avoid detrimental impact on the building's structural, aesthetic, acoustic and cultural properties and to cause minimal disruption to the fabric of the building during installation.

5.2.2 Electrical Systems

Historic buildings, in need of conservation, generally have substandard electrical installations that, unless upgraded, pose a serious risk of fire. Furthermore, current day requirements require more extensive electricity provision. The layout of electrical systems, siting of distribution rooms and electrical equipment requires extreme care. The routing of cables and acquiring suitable fittings are often problematic - the former due to the structure and layout of the building, the latter due to the availability of aesthetically and practically appropriate materials. Some examples of materials and ways of providing appropriate installations are now described.

5.2.2.1 Cables, Socket Outlets And Switches

Cables can be run on the surface of walls and ceilings but the choice of wiring type is important. In this situation, routing cables along cornice tops, door architrave heads and beam tops is a suitable way to minimalise visual disruption.

Mineral Insulated Metal Sheathed [MIMS] PVC is sufficiently small to bend around masonry and can be totally concealed within walls and floors [example: used in an ornate floor in Chiswick House] (Fidler, 1987).

Flat under carpet power tape may be used in appropriate locations. This tape can be connected to island power sockets or wall fixtures without affecting the historic fabric, but is only suitable for use where the floor surface is smooth, rigid and not vulnerable to impact damage (Fidler, 1987).

A minimalist approach is recommended when choosing fittings and siting them within the building. Placing switches and sockets in locations where they are visually disruptive should be avoided [see Figure 5.4, p.62].

Floor sockets with trap doors and architrave switches are acceptable. If floor and skirting are too precious, pedestals that sit against walls or islands for gang sockets, sited under a desk or similar piece of furniture, can be used. Central switching may be an alternative in areas where the historic interior cannot be disrupted (Fidler, 1987).

5.2.2.2 Lighting

Improper lighting and its functioning can result in a loss of visual amenity and adversely affect the internal environment of the building causing (i) shrinkage or distortion to parchments and timbers (ii) fire and (iii) irreversible light damage to interior decorations and artefacts (iv) noise pollution from hum (Feilden, 1994).

- *Artificial Lighting*

Early luminaires, which may form part of the architectural and historical significance of the building, will not generally provide sufficient illuminance levels for present day needs or meet required regulations. The sources of light widely used in modern construction are invariably incongruous in listed historic buildings [see Figure 5.9 and 5.10, p.64]. Ruffles (2000) observes that even those who are not experts, in lighting, will spot that the chandelier is *'not correct for a fine Georgian interior'* [see Figure 5.10, p.64].

The challenge, to the lighting designer, will be to retain and conserve original fittings with cultural and aesthetic merit, whilst satisfying the specified level of illumination. To achieve this, the incorporation of metal halide uplighters and fibre optic lighting into lighting systems can provide a satisfactory solution (Lawson-Smith, 1995).

Sensitive positioning of spot lighting, uplighting or downlighting is appropriate in certain buildings [example: used in the Bodliean Library in Oxford (Ruffles, 2000)].

Central dropped ceilings with spotlights, around the edge of the lowered ceiling, to light pictures and furniture can be suitable in certain locations and uses of building [example: the approach, to lighting, adopted in Gallery 5 of the Wallace Collection, London (Ruffles, 2000)].

- *Emergency Lighting*

The best emergency lighting sources will be concealed within light fittings, sensitive to the individual historic building, or hidden from direct view (Lawson-Smith, 1995).

Fidler (1987) questions why emergency lights are ceiling or high wall-mounted. They can be aesthetically displeasing and disrupt the historic fabric [see Figure 5.3, p.62]. He goes on to say, that in smoke filled rooms any emergency light would be more useful at low level. Kay (1991) suggests that fibre optic lighting at floor level offers a favourable alternative and is more practical in times of emergency.

5.2.2.3 Security

The need to protect the historic building from intruders and theft has become forefront in the twenty-first century. Measures to provide security will comprise of some, or all, of the following: electronic detection systems, surveillance, security lighting and locks and keys. Before a system can be specified, to suit the site, a risk assessment and evaluation of the building and its particular vulnerabilities need to be ascertained. The problems encountered in this aspect of building services work are threefold:

Loss of visual amenity: a blind application of the building regulations produces aesthetic disasters (Feilden, 1994).

Functionality: movement in the structural members of old buildings and, false triggering by insects, limits the detectors that are practical (Lawson-Smith, 1995).

Conflict of objectives: desired objectives to protect the site and valuables can be at variance with statutory requirements in the case of fire, i.e. 'means of escape'.

5.2.2.4 Fire Protection

The type of construction [e.g. interconnecting voids] fabric [e.g. exposed flammable materials] and substandard mechanical and electrical installations, often present in historic buildings, makes them vulnerable to the outbreak and spread of fire (Bailey *et al.*, 1993). The objective of introducing fire detection and management systems, into buildings, is founded in saving the lives of people, not the life of the building and its contents. In historic buildings, fire protection measures must take account of both and this can pose a conflict of objectives. Fire protection in historic buildings made considerable advances, in the last decade, due to the disasters experienced at York Minster in 1984, Hampton Court Palace in 1986, Uppark in 1989 and Windsor Castle in 1992. Typically, fire protection systems, today, comprise of electric alarms, smoke and heat detectors, emergency lighting and firefighting equipment: extinguishers, hose reels and hydrants. Forrest (1996) states that the most automatic means to provide fire protection to any premises is to introduce a fire suppression system – the most common form being the water sprinkler. The design and installation of sprinkler systems must be exercised with great care to avoid the risk of needless water damage (Bailey *et al.*, 1993). If sprinkler systems are considered inappropriate, the installation of Automatic Fire Detection [AFD] can provide the vital design definition of time interval between fire initiation and detection (Forrest, 1996). Detectors must be sited in the building with extreme care to ensure correct functioning and avoid visual disruption to the historic interiors [see Figure 5.4, p.62]. Radio based systems have the advantage of minimal cabling thus avoiding the problems routing cables presents [par.5.2.2 refers]. However, Forrest (1996) notes that, in his experience, the benefits of reduced wiring can be offset by larger more intrusive units and increased maintenance costs.

In addition, installed systems must always be co-ordinated with other building services to ensure minimal risk of the spread of fire, adequate fire-stopping and compartmentalisation.

5.2.2.5 Lightning Protection

Donlon (1997) states that historic buildings were not constructed with lightning protection in mind. BS 6651:1999 'Code Of Practice For Protection Of Structures Against Lightning' [Annex C] gives guidance on routes along which surges can enter, where they go within the building and deciding factors for installing protection. The choice of material chosen for the system is critical in reducing the aesthetic impact it has on the building. Donlon (1997) goes on to say that the most suitable material for a sympathetic installation is an 8mm solid circular copper conductor, with heavy-duty cast cable saddles, but it does have the disadvantage of being more costly than other systems.

5.2.3 Obsolete Building Services With Architectural, Historical and Cultural Merit

Obsolete building services may contribute to the architectural and historical merit of the listed historic building and, as such, must be preserved. Some systems have ceased to be of use in modern day living, e.g. early communications systems: bells, indicators and speaking tubes; early mechanical conveyances: dumb waiters and some personal lifts (Watt & Swallow, 1996). Others, such as lighting, heating, hot & cold water and ventilation systems may still be functional [see Figure 5.11 and Figure 5.12, p.64]. New building services installations, where they interface with existing systems, must be sympathetic and compatible to the earlier work.

5.2.4 Scope Of The Study

In this study, heating systems, electrical services, air conditioning, ventilation, security, fire protection, and water supply systems are deemed as modern building services and these have been described in pars.5.2.1-5.2.2. Above, and below ground, foul and surface water disposal systems have not been included within the scope of this research.

The handling and removal of toxic waste, in the refurbishment of listed historic buildings, was identified as a characteristic in the pilot study [Table 4.2.1(b) refers]. The discovery and disposal of asbestos, or any other toxic materials, encountered in the listed historic building as part of the upgrade, renewal or installation of modern building services have not been reviewed.[1] It will, however, be referred to in this study, in relationship to the many other characteristics identified for the process of integrating modern building services into listed historic buildings.

5.3 OBTAINING RELEVANT CONSENTS

For the purpose of this study, discussion relating to obtaining relevant consents will be primarily focused on the process of obtaining listed building consent and complying with the regulations as set out in the Planning [Listed Buildings And Conservation Areas] Act 1990, as this requirement sets the listed historic building aside from other existing buildings. Not all works and alterations will necessarily require listed building consent and the extent to which works can be carried out, without permission, will depend on their grade of listing [see par.2.2]. Depending on the nature and extent of alterations to the building, the refurbishment work must satisfy the necessary requirements imposed by the Building Act, 1984 and the Building Regulations, 2000 [Approved Documents L1 and L2, 2002, specifically relate to historic buildings]; the Town and Country Planning Act, 1990 and other statutory legislation and regulations relating to the execution of the works and the building's proposed end-use.

5.3.1 Nature Of The Work Requiring Listed Building Consent.

The requirement for statutory consent relates to the building as a whole and, in this light, the local planning authority will review proposals for the refurbishment of the listed historic building [par 2.2.1 refers]. The conservation officer [or approved representative from the local authority] will assess the proposals, for the building services element of the work. According to Inskip & Cannel (1991) the areas under consideration are likely to include the following:

[1] In depth review of asbestos, other toxic materials and their disposal is beyond the scope of this study.

- Alterations or modifications to enriched plasterwork, panelled dados and forming permanent access to services and connections.
- Interventions that affect the character of the building such as adaptation of space to accommodate plant.
- The introduction of fittings: sensors, detectors, communications and security equipment [PPG15, C68 refers].
- Interventions that involve demolition or reconstruction of the building to accommodate services.

PPG 15 (1994) gives guidance to the local authority with respect to the introduction of building services in C69. It advises the local authority that installations must not adversely affect the structure, character or appearance of the building. Long runs of surface wiring, or pipework, should be avoided unless chasing-in would destroy historic fabric. Furthermore, their concealment within false floors and ceilings must not involve irreversible work or alterations to other features. Further guidance is provided relating to interiors, floors and floor strengthening in the document. In addition to these considerations, the local authority must also take into account existing services. Also, how the proposed new building services will articulate with any retained components of the existing systems in terms of historical, cultural and architectural merit.

5.3.2 Difficulties Experienced In Obtaining Listed Building Consent

The documentation required by the local authority in applications for listed building consent was outlined in par. 2.2.1.1. The level of detail, in any application, must be sufficient for the local authority to make an assessment on how proposals, for new building services, will impact on the listed historic building as described in par.5.3.1. The fact that historic buildings were not designed or constructed with the accommodation of modern building services, in mind, was stated in par.5.1. Therefore, before proposals relating to introducing new [or upgrading] building services can be produced, detailed information must be identified about the construction of the building (Lawson-Smith, 1995; Sharpe, 1999). This will necessitate a survey of the building by practitioners [e.g. conservation architects and/or building surveyors and structural engineers] and the undertaking of investigative work. Depending on the nature and scope of the work and, also, the listing category of the building [par.2.2 refers] interventions cannot be made to a listed historic building without first obtaining listed building consent for the work to proceed and this includes exploratory work Consent may be granted for investigative surveys but limit the nature of the work carried out, in order to protect the building (English Heritage, 1994). Any unauthorised work is illegal and if undertaken an Enforcement Notice will be issued under the Planning [Listed Buildings And Conservation Areas] Act 1990.

Scheme proposals, regarding the proposed building services and their articulation within the historic building, will require the expertise of a building services engineer to provide sufficient detail to the local authority, for their consideration. [Listed building consent procedures do not allow for outline consent, although it is possible to reserve specified details of works for subsequent approval (Pickard, 1996)]. Fidler (1987) notes the significance of the level of design, for the services element of the refurbishment package, available to planners and conservation officers at the time of application for listed building consent and planning permission. Incomplete designs or omissions in drawings [e.g. flue details for boiler rooms] may go *unnoticed.* Specification and detailing, at a later date, risk the work subsequently undertaken being at variance with conservation objectives. The Convention For The Protection Of The Architectural Heritage (1985) Article 16, advocates the need for specialist training in conservation work (Pickard, 2001). Both conservation officers and building services designers need to have an understanding of the respective information required from each other, to effectively carry out their roles in the project. Design, during the construction phase, will be limited to alterations and refinements that do not require listed building consent, otherwise, the client or his/her representative must go back to the local authority and apply for further permission. This may be refused or hold up the works.

In summation, considerable time and expense will be incurred before an application for listed building consent, regarding the introduction of building services, is ready for submission to the local authority. Having done so, the application may be rejected or granted subject to costly and/or limiting conditions. The owner of the listed historic building is then faced with the dilemma of which avenue he, or she, should take. [Risk relating to statutory bodies in conservation refurbishment projects was identified by Reyers & Mansfield (2000) par.2.5.] The need for conservation work and, hence, conservation refurbishment to be financially and economically viable was noted in par.2.6.2. Redman (1995) suggests that conservation officers should recognise/accept an owner's right to an economic return/beneficial ownership and encourage broad interpretation of guidelines such as PPG 15 (1994) Annex C. Baker (1983) contributes to this argument saying,

"Guidelines should not become rulebooks. Control over interventions is not intended to preserve a way of life deprived of modern comforts."

These viewpoints, however, should be embraced within principle cited by Strike (1994) *"Successful schemes are those that respect the original use of the site, revealing the building's history and retaining its identity."*

The challenge, therefore, is to devise a scheme for refurbishing and servicing the listed historic building that is acceptable to both the client organisation and the local authority [i.e. the scheme fulfils the key objectives outlined in pars 2.6.1(i) (ii)]. DEGW ETL (1997) comments on this point as follows:

"Crucial to the early stages of the consultation process is the need for the developer, the local planning authority and, where appropriate, English Heritage, to set out their expectations."

5.3.3 Difficulty In Obtaining Other Approvals

Pendlebury (2001) states,

"Because of the importance of securing the future of historic buildings, land use planning policies may be relaxed and allow changes of use not normally permissible."

However, it cannot be presumed that listed building consent will given for the scheme just because planning permission has been granted. In addition, the scheme may require building regulation approval. This often presents difficulty in instances where the standards in building regulations have been '*formulated with modern construction, in mind, and may be wholly inappropriate for historic buildings*' (Pendlebury, 2001). There is scope, however, for the local authority to dispense with or relax any building regulation requirement, providing the item in question is brought nearer to compliance (Highfield, 1987). 'Creative' solutions can be found to achieve fire protection in the listed historic building but Pendlebury (2001) goes on to say,

"What may be achieved may depend on the flexibility and imagination of fire officers involved."

The Fire Precautions Act, 1971 concerns life safety and adequate means of escape. Forrest (1996) advises that the Act relates to buildings with a designated use, e.g. the historic building incorporates office, shop, factory or hotel use. In these instances the associated fire certification process will also apply.

In addition, in the design and installation of modern building services, the specific regulations set out by the public utilities and professional bodies must be complied with and, also, statutory legislation relating to the design, construction and the proposed end-use of the building satisfied.[1]

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[1] A prescriptive list and review of *all* the relevant statutory legislation and other regulations relating to the proposed end-use use of the listed historic building, its refurbishment and servicing is beyond the scope of this study.

In summary, approvals must be gained for the proposed new work, its execution and once introduced, the installations upon commissioning. Within the full spectrum of regulations there is clearly scope for conflict between requirements. It is suggested that this difficulty necessitates flexibility, imagination, communication and, at times, realistic compromise between the *individual* objectives of those vested with the responsibility of ensuring that legislation and regulations are adhered to.

5.4 INTEGRATING MODERN BUILDING SERVICES INTO LISTED HISTORIC BUILDINGS

The need for the introduction of modern building services into listed historic buildings as a measure to facilitate their usefulness and survival was stated in par 5.1. Systems deemed to be modern building services were described in par.5.2 and difficulties in obtaining relevant consents outlined in par.5.3.2 & par. 5.3.3. A review of the design and construction process will now ensue.

5.4.1 Conservation Refurbishment Versus Non-Conservation Refurbishment

Strike (1994) draws attention to the fact that work, to listed historic buildings, requires a different approach than on other sites.

"Projects should be set up against the usual set of pragmatic values but they specifically require additional time, additional finance and particular skills." (Strike, 1994)

With respect to the integration of modern building services, in non-conservation refurbishment[1] projects, more latitude can be exercised in the approach to design and construction, as a general rule. When accommodating services, scope exists for modifications to the structure and layout of the building that would be prohibited in a listed building. Furthermore, detrimental impact on the historic value of the building is not usually a matter for consideration and temporary works and precautions may not extend to the protection and safety of vulnerable interiors and features and control of internal environments [humidity and temperature].[2]

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[1]Due to the wide scope of refurbishment i.e. types of work and types of building asset, (CIRIA Report 133 refers) for the purpose of this study, refurbishment has been divided into two categories: refurbishment in building conservation projects **'conservation refurbishment'** and refurbishment where conservation is not an objective **'non-conservation refurbishment'**.

[2] A detailed review of the different and specific approaches that are required in the non -conservation refurbishment of different types of buildings [e.g. housing, schools, hospitals, offices, shops, power generating stations etc.] is beyond the scope of this study.

In contrast, conservation refurbishment[3] *must* always take account of the special needs to protect the building's fabric, history and environments and the integration of modern building services will be constrained in design and construction by overarching conservation principles [par.2.1.3 refers].

5.4.2 Design Considerations

Great skill is needed in selection of the design team. The nature of the work requires a particular approach and skills (Feilden, 1994; Strike, 1994). A major objective is the balancing the needs of the building fabric, occupants and desired environmental criteria (Fitch, 1992; Baker, 1983; CIBSE, 2002). Before any design work can commence the adequacy of the structure to accommodate the building services must be checked (Beckmann, 1995; Feilden, 1994; Sharpe, 1992; Kay, 1991; Lawson-Smith, 1995). The demand for services *as a whole*, their maintenance and the need for renewal in the foreseeable future should be established (Sharpe, 1999) but also unnecessary work must be avoided (CIBSE, 2002). Impact on the aesthetic, historic, structural and architectural properties of the building and its internal environments must be evaluated and provide criteria for the building services design (Fidler, 1987). Standard solutions should be used with caution; building services must be sympathetic to their surroundings and compatible with the building (CIBSE, 2002). Furthermore, building services design should not be considered in isolation from other design works (Inskip & Cannel, 1991). There should be an aim to improve energy efficiency, where possible and to the extent possible, providing the work does not prejudice the character of the building or the building fabric in the long term [Building Regulations, Approved Document L2, Section 4.11].

In the case of '*commercial*' conservation [par.5.1 refers] work place design briefs are increasingly emphasising the requirement for improved environmental quality relating to heat, light and sound and more individual control of the local environment (DEGW ETL, 1997). This requires special attention and *must* respect the needs of the building in totality. Overall, with respect to the services design for historic buildings, a higher level of detail, in drawings and specification, is required than is necessary in modern construction to improve planning, appearance and to minimise unnecessary physical intervention (CIBSE, 2002).

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[3] The term 'conservation refurbishment' has been taken from the paper Reyers & Mansfield presented at the RICS Conference 'Cutting Edge' (2000) London.

5.4.3 Design And Workmanship: The Architectural Impact Of Different Approaches

In a report to the Research Awards Panel Of The Architects Registration Council Of The United Kingdom, concerning the introduction of modern building services into historic buildings. and their architectural impact on the building, Fidler (1987) encapsulated the situation thus,

"Modern services can look awkward, cause physical damage and weaken the fabric in archaeological as well as structural terms. From notching of joists to the causing of breshness in timber; from soil vent pipe exposures to television aerial tangles - the means to make old buildings more inhabitable need careful consideration and conservative usage if they are not to ruin that which they set out to save."

In the report, Fidler (1987) states that introducing visually disruptive features, damaging historic fabric, causing loss of structural integrity and creating damaging changes to internal environments are the result of *bad practice* in the integration of modern building services into listed historic buildings. Bad practice is likely where standard approaches to design and workmanship have been adopted that would only be acceptable in non-conservation refurbishment, an endeavour to meet unrealistic time or cost limits and the engagement of inappropriately trained and experienced designers and installers or the use of incongruous materials. The challenge to the services designer and services installer will be to provide building services that are functional and satisfy the needs of the building users, whilst fulfilling the objectives of providing appropriate internal climates, preserving visual amenity, minimising damage to historic fabric, maintaining structural integrity, allowing for reversibility and retaining/integrating existing building services with historical or architectural merit. Under these headings alternative approaches are described illustrating bad and good conservation practice.

The following tables have been compiled from the opinions, with regard to bad practice, and the advice, in respect of good practice, of Fidler (1987); Feilden (1994); Sharpe (1999); Kay (1991) Inskip & Cannel (1991). References are cited in the text if the opinion or approach is attributed to a particular author.

Table 5.1 **Providing Appropriate Internal Climates**

BAD PRACTICE	GOOD PRACTICE
Services engineers set climatic conditions for the comfort levels of occupants, without due consideration for the fabric of the historic building. If RH [Relative Humidity] levels are too low, shrinking, warping, brittleness, cracking and crazing occur in the building fabric and its contents. If RH is too high, mould growth, condensation, oxide-jacking (deterioration of recently laid leadwork) are likely (Fidler, 1987).	Specify and install a 'conservation' heating system that has a humidistat with an appropriate control strategy to provide good continuous control of RH (Lawson-Smith, 1998). Note: In 'commercial' conservation the building services engineer must provide a design solution to maintain RH levels, to suit the building fabric, and provide temperature and RH levels, to suit the building users' needs.

Table 5.2 **Allowing For Reversibility**

BAD PRACTICE	GOOD PRACTICE
Specifying and installing building services without thought for their renewal or removal, at a later date. The impact of the activity of removal has potential to permanently damage the fabric of the building and poorly designed and fitted installations, once removed, leave unsatisfactory evidence of their former existence.	Specify and install building services with due concern for renewal and removal, in line with the conservation principle 'reversibility' (Park, 1991).

Table 5.3 **Retaining Existing Building Services With Historical Or Architectural Merit**[1]

BAD PRACTICE	GOOD PRACTICE
The removal of existing services that have aesthetic, architectural, historical merit. Many refurbishment schemes will specify completely new installations for simplicity and economy and, without regard, for the opportunity to retain, modify or adapt existing ones.	At the design stage, evaluate the significance and usefulness of existing systems. Consult with the conservation team before commencing work on scheme proposals and establish what should be retained and what is appropriate for removal. *

[1] Where asterisks appear in the text, please refer to 'Pictorial Examples Of Poor Practice And Desirable End Results' (par.5.4.3.1) pp. 62-64, for illustrated examples of good and bad practice.

Table 5.4 **Minimising Damage To Historic Fabric**

BAD PRACTICE	GOOD PRACTICE
Installing air conditioning systems, with outlets vulnerable to exuding condensate, that drip on to masonry eroding and staining it (Fidler, 1987).	Careful siting of air conditioning outlets and regular operational and maintenance checks (Fidler, 1987). Examine the real need for air conditioning in the historic building.
Insensitive positioning and poor workmanship relating to the installation of power socket points and switches that ruin rare panelling (Fidler, 1987).	Where woodwork must be pierced the smallest possible hole should be drilled carefully, in the most inconspicuous position, so as to avoid splitting or mutilation. The path of all wiring must be approved by the architect.
Insufficient thought about investigative work prior to the building services contractor going on site. [Looking for suitable 'concealment' stucco has been chased and wainscotting inappropriately removed and reinstated (Fidler, 1987).]	If information is required about the building before work can be properly put into effect it is advisable for the contractor to negotiate a separate investigative contract before undertaking the services installations (Sharpe, 1999).
Laying cables and wires over fabric with aesthetic, historical and cultural merit i.e. applying a standard 'A to B' approach in wiring that is only likely to be acceptable in non-conservation projects.	Wiring must not be not be laid over the face of any carving or painting, nor must it be laid over the face of mouldings where another course is possible. Wires must be placed in positions so that they can easily be examined for maintenance.
Careless dismantling carried out by services installers [e.g. the removal of skirtings or floorboards for installation of heating pipes or electrical wiring and crudely replacing them with ill-matched timber].	When service installations affect historic joinery, an experienced joiner should be responsible for the careful lifting of boarding or removal of sections of wainscot, etc. and for carrying out necessary repairs before reinstatement by splicing new pieces in matched timber (Brereton, 1995).
Lack of thought and inadequate time preparing ways of distributing heat, power, ventilation, artificial lighting and water supply [hot & cold] relying on 'sorting things out' on site. Lack of clarity in the specification as to who is responsible for BWIC and, also, how it should be carried out.	Determine in advance the best way of articulating building services within the building. Where it is necessary to penetrate the original, unique or expensive materials the specifications should clearly state who is to do the cutting and subsequent filling in. Every member of the team should be aware that working with original fabric is different from working with new materials (Kay, 1991).

Table 5.5 **Maintaining Structural Integrity**[1]

BAD PRACTICE	GOOD PRACTICE
Identification of routes and subsequent routing of cables, pipes and ductwork left to inexperienced plumbers, electricians or other trades. This can lead to inappropriate notching in joists and beams, lintels, structural trussed partition struts and door frames.	Employ an experienced structural engineer to carry out appropriate diagnostics to establish best routes for services. Where penetration of a structural member is unavoidable ascertain its condition first. Only under very exceptional circumstances may holes be made or drilled through mullions, columns, detached shafts or vaulting ribs. Beams, structural timbers or mouldings may not be notched or sawn on any surface. When it cannot be avoided, the smallest or possible hole may be drilled through the centre of a beam. Avoid the point of most deflection and cut notches in reference to the condition of the beam.
Inappropriate design and fixing of heating apparatus requiring trenches and usually wall space, leading to damage to foundations. Damage to walls through fixing of heavy weight smoke pipes and/ or radiators.	Careful design of heating systems in conjunction with the structural engineer and conservation team. Locate plant and equipment in areas in the building that have adequate bearing capacity, e.g. basements. *
Installing systems with inappropriate climatic control systems causing breshness (crumbling) in timber, due to excessive heating and leading to loss of structural performance in the structural member.	The type and design of climatic control systems should be carefully considered and the question asked, 'Are systems which cause major disturbance to the structure really necessary?'
Applying standard approaches to devising structural engineering solutions and subsequently 'over-engineering'.	Challenge the presumption that high floor loadings are essential. The work required to strengthen floors can be insensitive and cause unnecessary disturbance to the structure.

[1] Where asterisks appear in the text, please refer to 'Pictorial Examples Of Poor Practice And Desirable End Results' (par.5.4.3.1) pp.62-64, for illustrated examples of good and bad practice.

Table 5.6 **Preserving Visual Amenity**[1]

BAD PRACTICE	GOOD PRACTICE
On external elevations, the insensitive siting of flues, extract fan assemblies, utility meter boxes, television aerials, satellite dishes, security cameras, telephone wires in a practical but visually disruptive way. *	Where ever possible design a system where these components can be dispensed with, concealed or site sensitively in inconspicuous positions.
Introduction of components to increase natural ventilation which break the architectural rhythm of the building e.g. fitting standard air bricks in string courses.	Innovative ways of adapting window openings: adaptation of the top rail or sawn slots under window cills.
Obtrusive positioning of electronic detector equipment in decorative ceilings, cornices or pediments.	Careful selection of detectors sited in either the ceiling void whilst maintaining functionality or in a camouflaged way in the ceiling itself.
Employing heat emitters that spoil elevational details or proportions.	Careful choice of heat emitter to suit location e.g. finned pipes behind basket weave grilles. *
Fitting luminaires without reference to levels of illuminance and visual acceptability. "Sham candles are an abomination" Powys (1998). *	Use standard fittings with caution. Specify luminaires that satisfy both the quality of visual acceptability and illumination Lighting fittings and fixtures, as far as possible, should be retained in their original position.
Unsightly surface runs of pipe work, ducting and cabling.	Look for voids and cavities, vertical and horizontal, through careful investigative techniques and then route services accordingly. *
The use of standard electrical fittings in inappropriate positions or where their use has a negative visual impact on aesthetically and culturally sensitive areas. *	Careful choice of fittings and sensitive siting of sockets and switches.

5.4.3.1 Pictorial Examples Of Poor Practice And Desirable End Results.

To illustrate examples of bad [or poor practice] and good practice, showing desirable end-results, photographs were taken of modern building services, installed in a Grade II listed building, as part of its refurbishment. The examples shown are not exhaustive but provide pictorial evidence of the approaches [marked with an asterisk] described in Tables 5.1-5.5.

[1] Where asterisks appear in the text, please refer to 'Pictorial Examples Of Poor Practice And Desirable End Results' (par.5.4.3.1) pp.62-64, for illustrated examples of good and bad practice.

VISUAL DISRUPTION

External

Figure 5.1: **Unsightly Aerials**
Insensitive location of an aerial detracts from the aesthetic amenity provided by the chimney and old weather vane.

Figure 5.2: **Trailing Cables**
Trailing cables on the external face of the building are visually disruptive and cause staining to the stonework.

Internal

Figure 5.3: **Obtrusive Positioning Of Sensors & Fittings**
The ornamental ceiling (pictured on the right) is ruined by the insensitive positioning of a sensor, for the fire detection system, and an emergency light.

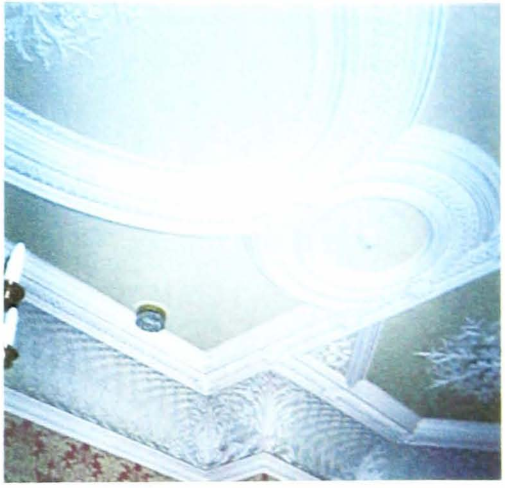


Figure 5.4: **Poorly Thought Out Siting Of An Electrical Fitting**
The positioning of the electrical fitting (pictured on the left) is obtrusive and ruins the architectural feature of the deep skirting board.

HEATING

Figure 5.5: **Siting Of Boilers**

The boiler for the heating system has been positioned in the basement. This illustrates good practice. It utilises an existing and approriate space with adequate bearing capacity for plant and equipment.

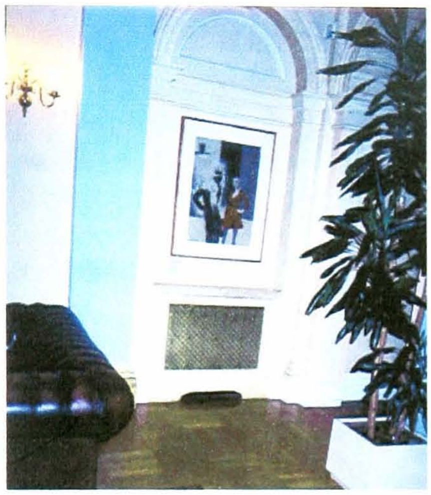


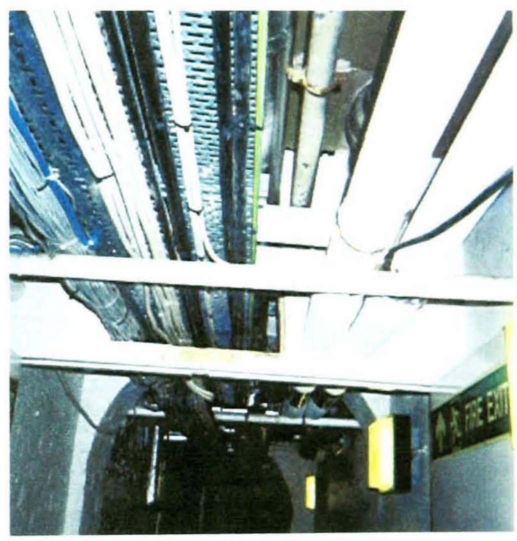
Figure 5.6: **Architecturally Sympathetic Radiators**

The radiators selected for use with the heating system are sensitively positioned and blend sympathetically with the interior architecture of the building.

SERVICE ROUTES

Figure 5.7: **Horizontal Distribution**

The main horizontal distribution of cables and pipes, shown on the right, makes use of the void in the basement of the building to minimise impact on the fabric of the building.



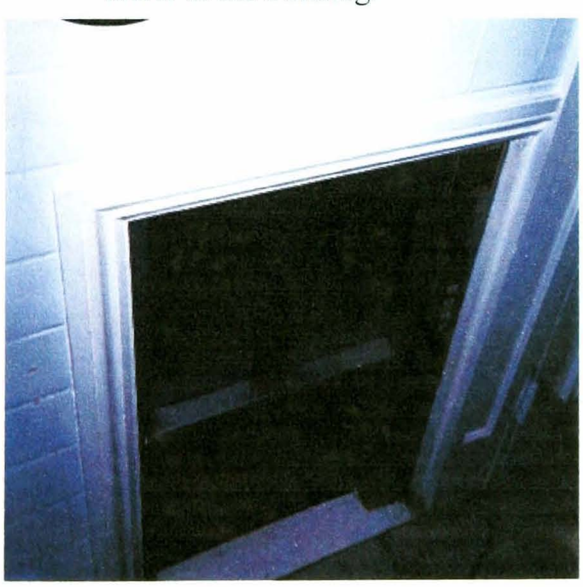


Figure 5.8: **Vertical Distribution**

The dumb waiter, pictured on the left, provides an existing vertical shaft to house service pipes and cables. This illustrates good practice through making use of an existing void to minimise impact on the fabric of the building.

INAPPROPRIATE SELECTION OF MATERIALS

Figure 5.9: **Inappropriate Lighting Fitting**
The light fitting of the type Powys (1981) describes as 'an abomination' has been fitted in the decorative ceiling. Not only are 'sham candles' incongruous but the levels of illuminance, provided by this light fitting, proved to be inadequate for the needs of the occupants of the building.

Figure 5.10: **Inappropriate Emergency Lighting**
The emergency light fitting impacts negatively on the lines of the ornamental plasterwork. Kay (1991) suggests fibre optic lighting at floor level offers a favourable alternative and is more practical in times of emergency.

UTILISING EXISTING BUILDING SERVICES

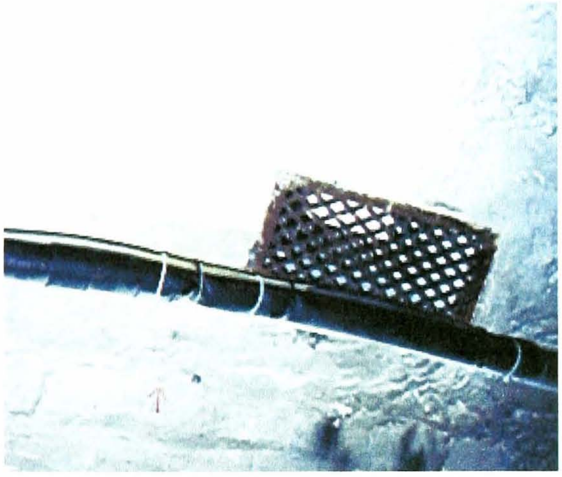


Figure 5.11: **Existing Ventilation Systems**
Pictured, on the left, is a ventilation grille in the house's original ventilation system. It was retained as part of the building services refurbishment solution. This old system provides historical interest in terms of building services and, also, reveals history about the house. Both functional requirements and conservation criteria are satisfied.

Figure 5.12: **Existing Lifts**
The operating system for an existing lift is shown on the right. Given the projected usage by the building occupants, the lift system was retained. The benefits are as described for Figure 5.11.

5.4.4 Management of the Process

Strike (1994) suggests,

"As in any manufacturing process it is possible to breakdown the conservation process into stages, identifying the need, selecting the team and deciding how the work should be carried out."

a) Identifying the need

Par. 5.1 sets out the reasons why modern building services are introduced into listed historic buildings. The need for modern building services, as part of the refurbishment of the listed historic building, will be based on one or a combination of these three criteria: practicality/efficiency, renewal and/or upgrade of defective installations or special needs in 'commercial conservation'.

b) Selecting the team

Conservation refurbishment necessitates employing a multidisciplinary project team. All team members need to be equipped with specialist skills required for building conservation work and, to be sure of this, great care must be exercised in their selection. In addition, the project leader must be of the necessary disposition to lead the project and he/she must understand the building in its totality (Powys, 1981; Feilden, 1994; Strike, 1994). Brereton (1995) points out,

"Perhaps the most important of all are the attitudes and degree of sensitivity of building owners and their professional advisers, be they architects, building surveyors, structural engineers or conservators, and those working on site."

If the client's brief sets out requirements to service the listed historic building, requisite expertise to fulfill these requirements will also be required. Building services engineers and building services installers with the specialist skills of their discipline and also those essential for conservation work must be appointed. Absence of the latter skill, due to inexperience, does not necessarily preclude appointment but provision must be made for specialist advice and support to be made available in these circumstances (CIBSE, 2002).

Selection does not merely rest with appropriate skills and attitude. Timing of appointments will also require very careful consideration. The Royal Institution of Chartered Surveyors advise in 'Building Services Procurement' (2000) that it is important to appoint the building services engineer at the same time as the architect and structural engineer. Furthermore, the early appointment of the building services contractor confers benefit in design, co-ordination, plant and equipment selection and procurement, buildability and the cost plan. [Early appointment must be weighed against the disadvantages of limited price competition and limited pool of suitable building services contractors able to develop and finalise the design.] In addition, CIBSE (2002) states,

"The terms of appointment can be very different from those normally used, and the amounts and costs of professional services will be higher, with more investigation, more consultation, more detailed design, more amendments and more working together with operatives on site."

In summary, selection of building services engineers and building services installers must be selected with the necessary skills. Those chosen must be capable of adopting the right approach to servicing listed historic buildings. Furthermore, the timing and terms of their appointment require particular consideration.

c) <u>Deciding How The Work Should Be Carried Out</u>

Criteria for good design, and good workmanship, have been discussed in par 5.4.3. However, deciding how the work should be carried cannot rest at following these criteria alone.[1] The refurbishment of the listed historic building [of which servicing the building comprises an element] will be undertaken by a unique, temporary organisation [the project team] composed of different disciplines, different craftsmen, tradesmen, site & office personnel and externalities. BS EN ISO 9000:1994 states,

"An organisation needs to identify, organise and manage its network of processes and interfaces."

This is complex when multidisciplinary activities are involved and working relationships, within the project, are forged for the first time. On the part of building services engineers, Parsloe & Wild (1998) claim their success is dependent on the way input is managed in terms of its preparation, timing and co-ordination. They observe that although the design stages of the RIBA Plan Of Work[2] fit well with architectural design they are not always matched to the building services appointments. In essence, the problem lies in the fact that *'for many design scheme appointments, design activities may end after the scheme design, detailed design being carried out by the installing contractor, when appointed'*. This is particularly pertinent in the servicing of listed historic buildings [par 5.3.2 refers].

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[1] Management of the refurbishment process is discussed in par.5.4.4.2.

[2] *"The RIBA Plan Of Work needs some amendment both in the names of the early stages and in the fact that much work occurs not in sequence but in parallel or as interlinked stages."* (CIBSE, 2002)

To ameliorate the problems created by the timing of detailed design for the building services element of the work, within an overall project scheme, Parsloe & Wild (1998) have developed a generic model for called a Process Protocol[3] to dovetail the RIBA Plan of Work with management sub systems[4]. Its efficacy relies on the involvement of the project team and the receipt of *all* necessary information on which designs are to be based. Hitherto, it is reasonable to say that timing, understanding and the readiness to communicate are crucial in the procurement of building services work. Furthermore, the synchronisation of the building services element of the work, within the works as a whole from inception, an essential contribution to achieving desired project outcomes.

5.4.4.1 Risk Management

According to Smith (1999) the need for risk analysis seems particularly apparent when projects involve:

- large capital outlays
- significant new technology
- unusual legal, insurance or contractual arrangements
- important political, economic or financial parameters
- sensitive environmental or safety issues
- stringent regulatory or licensing requirements

The integration of modern building services into listed historic buildings involves several or all of these, depending on the size and nature of the project.

To address risk in construction projects, many practitioners have developed their own models or methodologies (Smith, 1999). Their efficacy may, therefore, be in question. Individual attitudes to risk will influence the practitioner's perception of the risks involved in a project [par.2.5 refers]. This leaves scope for a disproportionate view of the severity of risks and a different approach to their management. (Smith, 1999) states,

"Failure to undertake risk management in a more explicit manner as a routine aspect of project management is increasingly regarded as commercial suicide."

In response to factors identified by the Partners In Innovation Project, the Department of Trade and Industry [DTI] has developed a model to manage risks, particularly suitable to projects

[3] The 'Process Protocol'was developed at Salford University.

[4] Development management, project management, resource management, design management, production management, facilities management, health & safety, statutory and legal management, process management and deliverables.

where building services engineering comprises an element of the works. The DTI (2002) has identified that *'many risks that a building services engineer may face in the execution of a project can be generated by the actions and performance of the other team members'*. The DTI purport that *early* interaction between team members is essential *'to engender a sense of ownership of the project and its risks'*. Its model to manage risk is founded in the use of feedback. It is based on the rationalised stages of the RIBA Plan of Work: inception, design, tender and installation. [Difficulties relating to exact adherence to stages in the RIBA Plan Of Work model were identified in par.5.4.4(c)]. In essence, it proposes that risks, in projects, should be anticipated and identified in a holistic way, early in the construction process, and managed by looking ahead. Remedial measures proposed to manage foreseen risks, and the risks themselves, should continue to be assessed and reviewed at stages throughout life of the project.

It can thus be summarised: Risk management should be taken in an explicit manner. Furthermore, where building services work comprises an element of the project, research indicates that the feedback method of risk management is beneficial.

5.4.4.2 <u>The Management of Refurbishment Projects</u>

CIRIA [Construction Industry Research and Information Association] Report 133 (1994)[1] serves as a general guide to the management of the process of refurbishment. The type of work and types of building assets in refurbishment projects are defined in the document. 'Conservation' is cited as type of work and 'Heritage' as a category of building asset [Heritage includes historic buildings, ancient monuments, National Trust assets and palaces].

Key issues relating to the generic process of refurbishment, and, hence, the refurbishment of listed historic buildings, are identified. A recommended approach for dealing with each issue is summarised as follows:

- <u>Client Involvement</u>: The client needs to have a continuous and intimate involvement with the project, especially if he/she remains in occupation.
- <u>Relationships Within The Project Team</u>: Close collaboration and a sympathetic relationship are necessary. Project team members should have a 'good track record' in the field of work.

[1] 'A Guide To The Management Of Building Refurbishment' has been based on a research report produced by the University of Birmingham.

- Occupancy During Refurbishment: Continued occupancy generally adds to time and cost, restricts ways of working and can be detrimental to the relationship with occupants. Therefore, the need for occupancy must be thoroughly evaluated.
- The Client Representative: The client must appoint a single point of contact. This will be his/her representative through whom all communication, with those undertaking the project, should flow.
- The Project Manager: The appointment of a project manger with total responsibility for the whole project [design, programming, cost control, construction, and liaison with the client] is essential. Definite and clear lines of communication and authority are very important.
- Preliminary Investigations: A preliminary investigation into the building's structure and substructure should be made and a long lead-in time allocated to enable as much thorough investigation and soundly based design as possible.
- Adjoining Premises: Depending on the location of the site, neighbours or passers-by can be affected by the project. In view of this, the impact of the works on these parties must be carefully considered at the planning stage and during the works.
- Design: Permanent and temporary works designs are often interdependent and responsibility for overall design must be clearly defined.
- Construction: Design and construction should be considered together and early involvement of the construction team with the design team should be encouraged.
- Handover: Operation or maintenance manuals must be available at commissioning. The effective working of installations [particularly communications] is frequently perceived by building users as an indication of the successful management of the whole refurbishment programme.
- Time & Cost Issues: Difficulties lie in obtaining reliable estimates of cost and time and it must be remembered that contingency allowances will always tend to be greater than in new build. Cost monitoring during the contract and effective cost control throughout the project are crucial.

In summary, the management of refurbishment raises key issues with respect to the nature of the work and the role and relationships of individuals and groups party to the project. Research indicates that there are best ways of dealing with these issues. Combined, these 'best ways', provide a management approach to facilitate the successful refurbishment of all buildings [of which listed historic buildings are a building type].

5.5 THE INTERRELATIONSHIP BETWEEN CONSERVATION, REFURBISHMENT, RISK AND MODERN BUILDING SERVICES

The interrelationship between conservation, refurbishment and risk [par.2.6.2 refers] has been discussed. In essence, conservation, in a listed historic building, is an intervention in its life to preserve its architectural, historical and cultural merit. Refurbishment is an intervention in the life of a building in response to its present condition, proposed use and the client's requirements. Refurbishment may be the chosen strategy to secure the future of the listed historic building [par.2.4 refers]. In this case, design and execution of the works must adhere to the principles of conservation and comply with statutory legislation protecting the listed historic building [par.2.2.1 refers]. The need for the introduction of modern building services into historic buildings, to provide them with facilities necessary for current day living as part of securing their future, was identified in par.5.1. Furthermore, substandard services installations that exist in historic buildings pose risk to the occupants and the building fabric [par. 5.1(b) refers].

Due to the uncertainty associated with working with an existing building the nature of both refurbishment and building conservation are 'risky' [par.2.4.3; par.2.5 refer]. In servicing historic buildings, the level of risk can be exacerbated by the timing and terms of appointments [par 5.4.4(b) refers] and the approach to design and workmanship [par.5.4.3 refers]. In summary, conservation, refurbishment and the introduction of modern building services all contribute to securing the future of the finite resource of the built heritage but this work, and the risks it involves, must be effectively managed if these interventions *'do not ruin that which they set out to save'* (Fidler, 1987) and/or lead to unsatisfactory outcomes in terms of budget and time.

5.6 THE RESEARCH QUESTION

Having reviewed the integration of modern building services into listed historic buildings, reference must now be made to the research aim,

'What are the characteristics of refurbishing listed historic buildings and what flows from them?' [par.1.1 refers].

The pilot study identified the servicing of listed historic buildings as *'an element of the refurbishment process which impacts on the whole project, but is narrow enough to facilitate further in-depth investigation'* [par 4.2.3.3 refers]. Good practice with respect to design, workmanship and execution of the works, have all been identified. However, the realisation of ideals is seldom easy, in practice, and realising ideals in servicing listed historic buildings, no exception.

In view of this, an investigation into what happens, when integrating modern building services into listed historic buildings, was undertaken in line with the research objectives [par. 1.1.1 refers] *viz.*

a) Once the work starts on site

- The frequency of occurrence and degree of difficulty of identified refurbishment characteristics.
- Practitioners' perceptions and attitudes to events or activities that posed risk.

b) The project process

- Factors that contributed to the successful outcome of the project and factors that threatened that success.

5.7 SUMMARY

The introduction of modern building services is a necessary intervention, in the life of the listed historic building, to secure its future and provide its occupants with the facilities required for current day living. Evidence indicates that obtaining listed building consent can be problematic and there are good and bad approaches to design and workmanship. The management of the process is discussed and the chapter concludes by describing the interrelationship between conservation, refurbishment, modern building services and risk.

CHAPTER 6

The Nature Of Refurbishment Characteristics: Difficulty & Frequency

6.0 INTRODUCTION

This chapter reports on the process of integrating modern building services into listed historic buildings. The findings of the pilot study [Chapter 4] identified this element of building conservation as being frequently high-cost and problematic. This fact was also identified by Lawson-Smith (1995) in the paper he presented to New College Oxford, in 1995, concerning historic buildings that are used for educational purposes. Further investigation was required to provide insight into such findings. A questionnaire survey was undertaken, to this end, and the elicited data is now described and discussed.

6.1 BACKGROUND

Inappropriate application of modern techniques when integrating modern building services into listed historic buildings, as part of the refurbishment process, can result in undesirable end results [Chapter 5 refers]. To throw more light on this factor, the research study now investigates the characteristics of this construction activity.

General refurbishment is a topic that was explored by the Construction Unit, Brunel University (Summers & Fellows, 1987). The study focused on occupied buildings. Through structured interviews, in which eleven contractors took part, the research sought to determine the nature and magnitude of arising problems and difficulties. Thirteen difficulties were identified, the major problems being: protection, management, supervision and noise. Young & Egbu (1993) [par.2.5 refers] continued the investigation into the issues surrounding the general refurbishment process. In their study, project managers were asked to make judgements about the degree of difficulty, and frequency of occurrence, of thirty-three refurbishment characteristics [List L.2.1, *Appendix II* refers].

These previous studies were seen as providing a suitable base to take the enquiry concerning the refurbishment process, yet further. In this investigation, the area under review was limited to the activity of integrating modern building services into listed historic buildings.

6.2 METHODOLOGY

Literature relating to the design of research instruments was undertaken and, with reference to Blank (1984) the questionnaire was designed to elicit data for this part of the study.

6.2.1 Questionnaire Design

When framing the questionnaire, three main criteria underpinned its design and were based on those outlined by Tull & Hawkins (1980). These were, essentially, what information was required, who the target respondents would be and what method of communication would be used to reach them.

6.2.1.1 Definitions

Modern building services, for the purposes of the study topic, included: heating, ventilating and air conditioning systems; hot and cold water services; fire engineering; lighting and power; security systems.

6.2.1.2 Questionnaire Content

The findings from the content analysis of the three-stage pilot study, detailed in Chapter 4 [Tables 4.2.1(a) and (b), 4.2.2(a) and (b), 4.2.3(a) and (b) refer] were compared with the set of characteristics identified, for the general refurbishment process, in the research of Young & Egbu (1993). As a result, five additional characteristics were identified for the process of integrating modern building services into listed historic buildings *viz.*

- Spatial constraints imposed by the building
- Structural constraints imposed by the building
- Influence of conservation objectives on the progress of the works
- Restriction on working methods
- Remuneration

Building regulations and statutory control were itemised as a single characteristic by Young & Egbu, (1993). Their study did not rank them as frequent or difficult [Degree of difficulty 32/33; Frequency of occurrence 25/33, the least being 33/33]. The findings of the pilot study, however, indicated that it was an area that could be problematic [Chapter 4 refers]. Feilden (1994) reinforces this view, *"New regulations are always more strict than the ones they replace and the process represents a danger to historic buildings as officials, often, do not consider their fundamental purposes but seek to apply them mechanically".*

To investigate this statement further the characteristic was subdivided into eight:

- Listed Building Consent
- Planning Permission
- Building Regulations
- Fire Protection Regulations
- Liaison with the Planning Officer
- Liaison with the English Heritage Inspector
- Liaison with the Fire Protection Officer
- Liaison with the Building Control Officer

The total number of refurbishment characteristics, relating to the integration of modern building services into listed historic buildings, now numbered forty-five. A question was set for each of these characteristics in the questionnaire instrument [see *Appendix I*].

6.2.1.3 <u>Phrasing, Question Sequence And Questionnaire Layout</u>

To keep things simple, and minimise the effect wording might have on the respondent, each question merely had a heading, e.g. *'Cost Control'*. This approach was based on the proposition by Blank (1984)

"The more precise the category is, the more reliable will be the ratings."

As such ambiguity, unstated assumptions or implied alternatives were not deemed to be distorting influences in the question format. No question was perceived to be easier or harder and, therefore, no particular sequence, other than grouping the questions in categories, was laid down. These were the same categories employed in the content analysis of the pilot study, e.g. 'Programme', 'Liaison & Communication', etc. [Tables 4.2.1(a) and (b) refer]. The rationale for this was twofold. Firstly, placing questions in a logical group helped the respondent to think in a more in-depth way about the topic. Secondly, it provided the basis for devising a framework to evaluate new data and facilitate comparison with previous findings.

6.2.1.4 <u>Response Format</u>

An itemised rating scale was chosen as the response format. This measuring device is cost-effective and easy for use, by both the respondent and the researcher. Practitioners taking part in the survey were well-placed to make objective professional judgements, although, it was recognised that such a measuring device might elicit biased responses through leniency, central tendency, halo-effect or by establishing a response set (Blank, 1984).

A pretest was undertaken using respondents with similar a professional background and experience to those chosen to take part in the questionnaire survey. Revisions were made to the instrument, to include the opportunity for additional comments in each question.

6.3 DATA COLLECTION

Consideration was given to various methods of data collection. A mailed questionnaire was selected as the optimal collecting method with respect to time and economy.

6.3.1 Sample Frame, Sampling Method And Time Frame

The sample frame was generated, with some difficulty, by combining the following sources: The Building Conservation Directory (Taylor, 1994); Consultant Engineers (Fullalove, 1994); A Directory of Specialist Crafts for Architects and Builders (Smith, 1990); The Chartered Institute of Building Directory (1994-1995); Royal Institution of Chartered Surveyors - List of Members (1994); Royal Institute of British Architects - Directory of Members (1994) and various journals [e.g. Building, CIBSE Journal]. It was proposed to use stratified random sampling [i.e. to separate the population elements into non-overlapping groups: architects, building services consultants, quantity surveyors, structural engineers, building surveyors, main contractors and mechanical & electrical contractors] as a probabilistic sampling technique. The scope of the study was restricted to evidence provided by the experiences of practitioners. This bank of experience was, also, limited to conservation refurbishment contracts undertaken within the previous five years and up until the date of the questionnaire survey. For the purposes of the questionnaire a building, over a hundred years old, was regarded as historic. The scope of the study was restricted to those with a listing category [Grade I, Grade II*or Grade II].

6.3.2 Piloting The Questionnaire

As a preliminary measure, the questionnaire was piloted to test the response rate. A random selection from the population was sampled. Those chosen were first telephoned and asked if they would be willing to participate in the study. Fifteen potential respondents were mailed the questionnaire. Although interest was expressed, by all those contacted, only two out of the fifteen, returned a completed questionnaire, even after follow up telephone calls. One was returned without completion, stating that the content was outside the scope of the consultant's work because *'it was intended for project managers'*.

This disappointing return led to a review of the method of distributing the questionnaire. As an alternative, it was decided to collect the data through personal appointment.

6.3.3 Revised Approach To Data Collection

The revised approach, to gathering information, dictated a change to the sampling method to comply with logistical and economical constraints. Larger samples are generally considered more reliable but also more expensive and time consuming. An optimal balance between cost and accuracy was sought and, as a result, it was decided to hand-pick the participants through purposive sampling. This involved the selection of professionals who were known to have worked on major building conservation projects. Furthermore, by conducting the questionnaire in person, it also provided an excellent opportunity to carry out an open-ended interview. The objective being to elicit opinions regarding factors that contributed to a successful outcome, when integrating modern building services into listed historic buildings. [The findings of these interviews are reported in Chapter 7 and *Appendix IV*.]

6.3.4 Legitimacy, Confidentiality And Anonymity

All respondents were telephoned, explaining how they had been selected. To establish legitimacy, a covering statement was issued identifying the researcher, the study and its goals. Respondents were given assurance that the no individual data would be connected to any named source. This sensitivity to confidentiality and anonymity was seen as conducive to obtaining more reliable responses and willing participants, for the questionnaire survey.

6.4 ANALYSIS OF FINDINGS

The questionnaire survey OBU/J/2 [see *Appendix I*] was conducted between February and May 1995, inclusive. The empirical data was manipulated using Word Excel. Quantitative analysis produced tables of descending mean values. Due to the small sample size [a maximum of 35 observations] it is not suggested that the results provided statistical evidence. Despite this, however, it is proposed that the findings provided valuable insight into the study topic and these will now be discussed.

6.4.1 Profile On The Respondents

Thirty-five practitioners, experienced in building conservation work, took part in the questionnaire survey. A quota of five from each of the following classifications of project team members was obtained *viz.* main contractors; mechanical and electrical contractors; architects; quantity surveyors; building services consultants; building surveyors and structural engineers. All those taking part in the survey held senior positions within their organisations, e.g. director of area, senior project manager. Respondents were asked about the projects they had worked on. From the information provided, a picture emerged of the main categories of work and client.

Table 6.1 **Main Categories Of Work, Building And Client**

NUMBER OF EXPERIENCED RESPONDENTS	CATEGORY OF BUILDING
25/35 (71%)	**Grade I and Grade II* Listed Buildings**
34/35 (97%)	**Historic buildings used or visited by the public**
	CATEGORY OF WORK
23/35 (66%)	**Projects valued at over £1 million**
	CATEGORY OF CLIENT
19/35 (54%)	**English Heritage**
14/35 (40%)	**National Trust**
21/35 (60%)	**Local Authority**

From Table 6.1 it was concluded that the majority of those participating in the questionnaire had been involved in major projects [greater than £1 million contract value] on buildings of special and exceptional historic interest and, also, for major organisations and owners [or trustees] of listed historic buildings.

6.4.2 Degree Of Difficulty & Frequency Of Occurrence Of The Refurbishment Characteristics Encountered When Integrating Modern Building Services Into Listed Historic Buildings

Respondents were asked about the degree of difficulty, and frequency of occurrence, of the refurbishment characteristics encountered in their professional working experience. A scale was provided coding the choice of response and average scores were computed from this data. Details of the analysed data are contained in *Appendix II* and serve as a reference to complement the research findings reported in this chapter.

6.4.2.1 Degree Of Difficulty And Frequency Of Occurrence

A table was prepared showing the degree of difficulty and frequency of occurrence of characteristics encountered when integrating modern building services into listed historic buildings. These were placed in descending order and this is illustrated as follows:

Table 6.2 **Degree Of Difficulty And Frequency Of Occurrence**

Ranking in descending order (most = 1 → least = 45)	DEGREE OF DIFFICULTY	FREQUENCY OF OCCURRENCE
1	Pricing the works	Pricing the works
2	Cost control	Remuneration
3	Spatial constraints of the building	Variation or change to order of works
4	Remuneration	Quality control & assurance
5	Structural constraints of the building	Spatial constraints of the building
6	Programming/scheduling the works	Handling and disposal of site rubbish
7	Storage of building materials/plant	Supervision of the works
8	Fire protection requirements	Cost control
9	Site access	Structural constraints of the building
10	Maintaining existing services	Storage of building materials/plant
11	Time prediction for completion of works	Site access
12	Influence of tenant on progress of works	Keeping the site tidy
13	Variation or change to order of works	Time prediction for completion of works
14	Influence of conservation objectives on the regular progress of the works	Protecting the works/adjacent buildings
15	Quality control & assurance	Materials handling
16	Selection and recruitment of workforce	Programming/scheduling the works
17	Protecting the works/adjacent buildings	Decanting the building for the comm. of works
18	Listed building consent	Maintaining existing services
19	Restriction on plant usage	Building regulations
20	Restriction on working methods	Selection and recruitment of workforce
21	Dust control	Fire protection requirements
22	Noise control	Productivity control and maintenance
23	Handling and disposal of toxic/hazardous substances	Protecting the general public
24	Site security	Contract documentation/arrangement
25	Supervision of the works	Site security
26	Liaison with the Planning Officer	Maintaining safety and welfare standards
27	Liaison with English Heritage inspector	Restriction on working methods
28	Materials handling	Dust control
29	Liaison with Fire Protection Officer	Liaison with the Planning Officer
30	Productivity control and maintenance	Liaison with Building Control
31	Contract documentation/arrangement	Liaison with tenant or occupier
32	Planning permission	Materials supply
33	Decanting the building for the commencement of the works	Listed building consent
34	Liaison with tenant or occupier	Influence of tenant on progress of works
35	Keeping the site tidy	Liaison with English Heritage inspector
36	Building regulations	Restriction on plant usage
37	Materials supply	Influence of cons. objectives on prog. of works
38	Maintaining safety and welfare standards	Liaison with Fire Protection Officer
39	Protecting the general public	Noise control
40	Handling and disposal of site rubbish	Restrictions on working hours
41	Restrictions on working hours	Handling and disposal of toxic/hazardous substances
42	Liaison with Building Control	Planning permission
43	Long and unsociable working hours	(Site) plant supply
44	Coping with employee stress and absenteeism	Long and unsociable working hours
45	(Site) plant supply	Coping with employee stress and absenteeism

The computed data in Table 6.2 is now evaluated to facilitate commentary.

6.4.2.1.1 *Most And Least Difficult Characteristics; Most And Least Frequent Characteristics*
[Table 6.2 refers.]

The top nine characteristics for both 'difficulty' and 'frequency' were identified. This represented 20% of the total number of refurbishment characteristics. *'Pricing The Works'*, *'Remuneration'* and *'Cost Control'* [the only three questions in the category of budget and financial matters] were all in the top 20%, as some of the most difficult and most frequent characteristics. *'Spatial Constraints'* and *'Structural Constraints'* were also cited, within this band, for both difficulty and frequency. Furthermore, *'Programming And Scheduling The Works'* was amongst the most difficult characteristics, whilst *'Variation/Change To The Order Of The Works'* was amongst the most frequent.

'Storage Of Materials And Plant', *'Site Access'* and *'Fire Protection Requirements'* were, also, cited within the 20% most difficult. *'Quality Control & Assurance'*, *'Supervision Of The Works'*, *'Handling & Disposal Of Site Rubbish'* were, also, identified within the 20% most frequent.

The nine least frequent, and least difficult, characteristics were identified. *'Site Plant Supply'*, *'Long And Unsociable Working Hours'* and *'Coping With Employee Stress And Absenteeism'* were amongst both the least difficult and least frequent characteristics.

In summary, the data suggests that financial issues are both difficult and frequent, when integrating modern building services into listed historic buildings. The building itself presents spatial and structural difficulties, frequently. Programming is not easy and this is probably exacerbated by the frequency of variations and changes to the order of the works. Interestingly, although handling and disposal of site rubbish was cited as frequent, it was also perceived to be one of the least difficult. By contrast, liaison with the fire protection officer was identified as one of least frequent characteristics and yet fire protection requirements were deemed to be amongst the most difficult.

6.4.2.1.2 *Comparison With The Findings Of Young & Egbu (1993)*
[Tables: DRC.1.1; DRC.1.2; FRC.1.1; FRC.1.2, *Appendix II* refer.]

This comparison between the findings of the study undertaken by Young & Egbu (1993) and the questionnaire survey OBU/J/2 is not based on statistical evidence. Different sample size, target audience and the number of refurbishment characteristics [33 versus 45] made anything other than simple observations unrealistic. However, the following similarities were evident:

- Degree Of Difficulty

'Pricing The Works', *'Cost Control'* and *'Site Access'* were amongst the top nine most difficult characteristics in both studies. Likewise, *'Materials Supply'*, *'Long Or Unsociable Working Hours'*, *'Coping With Employee Stress And Absenteeism'* and *'Site Plant Supply'* were amongst the nine least difficult.

- Frequency Of Occurrence

'Cost Control' and *'Quality Control'* were cited, in both studies, as being some of the most frequent. Likewise, *'Restriction In Working Hours'*, *'Handling And Disposal Of Hazardous And Toxic Substances'*, *'Site Plant Supply'*, *'Long And Unsociable Working Hours'* and *'Employee Stress And Absenteeism'* were deemed the least frequent.

In summary, the findings of the research undertaken by Young & Egbu (1993) regarding refurbishment [all types of buildings, including listed historic buildings] showed similarities to those elicited in the questionnaire survey, OBU/J/2, with respect to the most and least difficult and frequent refurbishment characteristics. However, it must be noted that two of the characteristics, absent from the study of Young & Egbu (1993) namely, *'Spatial Constraints'* and *'Structural Constraints'*, were identified in the questionnaire survey instrument, OBU/J/2, amongst the top 20% most difficult, and most frequent, characteristics.

6.4.2.1.3 *Difficulty And Frequency: Perceptions Of The Disciplines*

Analysis of the questionnaire results suggested that, when rating certain refurbishment characteristics for frequency and difficulty, some disciplines held similar opinions.
However, due to the small sample size, any clustering of results identified in the study is, essentially, only a possible indication.

- Architects / Main Contractors

  [Tables: DRC.1.3; FRC.1.3, *Appendix II* refer.]

  The data suggested that financial matters: *'Pricing The Works'*, *'Cost Control'* and *'Remuneration'* were some of the most difficult for both main contractors and architects [note: also for building services consultants]. Furthermore, both disciplines found *'Variations And Change To The Order Of The Works'* frequently difficult.

- <u>Building Services Consultants / Mechanical & Electrical Contractors</u>

  [Tables: DRC.1.4; FRC.1.4, *Appendix II* refer.]

  Building services consultants and mechanical and electrical contractors, surprisingly, did not display commonality in their opinions of the degree of difficulty and frequency of occurrence of the refurbishment characteristics, except for *'Time Prediction For The Completion Of The Works'*. Indeed, it appeared that main contractors and mechanical & electrical contractors shared more similar opinions each citing, *'Spatial Constraints'*, *'Structural Constraints'*, *'Programming And Scheduling The Works'* and *'Site Access'* as being within the 20% most difficult.

6.4.3 Time & Cost Implications

[*Appendix II* {individual question analyses} refer.]

The majority of respondents omitted to indicate whether the refurbishment characteristics specified in the questionnaire survey instrument, OBU/J/2, gave rise to consequences in terms of time and/or cost. Due to the poor response rate no conclusions have been derived from this data.

6.4.4 Additional Comments

[*Appendix II* {individual question analyses}refers.]

Additional comments, made by the interviewees when answering the questionnaire, are reported under the individual categories of 'Programme', 'Skills, Working Hours & Working Methods', etc.

To give an idea of the refurbishment characteristics, in relation to the degree of difficulty, they have been placed in three ranges:

- top range = top third [most difficult]
- mid range = mid third
- bottom range = bottom third [least difficult]

6.4.4.1 <u>Programme</u>

[6/45, 11/45, 12/45, 13/45, 14/45. All of the five characteristics under the 'Programme' heading were in the top range of characteristics for degree of difficulty.]

Summary of additional comments relating to: 'Programme'.

- o Programmes are difficult to keep to.
- o Building conservation objectives are a major influence on the construction programme.

- Building conservation work takes longer than general refurbishment.
- The flow of information is crucial.
- Inadequate design of the building services, when the construction starts on site, leads to programme delays.
- An investigative survey, in the preconstruction phase, is essential to ensure that problems, leading to programme variations, are minimised.
- Difficulties due to variations are exacerbated when there is pressure on time and resources and have greater impact at different stages in the construction programme.
- Noise control and working around occupants needs careful planning.

6.4.4.2 Skills, Working Hours & Working Methods

[*15/45, 16/45, 19/45, 20/45, 30/45, 41/45, 43/45, 44/45.* The eight characteristics in this category were in the mid, and bottom range, for degree of difficulty.]

Summary of additional comments relating to: 'Skills, Working Hours & Working Methods'.

- The choice of personnel with appropriate skills is paramount and more engineers, experienced in building conservation work, are needed.
- Restrictions relating to working hours and working methods should be clearly set out in the contract documents.
- Quality control and assurance is variable from job to job. The correct choice of contractor and regular site meetings are crucial.

6.4.4.3 Liaison & Communication

[*25/45, 26/45, 27/45, 29/45, 34/45, 42/45.* The six characteristics were mainly grouped in the lower mid range, and bottom range, for degree of difficulty.]

Summary of additional comments relating to: 'Liaison & Communication'.

- In supervision matters, contractors must be amenable to direction. [Some respondents dealt with this by using the same three of four contractors.]
- It can be difficult to achieve current day statutory requirements, relating to planning, building control, fire protection and building conservation. When negotiating and liaising with local authority officials, scope for applying common sense, and poor comprehension of time and cost implications were cited as limiting factors.

6.4.4.4 Health & Safety

[*21/45, 22/45, 23/45, 38/45, 39/45, 40/45.* The six characteristics were in the mid, and bottom, range for degree of difficulty.]

Summary of additional comments relating to: 'Health & Safety'.

- Control of noise & dust and disposing of waste [toxic or otherwise] were identified as:
  - a) the responsibility of, and down to management by, the contractor or specialist subcontractor
  - b) an aspect of the project that was set out in the contract documentation
- When maintaining safety and welfare standards, overfamiliarity is a danger.

6.4.4.5 Budget & Financial Matters

[*2/45, 1/45, 4/45.* All characteristics were in the top range [and top 10%] for degree of difficulty.]

Summary of additional comments relating to: 'Budget & Financial Matters'.

- Cost control is difficult in building conservation work and, generally, large budgets are required for high quality workmanship and design.
- Competitive fees are a problem and consultants should be selected on quality and experience.
- Pricing the works was seen as the responsibility of the quantity surveyor. In many projects, due to an absence of billed items relating to the building services element of the works, negotiating the valuation of variations is problematic.
- Interim or stage payments were not seen as problematic but settling final accounts and setting fee levels were noted to be difficult.

6.4.4.6 Statutory Control

[*8/45, 18/45, 32/45, 36/45.* The characteristics were in top, mid and bottom range of degree of difficulty.]

Summary of additional comments relating to: 'Statutory Control'.

- Application for Planning Permission and Listed Building Consent are not matters for building services consultants and they do not get involved with this aspect of the project. [One respondent cited that building services were rarely an issue.]
- Regulations relating to fire protection requirements are constantly being raised.

6.4.4.7 Site & Materials

[*3/45, 5/45, 7/45, 9/45,10/45, 17/45, 24/45, 28/45, 33/45, 35/45, 37/45, 45/45.* The characteristics were in the top, mid and bottom range of degree of difficulty.]

Summary of additional comments relating to: 'Site & Materials'.

- Generally site access, storage of building materials and plant, site security and materials handling, keeping the site tidy, were perceived to be the domain of the main contractor. Each of these refurbishment characteristics was cited to be difficult in city areas.
- Keeping the site tidy and requirements relating to maintaining existing services should be detailed in the contract documents. The latter characteristic is particularly difficult because there is often an absence of records of existing services and these services can be difficult to trace.
- The supply/matching of materials was deemed to be more difficult when construction programmes were short.
- Articulation of the building services within the building requires a lot of forward planning and, liaison between the structural engineer and the building services engineer is crucial.

6.4.4.8 Contract

[*31/45.* This characteristic was at the 'top end' of the bottom range of degree of difficulty.]

Summary of additional comments relating to: 'Contract'.

- Every contract is difficult and requires experience to produce good documentation. This aspect of the procurement of the work must be addressed well in advance.

6.4.4.9 Overview

In general, the comments supported and affirmed the findings in the pilot study. A review of the comments also revealed the following information.

- Certain respondents had very definite ideas about roles and boundaries of responsibility.

Such comments as *'the contractor's responsibility'*, *'building services consultant relied on heavily'*, *'specialist subcontractor's work'*, *'quantity surveyor's role'*, *'not a matter for the building services consultant'*, *'usually dealt with by architect'*, *'a matter for the building occupier/owner'* were mentioned by participants, in the survey.

- There was a reliance on the contract documentation.

This was exemplified by respondents' comments *viz. 'set out restrictions in contract documents', 'set out details in contract documents'* and *'need special provision in project specification'*.

6.4.5 Additional Characteristics

[Table SUM.1, *Appendix II* refers.]

Respondents were asked to identify any characteristics or 'operational problems', in the construction process of integrating modern building services into listed historic buildings, which had not been stated in the questionnaire instrument.

Essentially, the comments across the disciplines centred on the following:

- access through/within the building for the building services
- provision of adequate space for building services plant
- co-ordination with existing services and articulation of services within the building's structure
- attention to energy conservation
- user-satisfaction
- absence of records about the building
- noise and vibration control

6.4.6 Nil Responses

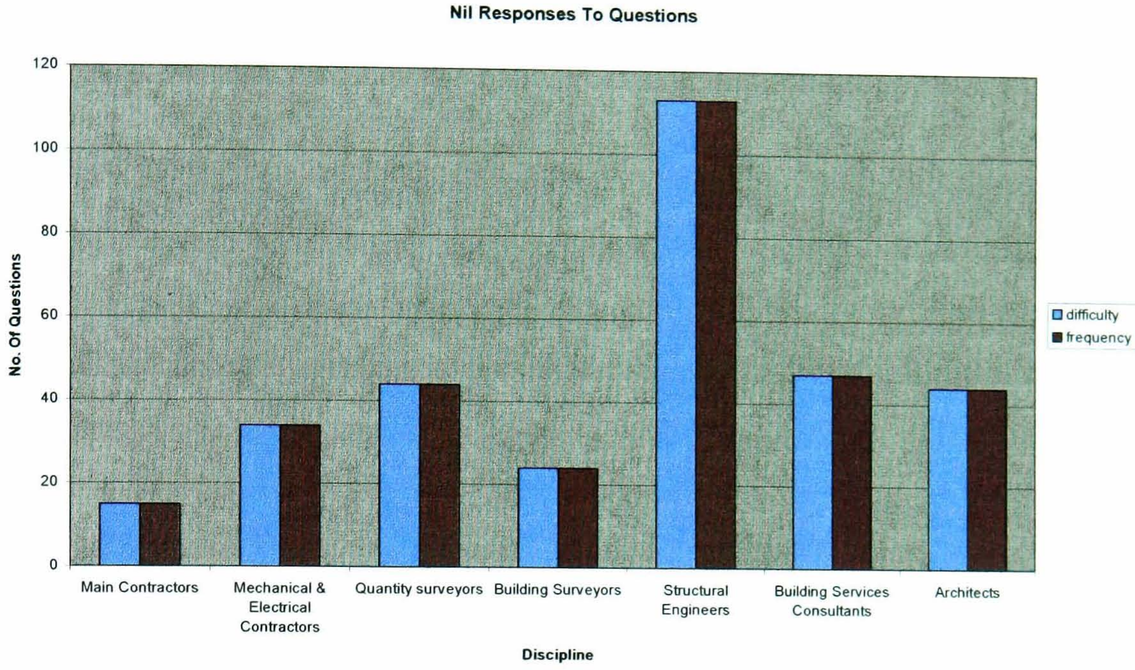
[Tables NR/D1; NR/F1, *Appendix II*, refer.]

When completing the questionnaire, respondents stated that certain characteristics were not encountered within their working experience. In view of this, they were unable to rate a characteristic for 'difficulty' and 'frequency' and their response was recorded as N/A [nil response]. An analysis of these 'nil responses' was undertaken, by discipline, and by refurbishment characteristic category and these results have been recorded in Tables NR/D1 and Table NR/F1, in *Appendix II*. Figure NRDF.6 below shows that the five structural engineers, who took part in the survey, registered more nil responses than any of the other disciplines. This was particularly evident for questions relating to 'Health & Safety'. Only four out of a possible thirty questions [6 questions in the category x 5 respondents] were rated. 'Site & Materials' was another category in which this discipline delivered a low response rate.

By contrast, the main contractors provided a high response rate, making only fifteen nil responses in a total of two hundred and twenty five questions [45 questions x 5 respondents =

225]. The relevance of such data cannot be concluded, with any certainty, but it is suggested that it reaffirms the findings, in par.6.4.4.9 that certain respondents [and from this data, some disciplines] had very definite ideas about the boundaries of responsibility.

Figure NRDF.6 **Distribution Of Nil Responses By Discipline**



6.5 DISCUSSION

The questionnaire provided a useful instrument to elicit data to contribute to the 'whole cloth' or fuller picture, when integrating modern building services into listed historic buildings. By drawing on the opinions of different disciplines, involved in this type of work, it is suggested that study's findings provided realistic material towards building a holistic overview of the nature of the process's characteristics, in terms of difficulty and frequency.

6.5.1 Validity And Representability

Grade I and Grade II* listed buildings represented merely 5.5 % of the listed building stock in the England, in 1994 (English Heritage Monitor, 1995). At the time of the study, the number of chartered building companies, listed by the Chartered Institute of Building, which specialised in refurbishing historic buildings, was six out of a total of two hundred and fifty-two,. Only one company undertook work valued at more than £250,000, a further indication of the very narrow field of the work. These factors help place the study's population sample in context. From the data, in Table 6.1, it evident that those interviewed had had involvement in this specialist area and, as such, were well-placed to make representative and valid answers to the questions.

6.5.2 Difficulties And Limitations

The questionnaire instrument had originally been designed with a view to eliciting data of a quantitative nature. The objective was to search for statistical trends and, also, to provide data to make comparisons with the research findings of Young & Egbu (1993). Due to the revised sampling method this has not been possible.

As respondents completed the questionnaire survey there was evidence of questionnaire fatigue. However, the breaks imposed by *'thinking about additional comments'* contributed to alleviating this problem. Furthermore, participants in the questionnaire found it difficult to make generalisations, without referring to the circumstances in individual projects. Nonetheless, they reflected on each characteristic and duly proffered what they regarded as a realistic judgement. Problems, e.g. central tendency, response set etc., referred to in par.6.2.1.4, were gauged to be minimal due the nature of responses, the attitude and the contribution made by the respondent in the personal appointment, overall.

6.5.3 Propositions From The Findings

Although no attempt has been made to make interpretations based on the quantitative analyses, general propositions founded in the qualitative and quantitative findings are suggested.

- **The process of integrating modern building services into listed historic buildings has its own discrete refurbishment characteristics and these may be some of the most difficult and most frequent.**

- **There is some commonality in the degree of difficulty and frequency of occurrence of the characteristics encountered in the general refurbishment process and integrating modern building services into listed historic buildings.**

Analysis of the coded data and additional comments made by respondents, both supported the proposition that:

- **Some professionals in the construction industry had very definite ideas about the boundaries of roles and responsibilities for the individual members of the project team.**

In conclusion, and mindful of the objective in the research strategy to contribute to the 'whole cloth' paradigm, it is asserted that the findings reported in this chapter have provided useful indicators about the process and the project team.

6.6 RELEVANCE OF THE DATA IN 2002

The data reviewed in this chapter is now seven years old. Review of literature and peer debriefing has provided evidence that, since the data was elicited from the questionnaire survey OBU/J/2, there have been:

- changes in legislation:
    - Health & Safety [Construction, Design & Management Regulations (1994) Health& Safety Commission (1996)]
    - Dispute resolution [Housing Grants, Construction & Regeneration Act (1996); Statutory Instruments (1998) Nos 648 & 649]
    - Energy conservation [Building Regulations, Part L (2002)]
- moves towards forming partnership agreements in procurement strategies (Lamb, 1998; Long & Wheddon, 1998)
- revisions in the terms of engagement for some of the disciplines (Lavers, 1997)
- recommendations to use simple technical solutions, in the building services design, for historic buildings (Bordass, 1994)

Nonetheless, practitioners maintain the characteristics of the process, of integrating modern building services into listed historic buildings, remain the same and the disciplines still encounter the same types of difficulties.

6.7 SUMMARY

Following on from the pilot study [Chapter 4 refers] a questionnaire survey was designed to investigate the degree of difficulty, and frequency of occurrence, of specified refurbishment characteristics. Different disciplines were selected, purposively, and invited to take part in the research study. The data elicited from their responses was analysed to provide the basis for propositions relating to the characteristics of the process of integrating modern building services into listed historic buildings and the project team.

CHAPTER 7

Risk: Likelihood & Acceptability

7.0 INTRODUCTION

The unfolding path of enquiry continues by examining the perceptions of the project team with regard to adverse events when integrating modern building services into listed historic buildings. The objective of this part of the study, as the second part of the questionnaire survey, is to try and fill in a little more of the emerging picture. It seeks to identify possible trends or patterns relating to risk and its management. The data is not robust enough to support detailed statistical analysis, therefore, it is preferable to take the broader view.

7.1 DEFINITIONS

Risk

According to the Norsk Standard (NS 5814) risk designates the danger that undesired events represent for humans, the environment or material values. Risk is expressed in the probability and consequences of the undesired events.

Godfrey (1996) categorises risks in construction in three ways:

- Risk to activity
- Risk to health & safety
- Risk to the environment

Risk Management Strategy

The management of risk is hazard management (Fellows, 1996). The risk will depend on the hazard itself, how it is used, how it is controlled, who is exposed and what is being done (Godfrey 1996). Tweeds (1996) describe a risk management strategy as a framework for managing risk to ensure time, cost and quality targets are met. In addition, risk to health & safety and the environment must also be managed.

7.2 BACKGROUND

Risk analysis and risk management had their origins in the insurance industry in the 1940's. (Raftery, 1994) Risk based decision making and risk perception began to attract considerable interest in environmental protection and environmental risk management in relation to the development of nuclear power in the 1960's. The way people perceive and respond to risk became a focus for study in the early 1980's in the area of environment and health physics. As a result risk communication, which is concerned with the presentation of risk information that is balanced and proportionate, started to become part of the risk management picture (Reid, 1999).

Integrating modern building services into listed historic buildings involves wide ranging expertise and experience from many disciplines and types of contracting organisation. Furthermore, it is a complicated process involving many activities, components and materials. In part, if not in total, the client, designers, managers and operatives will all be coming together, for the first time, to work on a site that is unique requiring its own design and technical solutions. The project team will use varying management styles and display different interpersonal behaviour (Raftery, 1994). All these factors have the potential to impact on the finished result in terms of time, cost and quality and, also, the safe undertaking of the work.

In the final report of the Government /Industry Review 'Constructing the Team' 1994, Sir Michael Latham asserts,

"No construction project is risk free. Risk can be managed, minimised, shared, transferred or accepted. It cannot be ignored."

Clearly from this statement the integration of modern building services into listed historic buildings, as in any other construction project, will involve addressing the issue of risk. Godfrey (1996) recognises that there is a *'cultural gap'* in terms of the approaches to risk management, by the constituent parts of the project team. He states, in relation to effective risk management,

"If real progress is to be made, input is required from all sections of the Construction Industry."

The thrust of this part of the enquiry was to examine the responses of the project team, to gain a holistic overview of their perception of risk, and to identify any risk management strategies used in the course of their work.

7.3 METHODOLOGY

'Risk Management Strategy', 'Likelihood of Occurrence' and 'Acceptability' are sections, contained in Section 4, of the questionnaire survey OBU/J/2 [see *Appendix I*]. This section of the questionnaire instrument was designed to elicit information, from practitioners, relating to 'Risk'. The thirty-five respondents who contributed to the first part of the questionnaire also completed this section. They were five from each of the following categories: architects, building services consultants, quantity surveyors, building surveyors, structural engineers, main contractors and mechanical & electrical contractors.

7.3.1 Risk Management Strategies Used By Interviewees

Respondents were asked whether, in the course of their work, they used any form of risk management strategy. If a risk management strategy was applied, interviewees were asked to give a description of the plan involved and, if not, how they considered the risks when integrating modern building services into listed historic buildings were best managed.

7.3.2 Perception Of Risk By The Project Team

Having asked interviewees about risk management strategy, the next stage of the questionnaire was designed to gain a perspective, on the perception of the project team, with regard to 'likelihood' and the 'acceptability' of specified adverse events in the construction process. 'Likelihood Of Occurrence' and 'Acceptability' tables were compiled, in accordance with the definitions proposed by Godfrey (1994) in his paper, 'The Control Of Risk' delivered to the Seventh Annual Conference, Risk, Management and Procurement in Construction at Kings College, London.

Risk was subdivided into five risk areas: Budget, Programme, Technological, Environment Health & Safety and Conservation. The selected adverse events in the questionnaire were compiled from the findings in the pilot study [Chapter 4] and literature review (Godfrey, 1994).

7.3.2.1 <u>Likelihood Of Occurrence</u>

"Risk is difficult to define and in most cases impossible to measure with any precision. Evaluating risk as part of the decision making process before the event will be concerned with opinions, professional judgements or degrees of belief about the events." (Raftery, 1994)

The 'likelihood' tables, in this study, were devised to gain an insight into the probability of risk. Respondents were asked to make a subjective assessment based upon their knowledge and experience.

7.3.2.2 <u>Acceptability</u>

Given the nature of the construction process, it is not only unrealistic and impractical to eliminate all risks but, also, counter productive. Godfrey (1994) refers to a quote by Rimington (1993)

"We can take it for granted that too much can be paid to avert harms; my thesis is that to pay too much to avert any harm is likely to increase harm in the long run."

Therefore, by their very nature, some risks will be intolerable and unacceptable whilst others will be deemed negligible, acceptable and not appropriate for risk reduction measures. The 'acceptability' tables were devised to gain an insight into the tolerance of risk.

7.4 SUMMARY OF FINDINGS

A detailed analysis of the data was undertaken. When evaluating the manipulated data, it was only sought to identify general and approximate trends. The following summaries are based on the tables in *Appendix III.*

7.4.1 Risk Management Strategy

[Table RMS.1, *Appendix III* refers.]

The majority of respondents stated they used a risk management strategy [63%]. Their strategies ranged from using risk registers and risk questionnaires by a very small minority on the one hand, to experience and intuition by the remaining majority, on the other. Quality plans, opening-up surveys, monitoring design changes, employing appropriately experienced personnel, getting work checked and use of contingencies were specifically identified as risk management strategies. It is worth noting that those respondents that stated they did not use a risk management strategy employed largely the same approach as those that did. These, once again, were principally, experience, checking, contingency, ensuring good communication with all parties and establishing ground rules. The findings of this survey suggest that the risk management process, whether it is deemed strategic or not, is founded, essentially, in established good practice, intuition and experience.

7.4.2 Perception Of Risk: Likelihood And Acceptability

Respondents ranked the likelihood and acceptability of specified adverse events. They selected one from five possible responses: *frequent*, *probable*, *occasional*, *remote* and *improbable*, when considering 'likelihood' and one from four possible responses: *unacceptable, undesirable, acceptable* and *negligible*, when assessing 'acceptability'. Results have been summarised for the five risk areas as follows.

7.4.2.1 Budget

[Tables: LB1; AB1; LA1, *Appendix III*, refer.]

The likelihood and acceptability of the client or contractor becoming bankrupt were perceived by the vast majority of respondents to be remote and unacceptable. Opinion regarding claims by contractors was spread across all probabilities, from frequent to remote, with no clear majority decision. Most respondents considered it was frequent or probable that the whole contingency sum would be consumed and that this was acceptable, providing the risk was managed. There was no evidence to suggest contractors and consultants held markedly different opinions. The following summarises additional comments made by respondents in relation to budget risk.

- Bankruptcy is more frequent when the Construction Industry is in recession.
- Some contractors safeguard themselves by investigating all private clients and obtaining credit references.
- Consultants frequently take clients at face value but carry out a financial assessment on contractors.
- Main contractors take risks to make money.
- Grey areas in design and unknown factors in the building's construction lead to claims and damages.
- Finding asbestos in the building is a common cause for claims.
- The contingency sum is frequently consumed and more so when the budget for the project is low.

7.4.2.2 Programme

[Tables: LP1; AP1; LA1, *Appendix III*, refer.]

The opinion relating to *'Complete programme reorganisation'* was widespread, responses ranging from probable to remote. The contractors interviewed, perceived this adverse event to be more likely than consultants. Over half of those interviewed, deemed *'Completion date over run'* to be frequent or probable. The majority of respondents considered *'Disruption to other trades'* and '*Minor hold ups*' frequent, probable and acceptable [providing the risk was managed]. The following summarises additional comments made by respondents, in relation to programme risk.

- Complete programme reorganisation occurs particularly in refurbishment projects.
- Unforeseen problems are a common occurrence in refurbishment. Contractors must devise realistic construction programmes with this in mind.

- '*Minor hold-ups*' are more likely to be in the architectural work than in the building services installation.
- '*Disruption to other trades*' and '*Down time of plant*' are problems for the contractor to deal with.

7.4.2.3 Technological

[Tables: LT1; AT1; LA1, *Appendix III*, refer.]

Most respondents considered that the *'Structural integrity of the building being undermined'* was remote/improbable and unacceptable. The range of responses for '*Quality standards not met'*; *'Latent defects'*; *'Abortive works'*; *'Materials/skills not available'*; 'Superficial damage to the building fabric' and *'Minor damage/problems that can await repair'* were more widespread. The latter two were perceived to be more probable and also more acceptable than the others. Overall, contractors and consultants were similar in their opinions, excepting *'Quality standards not met'*. In this case contractors, in the main, were far more optimistic deeming this possibility to be more remote or improbable. The following summarises additional comments made by respondents, in relation to technological risk.

- Maintaining the structural integrity of the building overrides the building services requirements.
- Selecting the right contractor for the project contributes to reducing risk and also helps eliminate problems relating to resources and skills.
- Quality varies, from job to job, but careful monitoring and adequate inspection substantially reduce quality problems.
- Most commonly, quality standards are not met in the building's finishes.

7.4.2.4 Environmental/Health & Safety

[Tables: LEHS1; AEHS1; LA1, *Appendix III*, refer.]

Major disasters [e.g. *'Death'*, *'Serious pollution hazard'*] were deemed to be improbable and unacceptable. Less serious events [e.g. *'Injury requiring first aid'*] were considered to be less improbable and although, generally recognised as undesirable, were considered by some interviewees to be acceptable, providing the risk was managed. Consultants and contractors showed no observable difference of opinion.

The following summarises additional comments made by respondents, in relation to environmental and health & safety risk.

- Construction, Design and Management Regulations (1994) can help reduce adverse events.
- Welfare on site is the responsibility of the contractor, as a rule.

7.4.2.5 Conservation

[Tables: LC1; AC1; LA1, *Appendix III*, refer.]

The perception of likelihood and acceptability of these adverse events followed a similar pattern to those in the previous risk areas. Essentially, more catastrophic events were perceived to be less probable and less acceptable. *'Significant loss of historic fabric'*, *'Intervention which is not reversible'* and *'Aesthetic drawback'* were, almost unanimously, considered to be improbable and unacceptable or undesirable. By contrast, approximately a third of interviewees deemed *'Minor superficial damage to the building'* to be occasional and acceptable, providing the risk was managed.

Responses were slightly more wide ranging for consultants than contractors.

The following summarises additional comments made by respondents in relation to conservation risk.

- Intervention, which is not reversible, occasionally happens but usually to elements of minor importance.

7.4.3 Risk And The Role Of The Disciplines

[Table AR/AC1, *Appendix III*, refers.]

As a result of the findings, from the pretest of the questionnaire, it became apparent that the acceptability of adverse events could be considered in two ways.

(a) If a practitioner considered risk management was part of his/her role, within the project team, a response could be made in respect of: *'the acceptability of taking the risk that an adverse event might occur'*.

(b) If a practitioner considered risk management was *not* part of his/her role, within the project team, a response could be made in respect of: *'the acceptability of the consequence of the adverse event occurring'*.

In view of this, respondents could elect to rank their acceptability of the specified adverse events based on (a) or (b). Evidence in the acceptability tables showed there was no obvious difference in judgements, regarding tolerance, whether ranking acceptability on the basis of (a) or (b).

Some disciplines did, however, fall into different camps when electing to respond on the basis of (a) or (b). The data suggests architects and main contractors, for the most part, considered risk management to be within the scope of their role *across the board*, whilst structural engineers did not. Building services consultants, mechanical & electrical contractors, building surveyors and quantity surveyors were almost equally mixed in their response.

7.5 DISCUSSION

Having reported the findings of Section 4, Questionnaire survey, OBU/J/2, validity must now be questioned. Almost every project is a prototype (Bingham, 1994) and people's beliefs and opinions are different. Raftery (1994); Flanagan & Norman (1993) identify that bias, will inevitably have been introduced into responses, to some extent, for the following reasons:

- recent experiences dominate memory recall
- respondents may have difficulty in making a generalisation or constructing a mental model of what is representative – projects are rarely the same
- respondents will have differing risk attitudes (utility) due to their personality, experience and profession
- professionals are prone to overconfidence and metacognition (self-knowledge)
- low probabilities have a tendency to be overestimated
- group effect: a group sharing the same risky situation even more easily accepts such risk activities (Osei, Amon & Schandorf, 1997)

However, these biased opinions and inconsistency are a resource (Raftery, 1994). They form part of the picture of integrating modern building services into listed historic buildings. On this basis, it is proposed that the reported findings, relating to risk, provide an informed multidisciplinary overview. Their value is not in the precision of the facts but,

(a) their contribution to a wider understanding of the project and project team
(b) the questions that they raise.

7.5.1 Generalisations And Questions

Having examined and reported the data, relating to risk, generalisations will now be proposed and discussed.

- **Experience, intuition, checking and established good practice largely form the basis for managing risk when integrating modern building services into listed historic buildings.**

Only a small proportion of interviewees used regularly updated risk registers and risk questionnaires, others seemed unaware of their existence. Some practitioners bemoaned the additional time and cost involved in managing risk, using these tools. [Competitive fees and reimbursement for professional services were identified as frequently being difficult. {Chapter 6 refers}]. One respondent remarked, *'Who has time for this when the client is on the phone?'* Even so, Thompson (1993) suggests,

"Willingness to invest in anticipating risk is a test of the client's wish for a successful project."

Godfrey (1994) recommends the use of systematic risk management arguing,

"Intuitive resources tend to be resource-effective but not always efficient."

It is beyond the scope of this study to comment on the efficacy of the 'experience, intuition and good practice' risk management approach, used when integrating modern building services into listed historic buildings, but it does pose the following question:

Given time and cost constraints, how are clients and constituent members of the project team to be persuaded to examine their existing risk management approach and be made aware of the potential benefits of using systematic risk management?

- **Management of risk, whether deemed strategic or not, adhered to no common framework.**

People's perceptions are very much modified by the availability of information and the subjective characters of the individuals. Godfrey (1996) identifies people as being the most unpredictable hazard and lack of communication, usually, the biggest hazard of all. In view of this, the following question must be considered.

When integrating modern building services into listed historic buildings should:

(a) a common framework be devised for risk management?

(b) a risk culture be developed, common to the nature of the work?

- **Certain disciplines viewed risk, and its management, to be more within the scope of their role than others.**

Flanagan & Norman (1993) state that certain disciplines will be subjected to high or low risk exposure due to the nature of their role in the project, e.g. main contractors and architects are subject to 'high risk exposure'; engineers subject to 'low risk exposure'. In effective risk management, risk should be allocated to the parties best able to manage it. Furthermore, deciding who owns the risk is sometimes difficult. Individuals who are not practised at making risk related decisions often lose the ability to make good judgements about risk (Flanagan & Norman, 1993). The findings of this study confirm that risk, and its management, are perceived to be more within the role of certain disciplines than others, namely architects and main contractors. Furthermore, members of the building team will build up their risk management strategies to protect their own business. This begs the following question:

*Given that certain members of the project team will be more exposed to risk, more practised at making risk related decisions and take more responsibility for risk and its management how best can a **holistic** and **interactive** approach to risk management be achieved?*

- **Generally, catastrophic events were perceived to be remote and unacceptable whilst less threatening events were deemed more frequent and more acceptable.**

Identifying tolerance levels and the assessment of low probabilities is particularly precarious. A realistic tolerance to less threatening events may be distorted for the following reasons:

- underestimation of the incidence of the mundane
- cultural mores
- risks may be taken, with little idea of their magnitude, because the activity is believed to be within control of the individual's environment and safety (Osei *et al.*, 1997)

The above factors have the potential to push events below the threshold for concern. On the other hand, familiarity may cause individuals to exaggerate the probability of commonly encountered events. To compound this, construction activities are rarely mutually exclusive and a marginal risk may give rise to a serious or series of consequential secondary risks and/or indirect costs (Tweeds, 1996; Fellows, 1996; Godfrey, 1996). Over analysis in risk identification and assessment have the potential to create a misleading sense of security, weary the risk management team and be counterproductive in terms of time and cost. This raises the question:

When managing marginal risks should the greater emphasis be placed on deepening awareness and ensuring good communication?

7.6 RELEVANCE OF THE DATA IN 2002

Prolonged involvement and interaction with practitioners who have knowledge of recently completed projects, as well as those in progress, provided abundant evidence that projects are still frequently over budget, run beyond the date of completion and experience considerable problems integrating modern building services into the existing historic building structure. Risk assessment and risk management continue to be founded in experience and intuition with some

formalised processes [risk registers and risk questionnaires]. Whilst it is evident that practitioners are developing procedures, to manage risks more effectively, Faber Maunsell observe they are generally tailored to minimise risks, to their own organisation. The PII project, 'Allocation & Management of Project Risk' [led by Faber Maunsell] was aimed at managing total project risk,
"To provide building services engineers with the basic information and tools to more effectively apply risk management procedures to their work."
As a result of this research initiative, the Department of Trade and Industry produced a document to aid the way risk is managed in the building services element of construction projects (DTI, 2002). The reported findings in this chapter and the propositions they generate have been based on data elicited from seven different disciplines and contribute points that should be evaluated when looking at the wider *total project risk* picture, when integrating modern building services into listed historic buildings.

7.7 OVERVIEW & RECOMMENDATIONS

Experience and intuition frequently underpin practitioners' decision making when managing risks within the project. Different team members will own and manage different risks, in different ways. Good communication continues to be identified, as essential. Based on the reported findings in this chapter, as a possible solution to the questions raised in par.7.5.1, it is suggested that further research might explore the feasibility of developing a common risk management framework for the refurbishment of listed historic buildings. It is proposed that its design should focus upon:

- clearly defined and workable communication channels
- balanced and proportionate understanding of risk

It is envisaged that adopting a common risk management framework could confer benefit by:

- interrelating different risk management strategies through a standardised infrastructure
- encouraging a collective risk style and cultivating a risk culture, appropriate to the nature of the work
- tutoring the uninitiated, including the client, through common practice
- improving risk communication between members of the building team who have different expertise and different professional objectives.
- establishing equitable approaches to risk sharing

- forging well trodden communication pathways that can be replicated, from project to project, and recognised by all the project team
- deepening an understanding of the impact of marginal risks and their interdependencies
- clarifying and publicising responsibilities to all the project team

It is suggested that the common risk management framework should adopt a standard but flexible system to embrace the foregoing objectives. In summary, it is proposed that such an instrument would make a positive contribution to risk management for project process of integrating modern building services into listed historic buildings.

7.8 SUMMARY

Respondents were more consistent in their perception of the likelihood and acceptability of the occurrence of catastrophic adverse events, in budget, programme, technology, environment/ health & safety and conservation, than those that can be regarded as less catastrophic adverse events. Methods of risk management were variable. As a result of these findings, exploring the feasibility of a common risk management framework for the refurbishment of listed historic buildings has been recommended as an area worthy of further research. Godfrey (1996) identifies the importance of focusing on success stating,

"Ascertain what needs to happen to judge your project a success and examine what important issues might threaten that success."

Key factors relating to success and problems, when integrating modern building services into listed historic buildings, form part of the next stage of the enquiry. These are discussed in Chapter 8.

CHAPTER 8

Aids And Threats To Success

8.0 INTRODUCTION

A multidisciplinary perspective on the frequency and difficulty of refurbishment characteristics, and the likelihood and acceptability of risk, when integrating modern building services into listed historic buildings, has been reported and discussed in Chapters 6 and 7. The investigation drew on the resource of experience and expertise held by practitioners, in building conservation projects. The next stage of the investigation continues by discovering the opinions, of the project team, regarding factors that contribute to the successful outcome of the project and factors that may threaten that success.

8.1 BACKGROUND

Godfrey (1996) identified the importance of focusing on factors that contribute to the success of the project [and how such success might be threatened] as an aid to determining a risk management strategy. The Construction Best Practice Programme funded by the DETR [Department of Environment and Transport and the Regions] strives to improve business and management practices in the Construction Industry. Any model, practice or factors identified by practitioners, which aids successful project performance makes a valuable contribution to the pool of knowledge for improving the efficiency of the Construction Industry and ultimately, value for money for the client. Historic buildings form part of the Nation's Heritage and this presents a special responsibility to those who are involved in its conservation. A key aim must be to safely conserve the building, its ethos and its fabric. The findings of this study sought to identify '*success factors*' that were conducive to good management practice, procuring satisfactory workmanship and materials, providing value for money and meeting building conservation objectives.

8.2 METHODOLOGY

Thirty-five interviews were conducted to discover what the project team considered were key factors, in the successful integration of modern building services into listed historic buildings, as part of the refurbishment and building conservation process. Directly after the questionnaire OBU/J/2 was completed, an open-ended interview was conducted with the same respondent. The

discussion that took place had no prescribed structure. The interviewer refrained from making prompts and no specific aspects of the project and /or processes were mentioned to the interviewee. Each interview was timed to last approximately ten minutes. Participants were asked to identify what, *in their experience*, contributed to success and how that success might be threatened. They were also invited to make any comments they considered made a contribution, to the wider picture of the whole process, but were not necessarily attributed to success or problems. A content analysis for thirty-five interviews was undertaken and the data was compiled under the same categories that were devised for the questionnaire, namely: Programme; Skills, Working Hours & Working Methods; Liaison & Communication; Health & Safety; Budget & Financial Matters; Statutory Control; Site & Materials and Contract.
Each of these categories was subdivided into three sections:

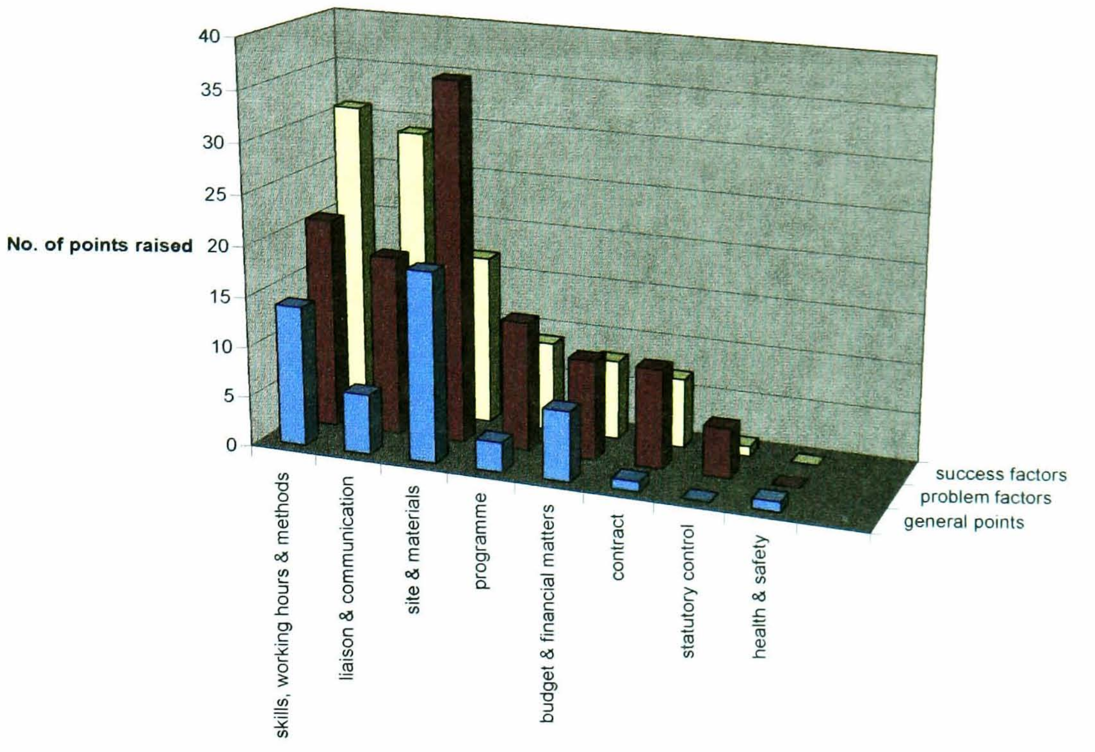
- success factors
- problem factors
- general points

For the purpose of this part of the study, success factors, problem factors and general points were defined as key points. Success factors, problem factors and general points were recorded in the relevant subsection of each category. A full content analysis of the interviews is contained in *Appendix IV*.

8.3 SUMMARY OF FINDINGS

Key points, identified by the interviewees, were counted and classified in the most appropriate category. From the content analysis of the interviews, it became apparent that different categories, and certain subsections, contained more key points than others. In order to illustrate this, graphically, the categories, i.e. Programme; Skills, Working Hours & Working Methods etc., were then placed in descending order, based on the number of success factors identified for their respective 'success factor' subsection. A graphical presentation of the distribution of the key points identified by interviewees is shown in Figure KP1.

Figure KP1 **Key Points Identified At Interview**



Project category

A summary of the findings, for each of the categories [Programme; Skills, Working Hours & Working Methods etc.] now follows based on the full content analysis, detailed in *Appendix IV*.

8.3.1 Skills, Working Hours & Working Methods

<u>Success Factors</u>

The multidisciplinary project team must be experienced in the field of work, have a clear understanding of what is involved in the process and be sensitive to the constraints imposed by historic buildings. A genuine interest in old buildings is important. The design should be kept as simple as possible, sympathetic to the building, economic and visually acceptable. It must be centred on the existing construction to avoid modifications to the fabric and structure. Designers should be open to alternative and innovative solutions. An adequate level of control is crucial to ensure standards of quality are met. The selection of the right workforce [subcontract or direct labour] is paramount.

Problem Factors

Technical knowledge is variable. Different disciplines display different approaches and there is a dearth of specialist courses, for all the project team, in this area of building conservation. Many of the complications and problems present themselves once the contractor takes possession of the site, particularly relating to: working drawings, the conflict between conservation objectives & functionality and solving problems independently.

General Points

Building conservation is a complex and challenging process, requiring sound technical knowledge, appropriate skills and special care.

8.3.2 Liaison & Communication

Success Factors

The team dynamic[1] and interrelationship between the members of the project team plays a crucial part in liaison and communication. Good working relationships must be cultivated form the inception of the project and facilitated by proactive leadership. Mutual trust, a clear understanding of the roles, needs and objectives of the respective team members, information flow and a common work ethic must be established and reinforced by regular and structured interaction within the whole team.

Problem Factors

Lack of information, lack of clarity and insufficient comprehension of the documentation create difficulties. Self-seeking attitudes, personality clashes, mistrust, procrastination [especially in decision making] impasse and diminished goodwill are also detrimental.

General Points

The quality of documentation, working relationships and communication require careful attention, when integrating modern building services into listed historic buildings.

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[1] Team dynamic: *The forces of personality, ambition, energy & new ideas* (Collins English Dictionary, 1992).

8.3.3 Site & Materials

Success Factors

Thorough investigation of the building, using nondisruptive investigative survey techniques and researching archive material, is essential in the *early* stages of the project. The sizing and siting of pipes, cables, ducts and building services plant must co-ordinate with the building structure, adopt the 'simple approach', where possible, and have minimal impact on the building fabric and visual amenity. If the design is conceptual or based on performance criteria, vigilant quality control must be employed *on site*.

Problem Factors

Historic buildings were not designed with building services, in mind. and impose severe spatial and structural constraints on any design solution. Unknown factors in the building's construction and lack of records relating to the original, alterations and maintenance often necessitate educated guess work. Protecting the existing building, stripping out existing building services and their disposal can be difficult. Furthermore, the interface between new and remaining systems can be problematic.

General Points

Building services are a growth area, *viz.*: fire protection, security, controlled environments and Information Technology. Examining alternative approaches and innovation are beneficial when seeking an optimal solution.

8.3.4 Programme

Success Factors

A strategic and holistic approach to planning and programming is required, allocating adequate time for procurement periods and making adequate time allowances for arising problems and their associated knock-on effects. Variations must be dealt with promptly, mindful of their impact on the construction programme.

Problem Factors

Changes in the client's and/or consultants' requirements disrupt the construction programme. Poorly thought-out or impractically short contract periods lead to time overruns. Insufficient time, in the precontract phase [traditional procurement] spent on planning, inspection and investigation results in more technical queries and programme hold-ups, in the post contract phase.

General Points

Usually, refurbishment in listed historic buildings takes longer than general refurbishment or new build.

8.3.5 Budget & Financial Matters

Success Factors

Successful financial management is aided by providing timely cost estimates, schedules of rates and realistic contingencies. Submitted tenders and the financial standing of tenderers should be carefully checked. A budget must be allocated for a thorough investigation and survey of the building. The objectives of the project team should not merely focus on financial reward.

Problem Factors

Inadequate information and/or time create difficulties for the parties bidding for work, consultants, contractors and suppliers. The building services solution is often suppressed by financial constraints.

General Points

The building services element, in building conservation, often represents a high proportion of the contract sum. Large provisional sums and contingency sums are commonplace.

8.3.6 Contract

Success Factors

The tender documentation must convey as much information, as possible. The type of contract employed must be carefully structured and appropriate to the nature of the work. Preferred specialist subcontractors should be named in the contract documents.

Problem Factors

Lines of responsibility and design information are frequently 'grey areas' at the tender stage. Contractors do not always read the preliminaries.

General Points

Competitive tendering does not always lead to good quality work and value for money.

8.3.7 Statutory Control

Success Factors

Issues arising from Statutory Control should be addressed and resolved, if necessary, early in the project.

Problem Factors

Conflict between conservation objectives and fire protection requirements may arise. Furthermore, there is an absence of feedback on proposals and drawings by statutory officials.

8.3.8 Health & Safety

General Points

Health & Safety is a key issue in this type of work, requiring continued and regular risk assessment.

8.4 ANALYSIS

Cooke-Davies (1998) identified the measurement of success as a '*daunting hurdle*' and a '*complex topic*' due to the different objectives of the stakeholders[1] in a project, their individual success criteria and respective levels of importance. In the interviews, aids to success [success factors] and threats to the successful outcome of a project [problem factors] were readily identified by different stakeholders but it was beyond the scope of this study to assign any level of importance to any particular criterion.

8.4.1 Validity And Representativeness

The findings provided a pragmatic insight into the project, and its processes, and made contribution to the 'whole picture'. However, when categorising the data the following factors were recognised:

- Interviewees only discussed the points *they* considered were aids or threats to success

[1] Stakeholder: *A person who holds an interest in something, often financial* (Collins English Dictionary, 1992).

- Some of the points raised overlapped into other categories, e.g. a point could be assigned to either 'Liaison & Communication' or 'Statutory Control'
- More than one interviewee made the same general point
- Confidentiality may have restricted the interviewee from discussing certain factors [e.g. financial or contractual points]

8.4.2 Success And Problems

The majority of points fell into the categories of 'Skills, Working Hours & Working Methods', 'Liaison & Communication' and 'Site & Materials' [see Figure KP1]. Although, it could not be concluded that these were always the most prolific categories relating to success, the data provided ample evidence to support the proposition:

- **When integrating modern building services into listed historic buildings the following factors contributed to the successful outcome of the project.**

  ✓ a strategic and holistic approach
  ✓ knowledge and understanding of historic buildings
  ✓ suitably skilled and experienced personnel
  ✓ adequate and timely information
  ✓ simple, alternative and innovative design solutions
  ✓ sufficient levels of supervision and organisation
  ✓ good communication and fruitful liaison
  ✓ positive and interactive working relationships
  ✓ well thought-out project /construction programmes
  ✓ realistic financial resources
  ✓ approriate contracts and tender documentation

The data also illustrated, however, that problems still occurred for the following reasons:-

- technical knowledge was variable
- information was often unavailable, insufficient or unknown
- mistrust, personality clashes, impasse and procrastination existed
- problems were solved independently
- time overruns were commonplace

- the minimal amount of time was allocated to the project before the contractor took possession of the site
- inadequate financial resources were dedicated to the project, early on
- project documentation was not always clear, carefully read, understood or to hand

8.4.3 A General Observation

The data also revealed that integrating modern building services into listed historic buildings was a complex, challenging and often major element in heritage refurbishment.

8.5 DISCUSSION

The interviews provided evidence that the project team were aware of the factors that contribute to the successful outcome of a project but, in spite of this, difficulties still existed to threaten that success. It is reasonable to say, threats to success were not generally founded in ignorance of the issues involved but arose largely from factors relating to resources, procurement and organisation. These will now be briefly discussed.

8.5.1 Skills Resources

The need for the building team to be suitably skilled and experienced was cited as a requirement for the successful outcome of a project [par. 8.4.2] but the fact that technical skills were variable, was also identified as a problem.

Training

Torrence (1992) proposed the future success in training would lie in commonality and breaching the traditional boundaries of architecture, structural engineering, building services engineering and surveying. The findings reported in this study supported his argument. It was identified that problems were caused because individual disciplines adopted different approaches. This is not helped by the dearth of specialist courses, for *all* the project team.

An enquiry conducted by Steel (1996) into the supply of engineering services for the repair and maintenance of historic buildings has reported preliminary findings relating to electrical building services. The report provided evidence that some firms found it necessary to give additional training for personnel undertaking historic structures contracts.

Availability

The supply of construction services for the repair and maintenance of historic buildings was investigated in 1994. Drewer (1995) identified that only one third, from a sample of one hundred and eighteen firms involved in this area of work, reported they rarely had difficulty in recruiting skilled staff. In addition, the majority of these firms felt it was either unlikely to improve or would become worse in the five years leading to the year, 2000. No projection was made after that date. Albeit, based on limited evidence, it is suggested that skills resources and training are an issue in building conservation work. Furthermore, it is proposed that educational courses in this area, their design and their content could also benefit from review.

8.5.2 Financial Resources

Davey (1992) claims,

"A contract which can be properly priced, which gives the best value for money to the client and which protects the legitimate interests of the contractor and the client will often proceed smoothly with mutual satisfaction all round."

Based on the data elicited at interview it is suggested that this is not an objective that was easily achieved. The evidence of this study highlighted incomplete design of the building services element of the job created difficulties when bidding for the work. Furthermore, Kay, (1992) argues,

"Competitively achieved pricing can so easily be lost if the design process continues during construction."

Consultants' fees and financial constraints were also problems cited by interviewees [see *Appendix IV*, Budget & Financial Matters]. Chevin & Barrick (1995) recognised the worrying difficulty, experienced by architectural practices trying to reconcile required levels of professional services with sustainable profit margins. This has served to compound the problem. It is suggested, from the findings of this study, that the client and project team should thoroughly discuss and think through the allocation financial resources, in both the design phase and construction phase, at the inception of the project.

8.5.3 Time Resources

A flexible and holistic approach to planning was noted in both literature review (Davey, 1992; Feilden, 1994) and at interview, as an effective way of dealing with the problems commonly encountered in practice, e.g. changes in requirements, technical queries in the construction phase and the unforeseen [par 8.4.2].

Feilden (1994) also proposed that completion dates should be decided with the inclusion of a time contingency factor. Unfortunately, the data suggested translating this ideal into reality, was not always possible. Interviewed practitioners, stated that required contract periods were sometimes too short and resulted in time overruns. It is beyond the scope of this study to establish whether inadequate time was the sole root of the problem. However, it is suggested, that the benefits of skilful planning and programming were undermined when unrealistically short contract periods were demanded. Furthermore, it is proposed that methods of communication and organisation should also be examined to throw further light on this problem.

8.5.4 Procurement And Organisation

Interviewees described the integration of modern building services into listed historic buildings as a complex, challenging and often major element in historic refurbishment [par.8.4.3]. Mr. James Nesbit referred to the complicated nature and organisation of the design process [albeit for the mechanical and electrical content of work in the field of construction, as a whole] in his submission to the Final Report of the Government/Industry Review 'Constructing the Team' (Latham, 1994). He concluded that commonly adopted design and contractual arrangements led to *'difficulties and animosity in the management of cost and the administration of contract conditions'*. Furthermore, Parsloe (1997) reported that problems integrating the mechanical and electrical specialist's design created two main sources of conflict, on site: firstly, additional work incurred in planning and agreeing new routes and secondly, the allocation of practical and financial responsibility for such work. It is suggested from the findings at interview, that the design process and subsequent installation of modern buildings services, into historic buildings, were dogged with these same problems. It was also evident, from the data, practitioners were aware of the technical problems presented by their work and were duly familiar with methods of resolving them. Gosnell (1999) suggested that technical claims were not at the root of most problems. He held they were due to *'dissatisfaction with the approach or method'*. The benefits of the multidisciplinary approach, and teamwork, have been extolled by Latham (1994); Egan (1998); Feilden (1994); Davey (1992) - likewise, the interviewees. Mindful of this, however, difficulties in working relationships and communication were still identified as stumbling blocks, in this study. Based on the foregoing, it is suggested that the composition and organisation of the project team and its approach to procurement, working methods, working relationships and establishing good communication should be a key focus at the inception of the historic building refurbishment project.

8.6 RELEVANCE OF THE DATA IN 2002

The propositions in this chapter were generated from data collected in 1995. Their relevance in 2002 must therefore be questioned. Drewer (1995) identified Oxford, as one of four key markets for construction services in the maintenance and repair of historic buildings in the United Kingdom. On this basis, it is suggested, that a major client organisation and custodian of historic buildings in Oxford was well positioned to provide a representative overview for the current day. An interview was conducted in March, 2002. Its findings revealed that, taking 1995 as a reference point, procurement routes and project organisation essentially, still adopted the same approach. Problems surrounding budget, the quality of the end product, user- satisfaction, timely completion, procurement of skills [contractors and consultants] statutory control, project organisation, team relationships and contract were viewed to have not changed and/or improved although the situation relating to health and safety was marginally better. It is suggested, from these findings, that the data elicited in 1995 continues to provide a valuable and relevant insight into the process of integrating modern building services into listed historic buildings.

8.7 OVERVIEW AND RECOMMENDATIONS

Data elicited, at interview, has been reported, analysed and discussed. The findings related in this chapter supported the following proposition:

- **When integrating modern building services into listed historic buildings, the meeting of time, cost, quality and building conservation objectives is inextricably linked with the composition of the project team and how it organises and manages itself.**

In addition the data supported the following recommendations:

- o Time and cost parameters must be questioned and established realistically
- o Adequate training must be provided for consultants, contractors, craftsmen, operatives and any other personnel involved in heritage refurbishment
- o A key focus must be placed on the composition of the project team and how it communicates, co-ordinates and, also, facilitates positive team relationships

8.8 SUMMARY

An insight into the factors that contribute to, or threaten, the successful outcome of the process of integrating modern building services into listed historic buildings has been gained. Areas for review have been identified and propositions suggested. Investigation into project organisation, and the realisation of project objectives, formed the next stage of enquiry and the findings are reported in the following chapter.

CHAPTER 9

3 Case Studies: A Critique Of The Project Process

9.0 INTRODUCTION

In the study, so far, data has been drawn from the opinions of different members of the project team involved in building conservation. These opinions were based on the practitioners' professional working experience, generally. The unfolding path of enquiry now continues by an investigation into the facts surrounding three individual projects.

9.1 BACKGROUND

In the Report of The Construction Task Force 'Rethinking Construction', Egan (1998) claims *"The process of construction is repeated in its essentials from project to project.....much repair and maintenance work also uses a repeat process."*

Relating to the integration of modern building services into listed historic buildings, the research study now sought to throw light on two factors, *viz.*

- what, if any, could be regarded as repetitive essentials in the process
- what were the lessons to be learned from previous projects.

Behind the belief, held by Egan (1998) that the Construction Industry could improve its performance and products, by '*integrating the process and team around the product*', was the premise that the integrated project process must first be defined, in order for the process to be easily understood by the participants and their clients. In view of this, case studies were reviewed to ascertain how best the process for integrating modern building services into listed historic buildings might be defined.

9.2 METHODOLOGY

The case study approach was the chosen research methodology, in the last lap of this enquiry, for the following reasons. It was deemed to offer a research framework that:

(i) identified any repetitive characteristics in the process that might exist, from project to project

(ii) could gain further insight into factors contributing to problems and success relating to the project process

(iii) provide a vehicle from which propositions could be generated relating to the process.

9.2.1 Multiple Case Design

The design for the case study research methodology was based on the writings of Yin (1994). For the purposes of this enquiry, it was considered the multiple, rather than the single, case study approach provided a more robust methodology. Yin (1994) refers to a quotation made by Herriot & Firestone (1983) who stated,

"The evidence from multiple cases is often considered more compelling."

The multiple case design [three case studies] was both descriptive and exploratory. It was intended that the data would make a useful contribution to:

- understanding the process
- the body of knowledge available about the process.

In each case the sources of data were:

a) focused interviews, containing open-ended questions, with the client's representative and members of the project team
b) site visits
c) available documentary evidence.

9.2.2 Choice Of Case Studies

The subject of each case study was a listed historic building that was originally constructed as a house for residential accommodation. The properties had been recently refurbished, or were nearing completion, at the start of the research enquiry. The former use of these houses had changed from private residential accommodation to one of a commercial nature.

9.2.3 Case Study Protocol

Yin (1994) describes the case study protocol as a major tactic in increasing the reliability of case study research. The protocol, used to conduct the research gathering process, is now outlined.

9.2.3.1 Preliminary Work

The case study protocol requires that two areas of preliminary work precede data collection. Case studies must be chosen using appropriate selection criteria. Units of study must be devised for gathering data [these are usually based on the findings gleaned from a pilot enquiry].

- *Case study selection*

Case studies were selected on the basis of four key criteria:

1. *The building*: pre 1900, listed and recently refurbished (or nearing completion at the start of the case study enquiry) with the integration of modern building services, a major component of the works.
2. *Locality*: Oxfordshire
3. *The client and project team*: different organisations and individuals for each case study
4. *Sample population*: no party was to have contributed to the research undertaken in the study so far.

Criteria (1) and (2) set the parameters in terms of the product. Criterion (3) was a variable factor - the client and the composition of the project team. Criterion (4) was included to avoid the introduction of bias, on the part of the researcher, through former acquaintance with individuals comprising the project team and familiarity with their approach to building conservation. Furthermore, it was undesirable that any member of the project team had made prior input into the study, lest it should colour or affect their judgement when contributing to the case study research.

- *Pilot enquiry*

No specific pilot enquiry was undertaken. The nature of this study '*an unfolding path of enquiry*' dictated flexibility, within the structure of the case study design. For this purpose, it was decided that the findings of the questionnaires [Chapter 6 and 7] and the interviews [Chapter 8] served as the best basis for devising the units of study and research questions.

9.2.3.2 Procedures

Once preliminary work is completed the case study procedure can be devised. This research study included the following:

- *Scheduling the site visits*

Visits to the site were arranged, once at the beginning of the case study enquiry and, for a second time, towards the completion of the data collection. This provided an opportunity to collect any empirical evidence that had been overlooked or had come to light through out the duration of the investigation and gave the opportunity to review the data to ensure that misinterpretation had been avoided.

- *Persons to be interviewed*

Individuals representing the client organisation, consultants, contractors and external bodies who were involved in the project were interviewed either on site, or in their place of work.

- *Other sources of information*

Briefing documents or construction drawings, that were available and free to inspection, were sought as supporting evidence whenever possible.

9.2.3.3 Questions To Be Answered Through The Research Instrument

The following topics, and questions, were selected for case study enquiry:

- *Background information to set the scene*

  Question: What, when, how and who? [i.e. Details relating to the building, client, project brief, design, procurement route, project team and process co-ordination.]

- *Project review*

  The project was reviewed under three headings.

  Question: What were the major challenges in the project? What were the principal successes in the project? What were the significant problems in the project?

- *Key points*

  Question: The research question sought to identify key points. These points were generated through discussion in the focused interview.

9.3 SUMMARY OF FINDINGS

The full case narratives are annexed in *Appendix V.* To avoid duplication and wearying the reader, this chapter has been restricted to an overview of the data that identified repetitive essentials, lessons to be learned and provided guidance for defining the project process. Case studies were selected at random but fulfilled the criteria in par.9.2.2. In order to protect the case, and its participants, such information has not been stated. It was feared that disclosure of names and places would inhibit or restrict the input, by the case study participants. Yin (1994) proposes that anonymity eliminates important background for the case study. However, people names and place names were not seen as making a major contribution to the case study data, in this research, and no need was identified to assign fictitious names or places, for the purpose of the case study narrative and analysis.

9.3.1 Analysis

Multiple sources [site visits, focused interviews, conducted with the members of the project team and documentary evidence] yielded data. Yin (1994) argues that case studies, using multiple sources of evidence are rated more highly than those that relying on a single source. In light of this assertion, it is suggested that the findings of this study provided compelling evidence. During the analysis of the data elicited from each of the case studies, it was evident that different members of the project team had different recall about the events in the project, in the worst case, or held different perspectives on the process and the project, in many instances. However, observations made by visiting the site, eliciting supporting documentation and reviewing the already gathered data with study participants, gave credence to the evidence and brought to the fore, the most consistent data. No formal process of triangulation was undertaken in the evaluation of the data. The process was affected by so many variables, to accurately identify all the specific causal factors was beyond the scope of the study, in terms of financial and time resources and availability of data, if indeed such a research objective was attainable. Nonetheless, evidence of replication was sought, and as a result, very general propositions were generated.

9.3.2 Background Information

The background information, relating to each of the case studies, has been recorded in *Appendix V*. It was regarded as essential ancillary information and no attempt was made to identify possible relationships between the variables in respect of client, procurement route, project team composition and their potential impact on successes, or problems.

The rationale for this was twofold:

- <u>Simplicity</u> - It was deemed that only simple observations were feasible. The value in such observations was the insight that they provided into a highly complicated project process, with its own unique circumstances.
- <u>Validity</u> - over analysis and interpretation could lead to spurious conclusions or propositions.

9.3.3 Key Challenges

In each case, although the task was essentially similar, the challenges were quite different.

- **Case Study 1**

Designing and installing a system for controlling temperature and humidity, in individual zones, for which there was no prototype or existing component.

- **Case Study 2**

Maintaining existing building services and an environment to satisfy the requirements of the building occupants [the elderly] throughout the progress of the refurbishment process.

- **Case Study 3**

The installation of building services [heating, lighting, power, security, Information Technology and fire detection] into the building, over a short contract period: 10 weeks.

9.3.4 Summaries Of Success And Problems In The Projects

A brief overview of the findings is reported below for each of the case studies relating to success and problems.

Case Study 1

- <u>Successful outcomes in the project</u>

The project finished on time, within budget and the conservation objectives, set out in the brief, were satisfied.

- <u>Factors contributing to successful outcomes in the project</u>

The lead-in time allocated to planning and preparation before the construction phase, regular meetings and the dissemination of information, the focus and vigilance of the client's representatives on site, a good team relationship within project team and members working together well, largely contributed to the successful outcome of the project.

- <u>Problems in the project</u>

Differences in perception, visualisation, interpretation and levels of expertise, changes to 'made decisions' and a mis/lack of understanding [in the preconstruction phase of the job] about the size and requirements for the building services provision were evident as problems within the project. Furthermore, the electrical contractor got into financial difficulties; the control system [temperature and humidity] had to be designed, on site, and aspects of the construction of the building were unknown [interstitial space between floors] until the contractor took possession of the site.

Discussion

Despite over two years spent on planning and preparation, in the preconstruction phase, by a knowledgeable and experienced client organisation, problems occurred in the project, in relation to the integration of modern building services. The project would have benefited from a fuller investigation into the following factors: the availability of components, how the building services were to be articulated within the existing structure of the building, the adequacy of resources [including financial] and experience of subcontractors. There was also evidence that not all of those involved in the project shared an adequate common understanding of the nature of the building services element of the work.

Case Study 2

- <u>Successful outcomes in the project</u>

The quality of the end product was of a high standard and satisfying the conservation objectives was straightforward.

- <u>Factors contributing to successful outcomes in the project</u>

The goodwill on site, working relationships and co-operation between those involved in the project were identified as factors that contributed to success.

- <u>Problems in the project</u>

'Off the cuff' decisions, difficulties in visualisation re: the construction drawings, plus major changes in the location and requirements of the building services once, on site, led to time delays and higher costs. The physical constraints of the building, revealed in the construction phase, coupled with the fact it was occupied during refurbishment, had a major impact on the final building services solution.

Discussion

The successful aspects of the project and the problems experienced in Case Study 2 were not dissimilar to Case Study 1. The client representative, consultants and contractors all worked together well. Unknown, in the construction of the building, and difficulties relating to the building services solution, once on site, had a major impact on the job. Furthermore, there was, also, evidence to suggest that not all the project team shared an *adequate* common understanding of the nature of the building services element of the work. No building services consultant was identified as part of the project team, in this project, and this may have contributed to the problem.

Case Study 3

- Successful outcomes in the project

The project was completed on time and within budget.

- Factors contributing to successful outcomes in the project

There were very few variations and the design team responded quickly to problems. Appropriately skilled and experienced consultants, and contractors, were selected to do the work and had all worked well together on previous projects.

- Problems in the project

The constraints imposed by the construction of the building and the dictates of the conservation objectives complicated the integration of the building services. In terms of the building services installation, although time, cost and conservation objectives were met, user satisfaction could have been improved through better lighting and heating provision and greater ease of maintenance in use.

Discussion

In contrast to Case Study 1 and 2, the building services and its installation were not subject to difficulties presented by pioneering and developing new 'building services technology', on site, changes in the specification for the building services and their siting within the building, once the project had started. However, Case Study 3 could not be claimed to be a lesser or greater success than studies 1 and 2. There were problems relating to the building services final product and these related to user-satisfaction.

9.3.5 Key Points

Key points, identified in the case studies, were classified in the categories devised for the interview survey [see Chapter 8]. A brief overview, composed for each category, now follows. [Individual points for each case study have been listed in *Appendix V*.] The points that have been included are those that, although not specifically identified by participants, in *every* case study, were deemed to be relevant in each individual case.

- Programme

Programming building services is difficult when the scope of the works is not clearly defined. However, preplanning can cause problems if it limits flexibility. Time must be allowed, in the construction programme, for scheduled and regular project meetings, throughout the duration of the project.

- Skills, Working Hours & Working Methods

The practical and professional skills, experience and the knowledge possessed by the client, consultants, contractors and other individuals involved in the project are key. Mutual understanding and common appreciation of the work are very important. However, there is evidence that essential core knowledge, in respect of this, can be lacking in clients, contractors and consultants. Adherence to entrenched procedures, methods and ways of organisation would benefit from review. The client must be informed, decisive and clearly define what he/she requires. Realistic time must be allowed for the design and installation of the building services. Quality standards are upheld by vigilance and a presence on site. A good working relationship between designers and installers is instrumental in positively solving problems, relating to the integration of modern building services into listed historic buildings.

- Liaison & Communication

The style of authority, leadership and communication will strongly influence how the project team interrelates and focuses on the tasks it is set. The importance of a common appreciation of the visions of individual project members, by their respective fellow members, was identified. So was the desirability of a unified approach. Listening, enjoyment, compromise, flexibility, appropriate discipline and select personality traits were thrown into the basket of characteristics deemed beneficial to the operational well-being of the project team.

Note.

The 'people' issues pertaining to liaison and communication were highlighted, as above. However, no in-depth information emerged with regard to the practical facts of the mechanics of communication. e.g. letters, memos, instructions [literary and oral] guidance documents and the physical communication pathways, or electronic means of disseminating information.

- Health & Safety

No points were identified.

Note.

By way of comparison, the findings of the questionnaire [Chapter 6] and the interviews [Chapter 8] showed there was minimal response under this heading.

- <u>Budget & Financial Matters</u>

Priorities, as to where the money is to be spent in the allocated budget, should be established, in the early stages of the project. Both consultants and contractors must be appropriately experienced and adept at realistically pricing the work.

- <u>Statutory Control</u>

Planning Policy Guidance [PPG 15] does not define exactly what should be done, when integrating modern building services into listed historic buildings, but gives direction in the form of conservation principles. Legislation relating to fire protection, fire detection and means of escape in the case of fire was devised to protect the users of the building and not the building itself. Minimise and avoid unacceptable work by sticking to the parameters, guidelines and requirements set out by local authority officials.

- <u>Site & Materials</u>

It is essential that *all* the project team have a suitable level of understanding of the construction of the historic building, under refurbishment, and have complete respect for the site. Improving energy efficiency through the design of the building services system was highlighted as an important criterion. The main contractor's attendance re: the building services installation and BWIC [Builders Work In Connection] are both items that should be thoroughly evaluated and realistically costed. Problems, on site, were identified as being potentially detrimental to working relationships and are more likely when there is inadequate time and money allocated for investigative surveys of the historic building, in the preconstruction phase. [It is necessary to add, that no direct link between working relationships and investigative building surveys was identified.] Poor quality end results are frequently caused by unforeseen factors, although, these may have been beyond the control of the project team. On the other hand, thorough reading and understanding of the specification and drawings contribute to minimising abortive or substandard work. A regular presence, on site, should be maintained to monitor quality standards.

- <u>Contract</u>

The contract documents play a vital role and should be painstakingly prepared with a co-ordination check of the tender documentation. Low bids are not necessarily realistic bids and should not be the only basis for awarding the contract.

9.4 OVERVIEW

The multiple case study revealed findings that essentially confirmed data elicited in the unfolding path of enquiry, so far, through questionnaire survey and interview. In addition to consolidating former results, it provided information with respect to the research objectives stated in paragraph 9.1, *viz.*

- what, if any, could be regarded as repetitive essentials in the process
- what were the lessons to be learned from previous projects
- how best the process, for integrating modern building services into listed historic buildings, might be defined.

9.4.1 Repetitive Essentials

In each of the three case studies, the project team, were faced with quite different challenges. Furthermore, it is reasonable to say that, in all cases, individual project requirements and circumstances influenced the way the work was carried out. Nonetheless, the data elicited from the case studies reaffirmed the findings, in Chapter 8, relating to success and threats to such success. It is suggested, therefore, that the key points [par 9.3.5 refers] emerging from this stage of the enquiry, provided compelling evidence of repetitive essentials, when integrating modern building services into listed historic buildings.

9.4.2 Lessons To Be Learned

The importance of good working relationships, between appropriately experienced and skilled members of the project team, was noted and apparently existed in each of the projects investigated. This helped solving problems relating to the installation of the building services, once they had arisen, but it also raised the following query: *'Could these problems have been avoided in the first place?'* In summary, it is proposed that in all three cases:

- **Benefit would have been derived if more attention had been placed on the building services element of the works before the work commenced on site.**

The findings of this research enquiry have shown that the outcomes of the project process, concerning integrating modern building services into listed historic buildings, will be influenced by a variety of factors such as time, cost, management and expertise. It was impossible to evaluate from the data whether more money, more time or different expertise would have, inevitably, led to greater success in the three projects. Dedicating more attention to the building services element of the works, in the preconstruction phase, may well involve extra time, increased cost and different or additional expertise. Nonetheless, it is possible that by adopting this approach savings may be achieved in these resources, later on in the project, and the completed project deemed a greater success.

9.4.3 Defining The Process

Having reviewed the data, the task of defining the process of integrating modern building services into listed historic buildings [see par.9.1] raised certain questions *viz.*

- How should it be devised?
- How deep and how wide, in terms of detail?
- What would its major benefit be, practical or academic?
- How could it be an aid to integrating 'the process and team around the product'?
- If a general definition was devised, for practical use in all projects, how could adaptability and flexibility be ensured so that such an instrument would remain relevant in any project?

In response to these questions it is suggested that:

The development of a common project framework for the process of integrating modern building services into listed historic buildings would serve, as both definition and guidance.

[This will be discussed in Chapter 10.]

9.4.4 Relevance Of The Data In 2002

The data elicited in the case studies was based on projects completed over five years ago. How representative the data remains, in 2002, must therefore be considered. Clearly, the findings have value as historical data but they must, also, be evaluated in the light of how useful they are currently. An insight into the particulars of the refurbishment of a Grade I historic building, in the Oxford area, completed in 2001, has shown that projects are still vulnerable to the pitfalls encountered in similar work undertaken in the mid 1990's. Furthermore, mistakes made in the past, are still being repeated. Since the research study began, there has been a burgeoning of literature relating to the topics of: historic building conservation, refurbishment and risk. Despite this, even in eminent projects with experienced clients who are the owners and custodians of historic buildings, similar difficulties are experienced in achieving timely completion, budgets on target, quality and user-satisfaction. In view of this, it is suggested that the value of the data in the case studies, and throughout this entire survey, lies in the following. It has identified:

- characteristics of the process to produce the product

- details of what can go wrong, what can be successful and ways to remedy the former and achieve the latter.

To this end, such data would be relevant in the outline development of a common project framework, for integrating modern building services into listed historic buildings, and could be developed in conjunction with current literary guidance [par.9.4.3 refers].

9.5 SUMMARY

Further investigation has been undertaken using the multiple case study as a research methodology. The elicited data has confirmed findings and contributed to the body of knowledge amassed in the investigation, so far. The discussion closes with a proposal for a common project framework, for integrating modern building services into listed historic buildings, and this concept will be explored further in Chapter 10.

CHAPTER 10

Towards A Common Project Framework

10.0 INTRODUCTION

This chapter puts forward proposals relating to issues surrounding the multidisciplinary team and the project process. In seeking to find a way of improving performance, based on the findings of this study, a conceptual model is described that could be developed as an aid to product team integration - one of the 'five drivers of change' identified by the Strategic Forum for Construction (Egan, 2002).

10.1 BACKGROUND

In 'The Seven Lamps of Architecture', Ruskin (1880) quoted a definition for the principle of success, expressed by the artist, Mulready, *viz. "Know what you have to do, and do it."* Ruskin (1880) continued to provide an explanation by saying he believed that,

"Failure is less frequently attributable to either insufficiency of means or impatience of labour, than to a confused understanding of the thing that is to be done."

In 2002, the industry that is responsible for designing, constructing, maintaining and updating the building stock, in the United Kingdom, is still seeking clarification as to how it should successfully go about its business. Egan (2002) Chairman of the Strategic Forum For Construction, identified five drivers for change to improve the performance of the Construction Industry. In the report 'Rethinking Construction' (Egan, 1998) these were identified as committed leadership, focus on the customer, product team integration, quality driven agenda and commitment to people. In May, 2002, Sir John Egan called for views on a consultation paper which sought ways to continue to deliver improvement in the industry. In light of the objectives, set by Egan, to improve the Construction Industry's performance in the twenty-first century, and mindful of the premise tendered by Ruskin (1880) over a century ago, the aim of this chapter is to examine how facilitating *'product team integration'* and *'the understanding of what is to be done'* might be achieved using the findings from this research as an information source. Furthermore, the pursuit of such an initiative serves to satisfy the criterion of 'contribution' stated, in the research methodology, as *'identification of any patterns, trends or generation of propositions should be useful'*.

Before the development of such an initiative can be explored, the project team and the project process must first be reviewed.

10.2 THE PROJECT TEAM

The concept of *'product team integration'* is not a new one. In 1840, Viollet-le-Duc, a French architect and restorer of medieval buildings, saw buildings as an '*ensemble*' of contributions from various professionals, craftsmen and artists, each worker being linked to the entire building (Dupont, 1983). Viollet-le-Duc's approach to building conservation is now rejected but the concept of the '*ensemble*' still holds good, today. Successful conservation requires a respect and comprehension of this 'ensemble' and, therefore, an understanding of the roles of all the professionals involved. Feilden (1994) and Kay (1991) stress the importance of the multidisciplinary approach to this slow and sensitive work. Furthermore, the findings of the final report 'Constructing the Team' (Latham, 1994) and more recently 'Rethinking Construction' (Egan, 1998) highlight the benefits of integration and teamwork in construction processes. This is particularly relevant to the installation of mechanical and electrical work into buildings. Parsloe (1997) states that, in practice, such work is not a discrete activity with neatly defined edges, but is more typically an evolving process to which designers, specialist designers, manufacturers, installation managers and site tradesman all might contribute.

The findings of this study, confirmed that integrating modern building services into listed historic buildings is a multidisciplinary activity. Furthermore, selection of the project team members, who can offer appropriate skills and experience, is a crucial element in achieving a successful outcome to the project. It was also evident, from the data, it was not merely appropriate skills and experience that contributed to the efficacy of the project team. Handy (1993) observes that a *'proper understanding of groups'* will demonstrate how difficult they are to manage.

10.3 UNDERSTANDING THE MULTIDISCIPLINARY GROUP

Langford *et al.* (1995) describe the construction project team as,

"A temporary multi-organisation likely to be formed for, and disbanded immediately after the completion of a building project, and that such a situation requires a type of organisation better able to cope with the demands of numerous one-off schemes, particularly where there is a high level of discretion attached to the roles of individuals within the team."

Multidisciplinary teams, according to Wallace (1987) benefit from the positive contribution made by the different professionals' wider experience and expertise when formulating solutions. The interaction of the team individuals from different professional backgrounds, however, also has drawbacks. Wallace (1987) identifies the factor of goal ambiguity [variations in individual judgements due to individual goals and objectives] that creates difficulty when establishing team goals and, also, role ambiguity [a lack of appreciating their role within the team which leads to team apathy and impacts negatively on interaction and participation].

From the findings of this study, the inflexible stance taken by certain project team members was cited as a problem. Additionally, a lack of clarification as to whom was doing what, on the one hand, and the practitioner attitude 'it's the responsibility of team member A, B or C', on the other, were also identified. The research study further revealed that the project team was often composed of members who had worked together before. The '*former working relationship*' was mentioned by several of the interviewees as a contributory factor to '*project success*' and this, to an extent, may have dispelled barriers to effective group working. Butler (1991) claims that trust is only needed when the behaviour of one individual is beyond the control of the other. Data elicited in the pilot study, questionnaire survey and interviews revealed that there was '*a high level of discretion attached to the individual roles of members within the team*'. This being the case, trust between team members would be requisite. Furthermore, Butler (1991) states that according to the dynamic model of trust, devised by Zand (1972) trust develops between two individuals through a circular mutually reinforcing process. In view of this, it is not unreasonable to suggest that a level of trust is, to some degree, already in place in the newly assembled project team, if these team members have worked successfully together, before.

It could further be argued that, when integrating modern building services into listed historic buildings, the practice of working with people who have a previously established professional relationship has been employed as a way to avoid the negative impact of goal ambiguity, role ambiguity, and mistrust. Furthermore, this practice has, overtime, become cultural or the 'norm'. The disadvantage of adopting this approach must, however, be recognised. It may preclude the introduction of talented new blood into the field.

OVERVIEW

To make any further suggestions relating to understanding the project team, and its internal dynamic, is beyond the scope of this study. The propositions, relating to role and goal ambiguities and trust, are merely attempts to throw light on the subject and are not conclusive.

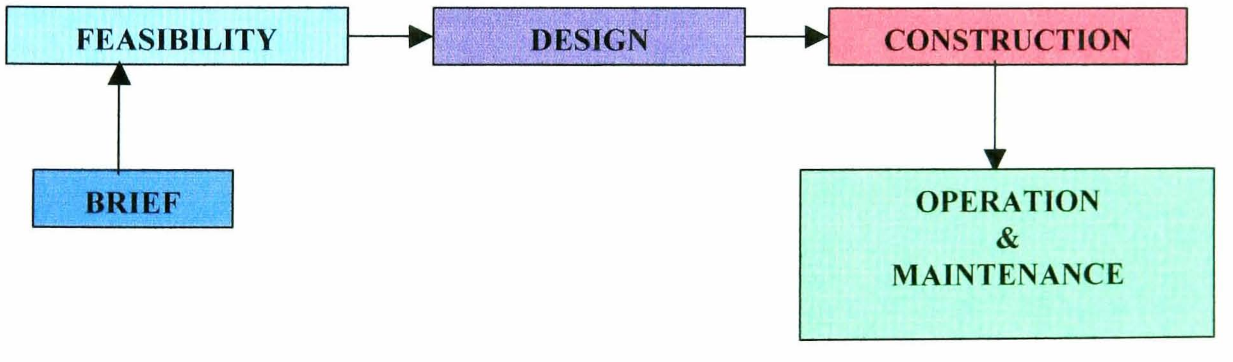
They are, however, recommended as areas worthy of further research. Nonetheless, from the findings of this enquiry, it is suggested that ensuring members are clear about the 'team objective', and understand their own role and the respective roles of other team members, within an organisational framework and environment conducive to developing trust, is fundamental to the effective operation of the appropriately skilled and experienced project team. Furthermore, this factor is recommended as an essential criterion in the management of the project team, as part of any proposal aimed at product team integration.

10.4 THE PROJECT PROCESS

In the early seventeenth century, the construction process was essentially an integrated approach between the client and the master artisans, under the Guild System. The design function and construction function were 'barely separable'. As a result of the Fire of London, in 1666, and the subsequent enormous rebuilding programme, the management of the construction process underwent various changes driven by the new approach of *'getting the job done and realising on an investment of capital or labour in the quickest and most profitable way'* (Higgen & Jessop, 1962).

To this end, the management and co-ordination of the construction process has continued to evolve over the years but the key stages, illustrated as a simplified linear model in Figure10.1, have remained relatively unchanged since the late nineteenth century.

Figure10.1 **The Project Process And Its Work Stages**



10.4.1 The Current Project Process And Its Work Stages

The Construction Industry, today, commonly adopts the RIBA Plan Of Work. It acts as an instrument by defining the work stages of the construction project and the activities to be undertaken at each stage. In 'The Guide to Building Services For Historic Buildings', CIBSE (2002) states,

"The RIBA Plan Of Work is widely used by architects to help organise their own activities and co-ordinate other members of the design team."

Due to the timing of appointments for building services consultants and building services contractors [par.5.4.4 refers] and, also, the nature of the design process [par.5.4.2 refers] the RIBA Plan Of Work, frequently does not fit well with the procurement of building services engineering for the building. To address this difficulty, various approaches have been employed and these are described as follows:

(a) Modification Of The Work Stages

For the purpose of the design and installation of the modern building services element of the project, in works to historic buildings, the CIBSE Guide (2002) has modified the work stages, used in the 1999 version, of the RIBA Plan Of Work. Their rationale for these changes is *'to give a better impression of the services required for an historic building than the standard ones'*.

Stage A **'Appraisal'** has been changed **'Initial Briefing & Appraisal'**

Stage B **'Strategic Briefing'** has been changed to **'Detailed Inspection & Support'**

Stage C **'Detailed Proposals'** has been changed to **'Outline Proposals'**.

Furthermore, Stage L has been changed to **'Practical Completion To Handover'** in order to *'clarify the point at which the design team's responsibility ceases'* (CIBSE, 2002).

(b) Integration With The Work Stages

To align the activities defined in the work stages of the RIBA Plan of Work with those required for building services engineering [all types of work, including new build] Parsloe & Wild (1998) have developed a matrix called a Process Protocol Map. Its function is to dovetail management subsystems with the work stages of the RIBA Plan Of Work, as an aid to the integration of the building services element of the work into the overall project [par.5.4.4(c) refers].

(c) Rationalisation Of The Work Stages

The Department Of Trade & Industry (DTI 2002) has rationalised the RIBA Plan of Work into four stages: inception, design, tender and installation, for the purpose of their risk management model. The approach to risk management is founded in the use of feedback, to continuously monitor and modify risk management proposals, for the building services element of the works [all types of work, including new build] within the project, as a whole, and as the work continues [par.5.4.4.1 refers].

10.4.1.1 Discussion

The need to synchronise the building engineering services element within the *overall plan of work* for the project and, also, the limitations of the standard framework imposed by RIBA Plan of Work,[1] are evident. In summary, through literature review, approaches to address this problem have been identified as 'modification of the work stages', 'integration with the work stages' and 'rationalisation of the work stages'. It must be remembered, however, the RIBA Plan Of Work is tailored to traditional procurement and competitive tendering; not *all* refurbishment work to listed historic buildings, involving the installation of modern building services, will be undertaken on this basis.

In view of this, issues relating to the current project process and its work stages must now be examined, within the research findings, to contribute to the 'whole cloth paradigm' [par.3.1.2 refers] and further satisfy the research objective, in part, stated in Chapter 5, *'to identify threats to the successful integration of modern building services into listed historic buildings'* [par 5.6 refers].

10.4.2 Failures In The Current Project Process & Its Work Stages: Interpretation And Presentation Of Empirical Data

In the unfolding path of enquiry, the findings of the research interviews [Chapter 8: 'Aids And Threats To Success' and *Appendix IV*; Chapter 9: '3 Case Studies: A Critique Of The Project Process' and *Appendix V* refer] revealed that failures manifested themselves in the project at **different times** and in **different ways**. No interviewee assigned failure to a particular 'work stage' as defined by the RIBA Plan Of Work. Furthermore, not all projects will follow the same procurement route, or the RIBA Plan Of Work. In view of this, when identifying failures that could occur in the project process, it was deemed inappropriate to adhere to the work stages in the RIBA Plan Of Work. **'Work Stages'** for the purpose of this study, therefore, are defined under the broader headings used in Fig 10.1 *viz.* Brief, Feasibility, Design, Construction, Operation & Maintenance as these five work stages hold good for any procurement route.

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[1] The application, benefits and limitations of employing the RIBA Plan Of Work, 1999, are beyond the scope of this study.

The findings of the research interviews, relating to failures in the project at different work stages, are tabulated in Tables 10.4.2 (a) (b) (c) (d) (e). The data represents the opinions of: architects, building services consultants, building surveyors, quantity surveyors, structural engineers, main contractors and mechanical & electrical contractors.

- Limitations & Ambiguities

When categorising the data, ambiguities and limitations were recognised as follows:

- **Factors could pose problems and also indicate failure**

[i.e. 'Building services consultant appointed too late' posed a problem in terms of realising the best solution for the building services engineering but, also, indicated a failure in the 'Timing of appointments'.]

- **The uncertain origin of failures; blurred edges of the work stage**

[e.g. Failure manifested in the construction stage could also be attributed to failure in the design stage. Also, design and construction may be concurrent in the construction stage.]

- **The general nature and source of the data: holistic and multidisciplinary**.

[The design of the research study was driven by 'real world ethos'; the challenge in the words of Robson (1994) '*to say something sensible about a complex, relatively poorly controlled and generally messy situation*'.]

- Presentation Of The Data

The data is presented in tabular format under the headings of 'work stages' and 'project categories' for the following reasons:

i. The element of integrating modern building services into listed historic buildings, as part of the refurbishment process, was subdivided into **'project categories'** [i.e. Skills, Working Hours & Working Methods; Liaison & Communication; Site & Materials; Budget & Financial Matters; Programme; Contract; Statutory Control; Health & Safety] to facilitate content analysis and provide scope for making comparisons, throughout this study. To this end, when considering failures in the current project process, these project categories continue to be employed.

ii. To avoid looking at failure in an isolated way [*"If one attempts to focus on certain portions of reality only, the whole falls apart as though the cloth had been cut with* *scissors."*(Guba, 1981)] the findings, tabulated in Tables 10.4.3 (a)(b)(c)(d)(e) are considered under both the headings of **work stages** and **project categories**. The failures that can occur, in the current project process, are not exhaustive due to the broad rather than deep approach, employed in the research study. However, it is maintained, by the author, that the data is representative based on the proposition tendered by Erlandson *et al*. (1993)

"By looking holistically at even a corner of the cloth we can usually predict, with great accuracy, the nature of the entire cloth."

10.4.3 Failure In The Project Process & Its Work Stages

Identified failures in the project process, and its work stages, are tabulated as follows:

Table 10.4.3 (a) **Failure At The Briefing Stage**

FAILURE AS A RESULT OF ACTION, ATTITUDE OR APPROACH IN THE PROJECT AT THE BRIEFING STAGE.	
Project Category	***Failure Through Approach, Attitude or Action***
Skills, Working Hours & Working Methods	Due to the *inexperience* of the client organisation, in refurbishing listed historic buildings, suboptimal briefing documentation is produced.
Liaison & Communication	Suboptimal documentation is produced due to clients *lacking clarity* when stating their requirements. Briefing documents *are not full enough* from the outset of the project.
Site & Materials	*Unrealistic demands* are stated in terms of the provision of modern building services and their functions.
Budget & Financial Matters	No failure identified
Programme	*Insufficient thought* is given to timescales, at the start of the project.
Contract **Statutory Control** **Health & Safety**	No failure identified

Table 10.4.3(b) **Failure At the Feasibility Stage [Detailed Inspection & Report[1]]**

FAILURE AS A RESULT OF ACTION, ATTITUDE OR APPROACH IN THE PROJECT AT THE FEASIBILITY STAGE.	
Project Category	***Failure Through Approach, Attitude or Action***
Skills, Working Hours & Working Methods	Skills of the building services consultant are enlisted *too late.*
Liaison & Communication	No failure identified
Site & Materials	*Insufficient consideration* is given to the scale of building services required for the building, leading to shortcomings in the design and difficulties in the installation process. *Insufficient information* is gathered about the building leading to shortcomings in design and difficulties in the installation process.
Budget & Financial Matters	Building services consultants are frequently asked to make a quotation for their professional services *with minimal information* and without *sufficient time.* The consultant who is prepared to take the biggest risk often secures the work.
Programme	*Insufficient information* is gathered about the building leading to more technical queries and programme hold-ups in the construction phase.
Contract **Statutory Control** **Health & Safety**	No failure identified

[1] Feasibility includes the activities of 'Appraisal & Report' defined by CIBSE (2002) p.22 as 'Stage B'.

Table10.4.3 (c) **Failure At the Design Stage**
(Outline & Detailed Design; Tender Documentation[1]**)**

FAILURE AS A RESULT OF ACTION, ATTITUDE AND /OR APPROACH TO THE PROJECT IN THE DESIGN STAGE.	
Project Category	***Failure Through Approach, Attitude or Action***
Skills, Working Hours & Working Methods	Client's requirements are *not successfully reconciled* with conservation objectives. Detailing and specification are frequently *inadequate*. Architect's drawings are generally only *ready at the last minute*, leaving insufficient time for the building services design.
Liaison & Communication	Project members are not always available *to make decisions*. This is detrimental to the effective production of drawings. *Co-ordination* of drawings, *extent of instruction* on drawings and *clear-cut decisions* of who is doing what are frequently insufficient.
Site & Materials	Producing a design to ensure *acceptable user-satisfaction* is not always achieved.
Budget & Financial Matters	The effort that goes into the building services solution is *suppressed* by financial constraints. Drawings are often only ready at the last minute, leaving the quantity surveyor *insufficient time* to provide cost estimates.
Programme	Working drawings for the building services are *seldom complete enough* when the contractor takes possession of the site.
Contract	Frequently the architect does not have *all the information* at the time the work goes to tender. Incomplete information at the tender stage *increases* the likelihood of claims. The preparation of sketchy tender documentation deters buildings services subcontractors from bidding for the work.
Statutory Control	*Lack of flexibility* in procedures involving statutory bodies can lead to impasse and hold-ups.
Health & Safety	No failure identified

[1] Design and tender have been grouped together, due to the nature of the design process in the building services engineering work, i.e. the building services installer may produce detailed designs after tendering for the work or the work may be fully designed before going to tender.

Table 10.4.3 (d) **Failure at the Construction Stage**[1]

FAILURE AS A RESULT OF ACTION, ATTITUDE AND /OR APPROACH TO THE PROJECT IN THE CONSTRUCTION STAGE.	
Project Category	***Failure Through Approach, Attitude or Action***
Skills, Working Hours & Working Methods	Failure to *achieve the balance* between providing too much detail, on the one hand, by *limiting the scope for continuity* in the design process once on site and leaving production of installation drawings *until after the contract has been let*, on the other.[2]
Liaison & Communication	Contractors find a *lack of* communication between building services consultants and structural engineers. *Co-ordination* by the lead consultant is often lacking.
Site & Materials	Materials are not readily *available.* Factors coming to light *after the contract* has been let that could have been identified in the 'feasibility stage' lead to problems, on site.
Budget & Financial Matters	Economic forces are forcing bids for consultants' services lower. *Less time* is available for the project and the client may not get the best value for money. Too much detail can make contractors wary of putting in a bid if the documentation is *expensive* to price.
Programme	Contract periods tend to be *too short*, creating problems with respect to lead-in periods.
Contract	Lines of responsibility *are not clear*: who is doing what and who is legally responsible. *Anomalies* arise in the contract documents. *Risk* is 'dumped' on the main contractor.
Statutory Control	Fire officers make *a subjective interpretation* of the requirements and these are difficult to accommodate within the structure.
Health & Safety	No failure identified

[1] The construction stage, in this study, is deemed to be the period from when the main contractor takes possession of the site until practical completion.

[2] This failure regarding skills and working methods, although relating to design, has been categorised in the construction stage because the failure *manifests* at this point in the project. The failure is, essentially, one of limitation imposed by either too much or too little design, once the work starts on site.

Table 10.4.3 (e) **Failure At The Operation & Maintenance Stage**[1]

FAILURE AS A RESULT OF ACTION, ATTITUDE OR APPROACH IN THE OPERATION & MAINTENANCE STAGE.	
Project Category	***Failure Through Approach, Attitude or Action***
Skills, Working Hours & Working Methods	No failure identified
Liaison & Communication	No failure identified
Site & Materials	In functional terms, environmental and maintenance factors fall short of the required standard, e.g. inadequacy of the heating and lighting at certain times, in certain situations and, also, maintenance difficulties.[2]
Budget & Financial Matters	No failure identified
Programme	No failure identified
Contract	No failure identified
Statutory Control	No failure identified
Health & Safety	No failure identified

[1] This stage will continue throughout the life of the newly refurbished listed historic building until either demolition or another major intervention takes place. In this study, it is limited to the immediate period after practical completion. Further investigation into this stage is beyond the scope of the study and, hence, the data elicited is very minimal.

[2] This failure could be attributed to failure at the design and/or the construction stage and/or the ineffective operation and maintenance of the system by building users.

10.4.3.1 Failures Identified In The Project At Different Work Stages

The data has been categorised under the headings of the project process work stages and project categories. Mindful of the limitations, stated in par.10.4.2, failures identified in the work stages of the project are summarised as follows:

(I) Briefing Stage [Table 10.4.3 (a) refers]

Failure to produce satisfactory briefing documentation occurs due to one, or a combination of some or all, of the following: the inexperience of the client; lack of clarity about requirements on the part of the client; insufficient information at the outset of the project; the statement of unrealistic requirements for the building services provision and poorly thought-out timescales for the project.

(II) The Feasibility Stage [Table 10.4.3 (b) refers]

Failure to produce acceptable feasibility studies, including detailed inspections and reports, occurs due to one, or both, of the following: insufficient consideration given to the scale of the building services provision and/or insufficient information gathered about the building. In some cases this is due to, or exacerbated by, the late appointment of building services consultant and/*or* his/*her* bid for the work being based on minimal information and at short notice.

(III) The Design Stage [Table 10.4.3 (c) refers]

The research study revealed that drawings and documentation, for the building services element of the work, often prove to be inadequate for the needs of the construction stage or unsatisfactory in terms of the client's requirements. The effort to produce a design solution totally acceptable to the client may be thwarted by the inflexibility of statutory bodies. However, the data revealed the cause for suboptimal 'design stage' documentation is related to the *process* of producing detailing, specification and instructions. This process fails due to:

(i) inefficacy in one, or a combination of some or all, of the following: timing, decision making, co-ordination and role clarification

and/or

(ii) insufficient information, time and financial resources.

(IV) The Construction Stage [Table 10.4.3 (d) refers]

The workmanship, on site, will be dependent on the approach and expertise of the constructors involved [par.5.4.3 refers]. However, even the best workman will be constrained in achieving optimal results, if the information and instruction they receive [and how it is communicated] is unsatisfactory or late; likewise, if appropriate materials are unavailable. These points are now considered in light of the research findings:

(i) *Information* - failure occurs if a balance is not achieved between (a) specifying too much prescriptive information and (b) providing too little detail and instruction. Imbalance impacts, negatively, on both the procurement of building services work and the installation of the building services.

(ii) *Communication* - failure occurs if the communication between the building services consultant and the structural engineer is inadequate. [This may also be evident in the earlier stages of the project.] Co-ordination by the lead consultant is often lacking and lines of responsibility are not clear.

(iii) *Timing* - failure occurs if information is identified too late; long lead-in periods for procuring materials are overlooked and contract periods are too short.

In conclusion, it is proposed that the workmanship in the construction stage will be undermined when the management of the process, in terms of communication, co-ordination, timing and the delivery of appropriate information, fails.

(V) Operation & Maintenance [Table 10.4.3 (e) refers]

The services in the building may prove unsatisfactory in use. This failure may be due to the operation and maintenance of the systems, by the building users, or poorly designed or installed building services.

OVERVIEW

Failures have been identified in the 'product' of each of the 5 work stages: (I) briefing documents; (II) feasibility & appraisal reports; (III) drawings, specification and contract documentation; (IV) construction; (V) functionality. Also, failure has been identified in the 'process' that leads to their production. Evidence, from this study, suggests such failure is founded in either the appropriateness of information or instruction *and/or* both: *and/or* shortcomings in the way information and instruction is organised and disseminated.

10.4.3.2 Sources of Failure Identified In the Project Categories

[Tables 10.4.3 (a) (b) (c) (d) (e) refer]

By employing the project categories, the data is manipulated in a different way. Sources of failure are now reviewed, under the project category headings.

(i) Skills, Working Hours & Working Methods

Sources of failure can be attributed to a lack of skills or expertise *and/or* the approach to the work adopted by the project team, as follows:

- the client organisation is inexperienced
- the skills of the building services consultant are enlisted too late
- the working method of the architect prejudices the timely issue of design information to the building services consultant
- a lack of skill in achieving the correct level of detail and specification before the building services contractor starts work on site

(ii) Liaison & Communication

Sources of failure can be attributed to poor liaison and communication within the project team, as follows:

- lack of clarity by clients and insufficient detail in their requirements
- unavailability of project members to make decisions; poor co-ordination of drawings limitations in the extent of instruction, and failure to make clear cut decisions about who is doing what
- lack of communication between the structural engineer and building services consultant [from the contractor's perspective]; failure by the lead consultant to co-ordinate the project team members

(iii) Site & Materials

Sources of failure in relation to the site and materials can be categorised, as follows:

- unrealistic demands stated by the client and/or architect, relating to the building and the building services provision
- insufficient consideration given to the site and the articulation of modern building services in the building before the refurbishment work starts on site

- factors about the building, that should have been identified early on in the project, coming to light after the mechanical & electrical contractors start work on the site;
- materials not readily available, for use on site
- building services solutions not providing acceptable user-satisfaction

(iv) Budget & Financial Matters

Sources of failure in relation to budget & financial matters can be categorised, as follows:

- quotations for building services consultants' professional services based on minimal information and inadequate time allowed for the preparation of the bid
- building services solutions suppressed by financial constraints
- drawings only ready at the last minute, leaving the quantity surveyor insufficient time to provide cost estimates

(v) Programme

Sources of failure in relation to the programme can be categorised, as follows:

- insufficient thought is given to timescales, at the start of the project
- insufficient information is gathered about the building leading to more technical queries and programme hold-ups in the construction phase
- working drawings for the building services are seldom complete enough when the main contractor takes possession of the site

(vi) Contract

Sources of failure in relation to the contract can be categorised, as follows:

- a lack of all the necessary information available at the time of preparing the tender documentation;
- sketchy tender documents deterring buildings services subcontractors from bidding for the work

(vii) Statutory Control

Sources of failure in relation to the statutory control can be categorised, as follows:

- lack of flexibility exercised by some officials representing the statutory bodies

(viii) Health & Safety

No failures were identified in relation to Health & Safety. This may be attributed to the legislation [e.g. Design {Construction & Management} Regulations, 1994] and the very clear guidelines set out in the statutory instruments.

10.4.3.3 Risk Management

Risk can be said to be a measure of the likelihood of a specific unwanted event and its unwanted consequences (Godfrey, 1994). Failures within the process and the product, or components that contribute to the make up of the product, can be regarded as unwanted events. In Chapter 5. par.5.4.4.1, Smith (1999) points out that failure to undertake risk management in a more explicit manner, as a routine aspect of project management, is increasingly regarded as commercial suicide. In Chapter 7, it was stated that the methods of risk management, employed by the practitioners interviewed, were variable. When integrating modern building services into listed historic buildings, as part of the refurbishment project, the absence of an explicit procedure devised to manage the likelihood of unwanted events occurring and their associated impact on the desired project outcomes can, therefore, be considered to be disadvantageous to the effective management of the risks in the process.

10.4.4 Failure In The Current Project Process And Its Work Stages: Observations & Recommendations

With reference to empirical data [*Appendices IV* and *V* refer] failures that can occur in the work stages of the process, have been identified. Using the same data but *'approaching the same intellectual puzzle from diverse angles'* (Mason, 1997) sources of failure have, also, been categorised under the project categories[1]. Having processed the data, the following observations can be made:

a) Practitioners can readily identify how failures occur in the project process and its work stages [*Appendix IV* {Problem Factors} refers] and, yet, these failures still continue to manifest themselves.

[1] Project categories were employed as a way of providing an analytical framework throughout the research study.

b) Failures in the current project process, and its work stages, stem from: inexperience, lack of information, ill-timing, inappropriate level of specification & design, poor co-ordination, communication & instruction, inflexibility and financial/time factors.

c) Failures identified in the project process, and work stages, can be addressed by considering them in the context of the 'project categories' and eliminating or managing the sources of failure, therein.

d) Failures in the project and its process can be regarded as unwanted events. These unwanted events pose risk to the project outcomes and an explicit procedure should be in place to manage risk.

Through literature review and the findings reported in this study, it has been identified that integrating the building services element of the work into the overall plan of work, and its work stages, is problematic and failures occur in the project process. Ways of ameliorating the situation have been identified in par.10.4.1 but there is no evidence, to date, to comment on either their usage or the improvements they have made, in practice. Furthermore, only the modifications to the RIBA Plan Of Work devised by CIBSE (2002) are specifically related to building services for historic buildings. It is not, therefore, intended to suggest further amendments. However, it is suggested in Par. 10.4.4 (c) that failures occurring in the project process and its work stages can be addressed by considering them in the context of the 'project categories' through eliminating or managing their sources of failure. It is proposed that this approach to addressing failures should be included in an initiative [par10.1 refers] aimed at facilitating *'product team integration'* and *'the understanding of what is to be done'*.

10.5 PRODUCT TEAM INTEGRATION & UNDERSTANDING WHAT IS TO BE DONE

'Product team integration' is not a new idea in building conservation work. Neither is *'the understanding of what is to be done'* which was also identified as an essential and contributory factor in the successful undertaking of projects [par.10.1 refers]. After over a century, the validity of these tenets remains unchallenged but the question they raise, continues to challenge the Construction Industry: *How does it bring about their effect?*

Latham (1994) highlighted the benefits of integrating the team as an approach to improving performance within the Construction Industry. Egan (2002) has taken this rationale, further, and proposes that integrating the project team and the process around the product, following the example of other industries, could yield benefit in terms of performance. *In response to this suggestion*, proposed by Egan, devising a project framework to integrate the project team and process around the product [servicing listed historic buildings as an element of refurbishment works] is now explored. Furthermore, it is suggested that the project framework could provide definition for the project process, as proposed in par.9.4.3.

10.5.1 Contribution Of The Data And Findings Of This Research And How The Data Could Be Employed To Devise The Project Framework, In Conceptual Terms

The research strategy adopted in this study utilised an exploratory approach, the researcher following an unfolding path of enquiry. As such, collection of relevant data for a project framework ***was not*** posed as a specific task. Review of the research data has, however, revealed factors that could be put to a useful purpose and, it is suggested, could contribute to *product team integration* and *the understanding of what is to be done.*

10.5.1.1 Contribution Of The Data And Findings Of This Research

The data collected in this research represents the views of the multidisciplinary project team and is, therefore, deemed to be holistic. The need for, and value of, *experience* in this area of work has been identified in the findings of this investigation and, also, highlighted as an essential criterion in literature review. The observations and recommendations, made by interviewed practitioners, are based on the fruits of their experience [derived from conservation refurbishment projects involving the installation of modern building services into listed historic buildings [the scope of projects is detailed in Table 6.1]. In view of this, it is argued, by the author, that the opinions of experienced practitioners provide valuable information.

Furthermore, it is suggested that the following proposals support the use of the research data to design the project framework, in conceptual terms.

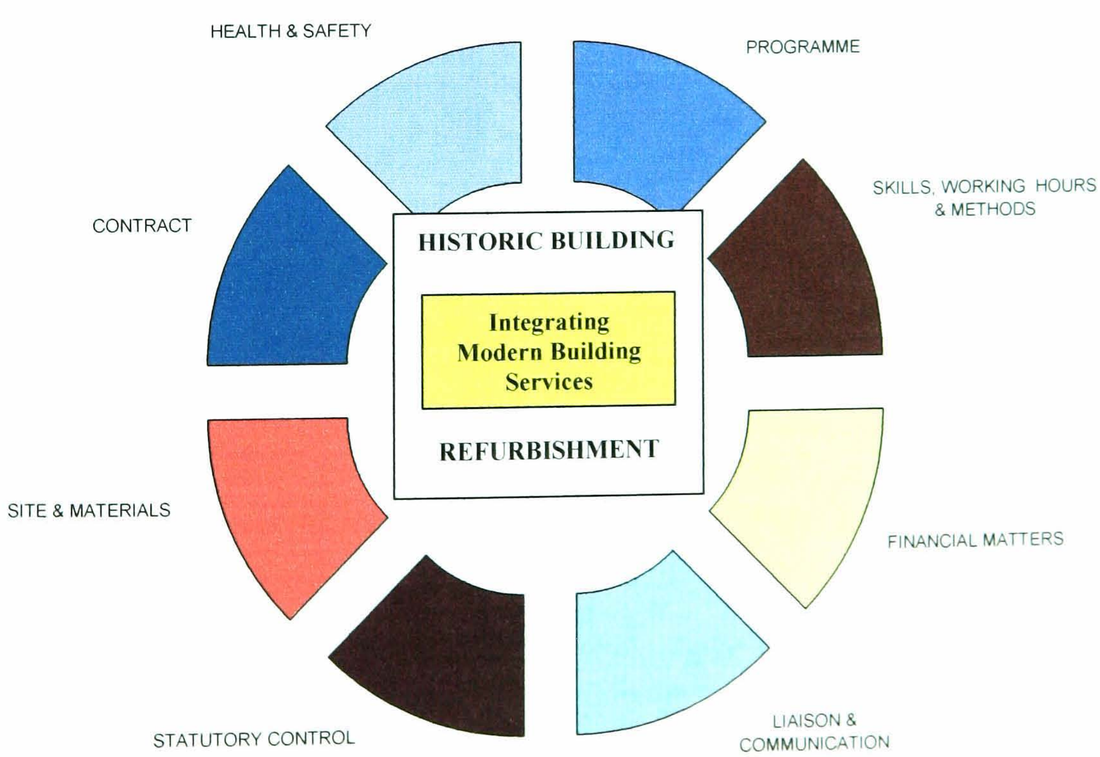
1. In Chapter 6, par.6.5.3, it was proposed that the process of integrating modern building services into listed historic buildings has its own discrete characteristics and these may be some of the most difficult and most frequent.
2. In Chapter 9, par.9.4.1, it was proposed that data elicited, in this study, provided compelling evidence of repetitive essentials relating to the integration of modern building services into listed historic buildings.

In summary, it is proposed that pragmatic and holistic data, collected from experienced practitioners, provides a reasonable basis upon which to outline a project framework aimed at '*product team integration*' and facilitating '*the understanding of what is to be done*'.

10.5.1.2 How The Data Could Be Employed To Devise The Project Framework In Conceptual Terms

When analysing the data, to gain a fuller *understanding of the topic*, it was deemed both practical and logical to divide the process of integrating modern building services into historic buildings, into various project categories [Chapters 6, 8, 9 and par.10.4.3.2 refer]. It also proved to be workable. This logic is now extended to the conceptual model, illustrated in Figure10.2, which also employs these same project categories. The rationale for the model is to provide *focus* on the 'product' and the characteristics of the work. The refurbishment of the historic building is represented in the central box as the product. The integration of the building services element of the project is contained within the refurbishment process and is, therefore, represented within the refurbishment box as part of the product. The various 'project categories' contain, within them, information to aid the successful undertaking and completion of the product, through providing guidance for *product team integration* and aiding *the understanding of what is to be done*. These 'components' will provide the structure for the proposed project framework.

Figure 10.2 A Conceptual Model



10.5.2 Development Of The Conceptual Model Out Of the Findings Of the Research

For the purpose of developing the conceptual model, in outline, the project categories will now be considered as 'components' of the 'product'. From review of the findings in Chapters 6, 7, 8, 9 [and the empirical data in their *Appendices II, III, IV , V*] these components will be defined in terms of the model's aim[1] as follows:

❖ ***Product team integration***

Ethos and approach are recommended as a way to encourage integration between:
(i) each team member and the product
(ii) the members of the project team
Every project team member must be aware of factors that integrate them with the individual 'components' that go to make up the product [as in Violett le Duc's 'ensemble' par.10.2 refers].

❖ ***Understanding what is to be done.***

Being informed of what can fail, or can cause problems, in the building services element of the conservation refurbishment project and, also, the likely difficulties and risks encountered in the construction phase, creates awareness within the project team. Having an awareness of what can go wrong contributes to the body of knowledge about the project process and facilitates an understanding of what is *not to be done* or *needs to be managed* if unavoidable. Being informed of the factors that contribute to the successful outcome of the project provides the project team with a pool of information of best approaches and facilitates an understanding of the *best ways* of going about the building services element of the work, in conservation refurbishment. 'Product Team Integration' and 'Understanding What Has To Be Done' are now outlined within the 'components' of the 'product'.

10.5.2.1 <u>Skills, Working Hours & Working Methods</u>

Product Team Integration

Consultancies, and contracting organisations, should have genuine interest in historic buildings. The consultants and contractors must be sympathetic to the building and the nature of the work. All aspects of building conservation work are complex requiring sound technical knowledge, appropriate skills and special care. Each project team member should have a core knowledge relating to building conservation, the technical input of the individual disciplines and practical

[1] The development of the model's objectives are discussed in par 10.5.3

input of the workforce on site. The building services design solution must be well thought out with input from the multidisciplinary team. Design should be suited to the building; the building should not be modified to accommodate the design solution.

Understanding what has to be done

- *Sources of failure to be eliminated or, managed if unavoidable, to optimise skills, working hours and working methods*

i. Inexperience
ii. Untimely procurement of skills
iii. Unsatisfactory working methods
iv. Inept skills

- *Problems to be avoided*

- Project team members who claim they can do the work when they cannot.
- Leaving the appointment of the building services consultant and/or the structural engineer until something goes wrong.
- Inability to organise timely delivery of design information and instruction.
- Inability to take sufficient time to solve problems and investigate alternatives.
- Insensitive and standard approach to design solutions.
- Inability to provide good design solutions re: user requirements.

- *Problems to be managed, if unavoidable*

- Client organisations and, also, building owners who lack experience in conservation work. [Support and guidance must be for provided for the inexperienced client. The need for such should be brought to the attention of the client.]
- Reliance on mechanical and electrical contractors to carry out all the design work.

- *Ways of achieving success*

Procurement of skills:

- The work requires a multidisciplinary approach; building services consultants and structural engineers should, ideally, be appointed at the inception of the project.

- Select consultants, contractors and subcontractors who are experienced in conservation refurbishment, understand the construction of historic buildings and can anticipate likely problems.
- Always select consultants, contractors or subcontractors that have a known track record and request examples of their previous work.
- Select the main contractor on the basis of quality and cost.

Working Methods[1]

- Team members should be open to alternative and /or innovative solutions and amenable to 'team solutions'.
- Keep things simple whenever possible.
- The quality of the design team, and its organisation, is key to a good project.
- Careful monitoring and regular checks, throughout the project, ensure good quality control and a successful end product.

> *Degree of difficulty: considerations before works start on site*

Evidence shows that in the construction phase, quality control & assurance; selection & recruitment of the workforce; restriction on site plant usage and working methods are generally grouped in the middle range [betwixt the most and least] difficult activities to manage.

> *Risk Awareness*

Differing opinions can occur, within the project team, with respect to the likelihood of adverse events *viz.* quality standards not met; abortive works; skills not readily available. Sorting out problems with the building services design and installation may take more time than installing the building services, themselves. Selecting the right contractor for the project contributes to reducing risk and, also, helps eliminate problems relating to resources and skills.

[1] A review of workmanship and good practice was undertaken in Chapter 5, par. 5.4.3. In-depth detail of best practice in workmanship is beyond the scope of the conceptual model, however, it is proposed by the researcher that the need for its inclusion, in the fully devised project framework, should be explored.

10.5.2.2 Liaison & Communication

Product Team Integration

The project team should embrace the same philosophic approach. The nature of the work involves working closely with other members of the project team, therefore, each one must be aware of the others' needs, concerns and problems. Patience and sympathy are paramount. The quality of documentation, working relationships and communication require careful attention. The building services consultant must work with the architect and other disciplines *early on* because other works will affect the building services provision. The *flow* of information is critical.

Understanding what has to be done

> *Sources of failures to be eliminated or, minimised if unavoidable, to facilitate good liaison & communication*

i. Lack of clarity
ii. Insufficient detail and instruction
iii. Unavailability of project members
iv. Poor co-ordination
v. Short comings and delays in decision making

> *Problems to be avoided*

- Mistrust leading to the cultivation of self-seeking attitudes.
- Loss of goodwill due to poor management of arising problems or the dynamic between different personalities.
- Poor communication between the project manager and the client. [This is particularly pertinent when listed historic buildings are occupied.]
- Insufficient clarification of who is responsible for what.
- Ineffective co-ordination of (i) drawings and instruction (ii) project team members.

> *Problems to be managed, if unavoidable*

- Unclear requirements, particularly those of the client.
- Difficulty experienced by the client in visualising scheme proposals.
- Problematic liaisons with the officials of statutory bodies.

> *Ways of achieving success*

- Ensure the brief provides the basis for *understanding* the project; know what the client wants.
- Ensure lead consultants and project mangers are skilled and proactive facilitators and can create a team dynamic conducive to trust.
- Ensure information *flows* from the top to the bottom of the team organisation and vice versa.
- Use a holistic approach; ask each other the right questions and provide timely answers. Hold full and regular meetings.
- Ensure the lead consultant/project manager understands the respective needs of team members, the requirements of the client and the statutory bodies[1], and irons out problems early on.
- Buildings services consultants should talk to both the building users and the client.

> *Degree of difficulty: considerations before works start on site*

Evidence shows that supervision of the works, liaison with the planning officer and English Heritage are midway between the most and least difficult activities, once the work starts on site.

> *Risk Awareness*

No data available from the findings of this study.

10.5.2.3 Site & Materials

Product Team Integration

The project team should recognise that modern building services are not always suited to listed historic buildings. The building services solution must be produced through considering the building, as a whole; a piecemeal approach should not be applied. The sequence of the building should be followed when planning services routes and installing ducts, pipes and cables. Building services are a growth area. Exploring alternative and innovative approaches can be beneficial [e.g. The Bodliean Library, Oxford specified that no lighting was to be fixed to ceilings or walls. Through lateral thinking, a solution was devised that utilised uplights in the window reveals. Downlights were attached with special spring clips, fixed into existing grooves in the masonry, and the cabling followed the path of the heating trench. A successful result was achieved through

[1] Negotiation with statutory bodies is also considered in 'Statutory Control'

alternative and innovative thinking, rather than trying to modify a more standard approach (Ruffles, 2000).]

Understanding what has to be done

> *Sources of failures to be eliminated or, minimised if unavoidable, to optimise factors relating to the site and materials.*

i. Inadequate consideration given to the relationship between the building, its building services provision and the needs of the users
ii. Unrealistic demands made by the client[1] and architect, given the constraints imposed by the building and its site
iii. Insufficient consideration given to building services, prior to work starting on site
iv. Inadequate survey/investigation of the building
v. Materials: procurement periods that are too short; using visually disruptive fittings

> *Problems to be avoided*

- Detrimental dead loads imposed on the structure, by services plant.
- Poorly thought-out removal of existing and unwanted building services systems.
- Inappropriate or inadequate temporary works/protection of the works.

> *Problems to be managed*

- Unknown in the construction of the building.
- The unpredictable nature of the structure of the building and structural constraints.
- Lack of interstitial spaces to accommodate cables, pipe runs and ductwork; severe spatial constraints imposed by the structure and fabric of the building.
- Rubble and debris in voids that pose fire risk.
- Interfaces between new and existing services.
- Disposal of asbestos/toxic materials.
- Fire compartmentalisation and the building services installation.

[1] Unrealistic requirements sought by clients, attributed to inexperience or lack of clarity, are also considered under 'Skills, Working Methods & Working Hours' and, also, 'Liaison & Communication'

> *Ways of achieving success*

- Establish historical facts about the building and look for alterations carried on throughout the life of the building; thoroughly investigate the structure in order to identify problems *before* work starts on site.
- Establish, early on, floor/ceiling arrangements so that service routes can be identified to articulate with the building structure [and where needed articulation with existing services] avoiding conflict with features and interiors.
- Use small ducts and pipes [wherever possible] and sensitive fittings, to minimise impacting negatively on the interior architecture of the building.
- Carefully consider the weight and location of building services plant.

> *Degree of difficulty: considerations before works start on site*

Once work commences on site, spatial and structural constraints imposed by the building, storage of building materials and plant, site access and maintaining existing services have been identified in the top third, most difficult factors, dealt with by the project team. The supply and matching of materials is more difficult if contract periods are short.

> *Risk Awareness*

Perception of the likelihood of latent defects, abortive works, materials not available and superficial damage to the building fabric can be wide ranging. [Consultants' views have been shown to be more variable than contractors'.] Quality varies from job to job but careful monitoring and adequate inspection reduce the risk of poor workmanship. The structural integrity of the building may be threatened if its structural properties are not considered in conjunction with the building services design and installation.

10.5.2.4 Programme

Product Team Integration

A strategic and holistic approach to planning and programming is essential; project criteria and construction activities must be examined and prioritised. Architects drawings must be made available in good time for the purposes of building services design and costings.[1] The project team must recognise that problems, relating to the historic building, will arise in the execution of the works. Allowance must be made for this in the construction programme. Co-ordination, and

[1] Cost estimates are also considered in 'Budget & Financial Matters' [par.10.5.2.5 refers].

how it is to be effected in the project programme, must be established. This is particularly important, and special attention should be paid to co-ordination between the structural engineer and the building services consultant and, also, the main contractor and mechanical & electrical contractors.

Understanding what has to be done

> *Sources of failure to be eliminated or, if unavoidable, managed to minimise negative impact on the desired outcomes for the project/works programme.*

Prior to work starting on site:

i. Insufficient thought given to timescales
ii. Insufficient information collected about the building
iii. Inadequate design information

> *Problems to be avoided*

- Absence of the building services consultant's expertise, from the outset of the project.

> *Problems to be managed if unavoidable*

- Changes in consultants' or client's requirements, once work starts on site.
- Impracticably short construction periods.
- Allowing foreseeable difficulties to manifest themselves, in the construction phase.

> *Ways of achieving success*

- Contractors must be selected who are experienced in planning and programming conservation refurbishment work.
- The building services installer must allow for more time in conservation refurbishment projects; listed buildings take twice as long as a general rule.
- Main contractors and mechanical & electrical contractors must flag up delays as soon as they occur, and the reasons why, to manage the knock-on or ripple effect on their respective programmes.
- Emphasis must be placed on forward planning with focus on lead-in periods: materials procurement schedules are essential.
- Variations must be dealt with promptly, taking account of their impact on the works programme.

- *Degree of difficulty: considerations before works start on site*

Evidence shows that programming & scheduling the works, time prediction for completion of the works, variations or changes to the order of the works, dealing with tenants [if the building is occupied] and, also, managing the influence of conservation objectives on the progress of the works, are generally in the top third most difficult activities re: management in the construction phase.

- *Risk Awareness*

Unforeseen problems are a regular occurrence. Minor hold-ups are more likely in the architectural work. Late completion is frequent. Disruption to other trades /down time of plant is probable. Some contractors perceive complete programme reorganisation to be more likely than consultants; discrepancies in viewpoints should be addressed.

10.5.2.5 Budget & Financial Matters

Product Team Integration

The building services element of the work often represents a high proportion of the contract sum. The objectives of the project team should not merely focus on financial reward. Cost and quality must be balanced. Maintenance costs and running costs also require due consideration. [i.e. Building services systems, once installed, will require routine maintenance and checking to ensure that performance levels are achieved; training sessions on operating, monitoring and maintaining the new system should be provided for curatorial and maintenance staff; back up systems must be in place, to prevent damage, when the main system is not working.] Adequate financial resources should be dedicated to procuring the professional services of each of the disciplines and the construction works executed by contractors.

Understanding what has to be done

- *Sources of failure to be eliminated, or managed if unavoidable, relating to budget & financial matters*

i. Fee bids prepared on the basis of minimal information and at short notice
ii. Building services solutions suppressed by financial constraints
iii. Insufficient time allowed to provide cost estimates

- *Problems to be avoided*

- Too little time and money spent on feasibility studies and costing exercises.

- Inadequacies in the tender documentation that can lead to claims.
- Firm tenders based on loose or approximate quantities, placing onus on the contractor.
- Contractors out pricing themselves, if they know the work and quality required but are bidding against less knowledgeable contractors.

> *Problems to be managed, if unavoidable*

- Economic forces driving consultant's bids for their services lower. Low bids often result in less time dedicated to the project and ultimately the client not getting the best value for money.

> *Ways of achieving success*

- Prepare timely budget estimates.
- Cost control is *easier* if the design and specification is complete at the tender stage.
- Ensure a schedule of rates is included in any tender documentation where the work cannot be exactly quantified.
- Estimate a realistic contingency sum.
- Allow for investigative work into the building, and its history, in the budget sum.
- Carry out a financial investigation on the contractor; a bond should be provided.
- Check the preliminaries are reasonable - look for front loading.
- Appoint contractors and consultants on the basis of cost and quality.

> *Degree of difficulty: considerations before works start on site*

Evidence shows that, in the construction phase, pricing the works[1] and cost control are generally the most difficult activities to be undertaken; an absence of billed items in the building services element of the works makes negotiating the valuation of variations [which have been identified as occurring very frequently] difficult. Consultants find remuneration for their professional services is also very difficult.

> *Risk Awareness*

Clients should be aware that it is both probable and frequent that the total contingency sum is consumed, and likely to be more so, when the budget sum is low. Contractors may take risks to

[1] No data exists relating to pricing the works in the early stages of the project.

make money. Grey areas in design and unknown factors in the building's construction lead to damages and claims[1].

10.5.2.6 Contract

Product Team Integration

Contractual arrangements should be considered so that lines and definitions of responsibility are considered in a holistic way. Competitive tendering may not be the best way to get good quality work and value for money.

Understanding what has to be done

- *Sources of failures to be eliminated, or minimised if unavoidable, to optimise contractual arrangements*

i. Lack of all the necessary information when preparing contract documents[2]

ii. Sketchy documentation

- *Problems to be avoided*

▪ Anomalies arising in the contract documents

▪ No clear definition of lines of responsibility

▪ Contracts that place all the risk with the contractor

- *Ways of achieving success*

• Ensure the tender documents convey as much information as possible

• Do not amend standard forms of contract

• Avoid letting the contract until any arising precontract problems have been resolved.

• Name preferred specialist subcontractors in the contract documentation.

- *Degree of difficulty: considerations before works start on site*

Contract documentation/arrangement has been identified in the lowest third of refurbishment characteristics for degree of difficulty, once work starts on site.

[1] Unknown factors in relation to the structure of the historic building are also considered under 'Skills, Working Methods & Working Hours, 'Site & Materials' and 'Programme'.

[2] Fee bids are also considered under 'Budget & Financial Matters'.

➢ *Risk Awareness*

No data available from the findings of this study.

10.5.2.7 Statutory Control

Product Team Integration

Consultants and contractors need to negotiate productively with conservation officers, planning officers, building control officers, fire officers and English Heritage inspectors. Talks should start, early on, with the scope for continued guidance throughout the life of the project with proportionate focus on the building and its users.

Understanding what has to be done

➢ *Source of failure to be eliminated to optimise satisfying statutory requirements*

i. Unsatisfactory negotiation with statutory body officials and English Heritage inspectors and advisors.

➢ *Problems to be managed*

- The conflict between statutory requirements to protect people and statutory requirements to protect the building.

➢ *Ways of achieving success*

- Sort out all issues relating to statutory control and English Heritage, early on.

➢ *Degree of difficulty: considerations before works start on site*

Fire protection requirements are perceived to be within the 20% most difficult factors to deal with. Liaison with the fire protection officer in the construction phase, however, is generally regarded to be one of the least frequent occurrences. This issue should be addressed. Matters relating to listed building consent, once works start on site, have been identified as being more difficult than those relating to planning permission or building regulations.

➢ *Risk Awareness*

Adverse events relating to conservation objectives are generally perceived to be remote or improbable. Perceptions are wide ranging between practitioners in relation to minor/superficial damage to the fabric of the building.

10.5.2.8 Health & Safety

Product Team Integration

It is recommended that the role of the planning supervisor and his/her interaction[1] with the design team, the Health & Safety Plan and the Health & Safety File should provide key criteria and guidance within the project framework.

Understanding what has to be done

- *Sources of failure to be eliminated or, minimised if unavoidable, to optimise health & safety; problems to be avoided or managed if unavoidable; ways of achieving success*

No data was identified from the research study. However, it is envisaged that decisions and project strategy, relating to this project framework component, would be undertaken in conjunction with the planning supervisor using the Construction (Design & Management) Regulations, 1994, as guidance.

- *Degree of Difficulty: Considerations Before Works Start On Site*

Dust control, noise control, handling and disposal of hazardous toxic substances are generally considered to be in the middle range of difficulty for contractors, once work starts on site. Requirements should be clearly set out in the contract documents.

- *Risk Awareness*

Construction (Design & Management) Regulations, 1994 can help reduce adverse events on site. Excluding the event of death, the perceptions held by contractors and consultants of the likelihood of adverse events, relating to health & safety, are wide ranging. This factor needs to be addressed.

10.5.2.9 Overview

Empirical data elicited from practitioners, who took part in the research study, has been categorised in the 'components' that provide the structure for the project framework. When compiling data, in this way, it became evident that factors frequently needed to be addressed in more than one component, and in different ways. It is proposed, by the author, that this confers benefit for the following reasons:

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[1] Interaction with the planning supervisor should also be considered under 'Liaison & Communication'.

- It illustrates how the components that make up the product are interrelated
- It highlights how factors should be addressed from different standpoints
- It identifies that factors will require input and skills from different disciplines

In summation, a project framework has been devised in outline. The focus is on the 'product' and all factors should be considered, in this context, to maximise product team integration and understanding what has to be done.

10.5.3 The Objectives Of The Project Framework

The structure and content of the project framework have been outlined in accordance with its aim to facilitate 'product team integration' and 'understanding what is to be done'. Within this aim, two objectives for the project framework are proposed:

a) To clarify the team objective, each team member understanding their own role, <u>and</u> the respective roles of other team members, within an organisational framework [par.10.3 refers].

b) To provide scope to address failures occurring in the project process at source [par.10.4.4 refers].

From review of the propositions and findings in Chapters 6, 7, 8, 9, these objectives can now be expanded, as follows:

- <u>To clarify the team objective, each team member understanding their own role, and the respective roles of other team members, within an organisational framework</u>

Par.6.5.3 proposes that some professionals have very definite ideas about their own boundaries, roles and responsibilities and, also, those of their fellow team members. It is suggested that this knowledge should be captilised upon to create an awareness of how each team member contributes to the project, and to discourage the cultivation of a dismissive attitude towards activities and responsibilities that are deemed to be outside of individual remits[1]. It is suggested that a communication infrastructure should be devised, for use in the operation of the project framework, through which team members identify the activities they are individually responsible for, and how they interrelate with those of the rest of the project team. From the findings of this research, it was proposed [par 8.7 refers] that focus should be placed on the composition of the

[1] Par. 6.4.4.9 refers.

project team and how it communicates, co-ordinates and, also, facilitates positive team relationships. The communication infrastructure suggested in the previous paragraph should be devised to fulfill these three criteria. Furthermore, it should be designed to reinforce the importance of the attitudes and approach identified in 'Product Team Integration' [pars.10.5.2.1-10.5.2.8 refer].

- Addressing failures occurring in the project process at source

Likely sources of failure, and typically arising problems, have been identified within the 'components' of the project framework. It is suggested that these should be addressed at the *outset* of the project and continue to be reviewed during the preconstruction phase, in response to the proposition in Chapter 9 [par. 9.4.2] that, *'Benefit would have been derived if more attention had been placed on the building services element of the works before work commenced on site'.* Within the structure, provided by the project framework, and using the proposed communication infrastructure, it is suggested that a project strategy should be formulated, agreed and *recorded* as a source of reference by all the project team, to minimise the likelihood of these failures and ameliorate problems. Proven ways of achieving success, also identified in the project framework 'components', provide guidance to the project team for development of this project strategy.

10.5.3.1 Risk Management

The need for an explicit procedure to manage risk was stated in par.10.4.4. To aid risk management, it is proposed that the project framework should include a clearly defined approach to encourage a collective risk style, improve risk communication, establish equitable risk sharing and deepen an understanding of marginal risks and their interdependencies [par.7.8.refers] and complement any systematic risk management instrument employed by practitioners

10.5.3.2 Overview

The development of a communication infrastructure to identify and clarify the roles of individual team members, and the interrelationships of these roles, is suggested. Also, promoting a more universal perception of the degree of difficulty and frequency of occurrence of activities, in the project, is advocated. It is proposed that these same communication pathways, employed within the project framework, should be utilised to access and disseminate information when

(i) devising the project strategy

(ii) identifying and managing risk

10.5.4 The Project Framework In Electronic Format

Having outlined the aim and objectives of the project framework, defined its structure and content, in principle, and suggested the use of a communication infrastructure to access and disseminate information, the vehicle for its use must now be considered. Finch (2000) observes that many information systems being used in design and construction *'slavishly adhere to an outdated transaction process'*. He goes on to say,

"Only by introducing more interactive communication methods can we overcome these deficiencies using rich interaction, including the old and established method of talking to one another. However, rich interaction is achieved at a price. It involves a considerable infrastructure which, until the advent of the Internet, has impeded the diffusion process."

In view of this, it is suggested that the project framework and its communication infrastructure should be developed in electronic format. Also, an interactive 'e' portfolio should be compiled for each project, accessible to all members of the project team and the client. Furthermore, data stored electronically could be invaluable for use in future projects [see par.10.6.6.6 'Database For Future Projects']. The development of the project framework in electronic format is recommended as an area worthy of further research [par.11.6 (1) refers].

10.6 APPLICATION & BENEFIT

In order to demonstrate the potential application of the research results, a conceptual model for a project framework to act as guidance to practitioners undertaking the refurbishment of a listed historic building, in which the design and installation of modern building services form an element of the works, has been outlined. Clearly, the proposed project framework would require piloting and appraisal to quantify benefit with any surety. However, *hypothetically speaking*, if the project framework had been employed in the management of the three case studies [*Appendix V* refers] it is suggested that benefits could have been gained. Utilising the electronic communication infrastructure [par 10 5.4 refers] developed for use with the project framework to enable 'rich interaction', viewpoints could have been elicited from all the project team members. It is proposed that addressing matters and formulating decisions, within the components that provide the structure for the project framework, problems could have been avoided or ameliorated as follows.

10.6.1 Case Study 1

[Problems A, B and C are summaries compiled from case study data. The case study narrative is reported in *Appendix V*, pp. xciv-civ.]

Problem A

The project team was experienced and the building services consultant was engaged at the outset of the project. Nonetheless, problems arose because the scale of the building services element of the work transpired to be greater, and more difficult, than could have been envisaged in the brief and this had an impact on programme and cost[1]. Aspects of the design that should have been completed, prior to work starting on site, were not undertaken.

Observations by the researcher had the project framework been employed:

- *Working Methods*

Being aware that insufficient time to solve problems and investigate alternatives is a problem to be recognised and avoided, resources would have been allocated to the project team for in-depth exploration of the building services element of the project, before work started on site. Allocation of time, financial and skills resources could have been arrived at with reference to the other 'components' in the project framework.

- *Liaison & Communication*

Scope would have existed for any shortcomings in the brief, due to lack of clarity or insufficient detail and instruction, to have been identified and discussed in an endeavour to resolve them.

- *Site & Materials*

The requirements set out in the brief would have been considered, giving due consideration to the relationship between the building services provision and the building. Opportunity would have existed for any unrealistic requirements to have been identified and communicated to the client. As much information, as possible, would have been provided about the building, and its construction, in order to evaluate the suitability of the proposals for the building services and to establish their necessity.

- *Programme*

Within the overall project programme, a realistic but also *flexible* time limit should have been allocated to solve problems and investigate alternatives for the building services. Utilising the

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[1] Costs were only kept within budget by omitting the item: trace heating, *after* work started on site.

structure, provided by the project framework, time limits could have been established, in a holistic way, through discussion and project team interaction.

- *Budget & Financial Matters*

The project team would have addressed the issues surrounding variations in the construction phase [they generally have cost implications, are often difficult value and have the potential to impact on the works programme]. It is proposed that efforts to minimise variations, once works started on site, could have reduced the impact on the works programme and cost.

- *Contract*

More detailed exploration into providing the building services solution would have ensured that the tender documents would have conveyed as much information as possible. This approach to preparing the tender may have highlighted difficulties before the work started on site.

- *Statutory Control; Health & Safety*

No observations can be made from the data.

Problem B

Different team members held different perceptions, or had different ideas, as to what was needed. The architect and client changed their minds many times during the project. The higher management, for making the final decision, had difficulty visualising the end product, with respect to the building services. Versatility and functionality, in some of the building services systems, did not provide optimal user-satisfaction.

Observations by the researcher had the project framework been employed:

- *Skills*

Given the knowledge that many clients are not equipped with the skills to read drawings, the electronic communication infrastructure could have been used to aid visualisation of scheme proposals, through providing a vehicle for discussion and questioning.

- *Liaison & Communication*

By using a holistic approach, team members would have asked each other questions to clarify and understand their respective individual objectives. Through use of the electronic communication infrastructure, timely answers could have then been provided and absent responses, readily identified.

- *Site & Materials*

Building services engineers would have talked to both the building users, and the client, as requirement of the project strategy, at the outset of the project.

- *Programme*

Being aware that variations have impact on the works programme, it is likely that the project strategy would have stipulated that *decisions should only be made* once all the necessary details had been established and discussed, within each of the project framework 'components'. As a result, needless changes to the works programme and their associated impact on the works activities might have been avoided.

- *Budget & Financial Matters*

Being aware that variations can have impact on cost, and are generally difficult to value, it is suggested that the project strategy would have stipulated that decisions should only be made once all the necessary details had been established and discussed, with reference to each of the project framework 'components'.

- *Contract; Statutory Control; Health & Safety*

No observations can be made from the data.

Problem C

With respect to subcontractors, limited knowledge and experience of working in listed historic buildings plus inadequate financial and skills resources to undertake the work, created problems. Insufficient attention was paid to specification and drawings. The availability of materials was not thought through thoroughly, in the preconstruction phase, and appropriate information about procurement periods never elicited. The BWIC [Builders Work In Connection] was extremely difficult to price. Record drawings of some installed systems were not made throughout the duration of works.

Observations by the researcher had the project framework been employed:

- *Skills*

Inept skills and inexperience would have been recognised as factors to avoid. The subcontractors would have never been appointed without clear demonstration, at the tender stage, that guidance would be provided by the company for its work force, in areas of deficiency.

- *Liaison & Communication*

Through monitoring and review of the project process, problems identified in relation to drawings and specification, inadequate attention to their instruction and production of record drawings, could have been flagged up immediately. Utilising the electronic format of the project framework, these matters could have been reported quickly to ensure timely management and resolve.

- *Site & Materials*

The project team would have ensured that availability and the likely length of procurement periods were established, before specifying components and discussed alternatives.

- *Programme*

The project team would have been aware of the potential difficulties in programming the mechanical and electrical work. As such, the need for information about procurement periods for components, fittings and plant would have been highlighted.

- *Budget & Financial Matters*

The project team and client would have been aware that contractors should be appointed on the basis of quality <u>and</u> cost. A more thorough investigation in to the financial and skills resources, held by subcontractors, would also have been undertaken and risks relating to insolvency evaluated.

- *Contract*

Following guidance provided by the project framework, preferred subcontractors would have been named in the contract who could have demonstrated a good track record in this area of work.

- *Statutory Control; Health & Safety*

No observations can be made from the data.

OVERVIEW

The observations made by the researcher are examples of how the project framework could have conferred benefit in relation to:

- Understanding of the scope of the building services and the roles and objectives of the team members
- The appropriate appointment of subcontractors and the subsequent satisfactory execution of the works.

10.6.1.1 Risk Management

No systematic risk management strategy was identified for the project when evaluating the evidence provided by the case study. Subscribing to the proposal by Smith (1999) benefit could have been gained from employing a systematic approach to risk management, as the project is characterised by the criteria cited in par.5.4.4.1.

10.6.2 Case Study 2

[Problems A, B and C are summaries compiled from case study data. The case study narrative is reported in *Appendix V*, pp. cv-cxiii.]

Problem A

Major refurbishment was carried out on an occupied building and maintaining the site in-use was very difficult. The size and scale of the building services increased once works commenced on site. More pipework and cables were required than had been originally anticipated. Problems encountered, when integrating the modern building services into the building, were also attributed to the physical constraints imposed by the building.

Observations by the researcher had the project framework been employed:

- *Skills*

As in Case Study 1, being aware that insufficient time to solve problems and investigate alternatives is a problem to be recognised and avoided, resources would have been allocated to the project team to explore, in depth, the extent and nature of the building services element of the project before work started on site. It is suggested that this approach should have been paramount, given that the building remained occupied throughout the duration of the construction phase. An awareness of the pitfalls, likely to occur when insufficient specialist expertise is provided in relation to the building services solution during the preconstruction phase, may have discouraged leaving the scheme proposals for the building services to the architect.

- *Liaison & Communication*

Given that communication between the project manager and the client is recognised as a potential problem, especially when buildings are occupied,[1] the communication infrastructure could have been employed as a vehicle to facilitate effective correspondence and interaction.

- *Site & Materials*

The need for a clear idea of the extent of cabling, and pipework, would have been identified when reviewing the articulation of the building services within the building.

- *Programme*

The team would have been aware of the potential impact of variations on the works programme and cost. This would have highlighted the need for adequate resources to be allocated re: investigating the nature and extent of the building services provision prior to the construction phase.

- *Budget & Financial Matters*

Allocation of financial resources, for in-depth exploration of the building and the nature and extent of the building services, would have been discussed and decided, mindful of the problems relating to insufficient financial resources - particularly in the preconstruction phase.

- *Contract; Statutory Control; Health & Safety*

No observations can be made from the data.

Problem B

The client was inexperienced in historic building conservation work. Visualising and understanding the details in the construction drawings were difficult for the client organisation. Decisions were made 'off the cuff'. Members of the project team delayed in making up their minds. Ambiguities were encountered in interpreting conservation objectives and the building conservation strategy was limited.

Observations by the researcher had the project framework been employed:

- *Skills*

The fact that the client was inexperienced in listed historic building refurbishment [and the integration of modern building services into listed historic buildings] would have been

[1] There is no specific evidence to suggest that communication between the client and the project manager was a problem. Nor is there evidence that it was optimal. As so, the 'best case' scenario is cited.

recognised as problem, to be managed. The need for support and guidance, to aid the client in taking an informed and interactive role in the decision making process, would have been identified.

- *Liaison & Communication*

It is suggested that delays in decision making would have been less likely, using the electronic communication infrastructure as a vehicle for posing questions, eliciting responses and recording dates and delivery of information. As in Case Study 1, the communication infrastructure could also be utilised to aid the client in visualising schemes, with scope for questioning and discussion

- *Statutory Control*

A more thorough discussion, to clarify any factors that were potentially ambiguous, would have been effected as early on as possible.

- *Site & Materials; Programme; Budget & Financial Matters; Health & Safety*

No observations can be made from the data.

Problem C

Radical changes were made to the original proposals for the building services in the construction phase. Factors arose, on site, that could not have been foreseen and alterations to preplanned works had to be made. Slight changes made by the client had a serious knock-on effect for the programme. Reconciling decisions relating to conservation objectives and financial pressures caused problems. The project was over budget and completion was late.

Observation by the researcher had the project framework been employed:

- *Working Methods*

The need to take sufficient time to solve problems and investigate alternatives would have been recognised; the project strategy could then have been devised to minimise the impact of the unforeseen in the construction of the building.

- *Liaison & Communication*

'Rich interaction' would have been paramount to ensure all parties were aware of the problems relating to unknown factors in the building's construction. All project team members would have contributed to discussions with respect to their own objectives, and how these objectives might impact on those of fellow team members.

- *Site & Materials*

The unknown factors in the construction of the building would have been recognised as a *serious* potential problem, when installing the building services. Discussion and viewpoints from all the project team, relating to the site, the building and the articulation of building services, could have provided the basis for devising a strategy, to deal with this issue, in an endeavour to minimise negative impact on the project's objectives.

- *Programme*

An essential stipulation when appointing contractors [and/or project mangers] would have been demonstration of their ability to plan and programme this type of work, particularly in relation to the building being occupied. The need to minimise changes, once construction had started, would have been a criterion in the project strategy.

- *Budget & Financial Matters*

From the inception of the project, the client would have been made aware that servicing buildings in conservation refurbishment projects is generally more expensive if standard approaches to design and installation are unacceptable. A realistic contingency should have been agreed, with respect to the unknown in the construction of the building and the knowledge that statutory requirements must be satisfied.

- *Contract*

Given the element of unknown in the construction of the building, through eliciting the viewpoints of the project team, prior to tender for the works, essential criteria would have been identified [1] and appropriate documentation could have been drawn up.

- *Statutory Control*

As a way of ensuring the project would prove to be as cost-effective, as possible, options relating to conservation objectives would have been reviewed, by all the project team through negotiation with the local authority conservation officer [or other representative].

- *Health & Safety*

No observations can be made from the data.

[1] Issues relating to programming in 'Programme' would contribute to the essential criteria that would form the basis for the contract documentation.

OVERVIEW

It is proposed benefit could have been conferred through use of the project framework; it could have aided the project team in devising a project strategy to minimise the potential negative impact caused by:

- Unknown in the construction of the building
- Occupancy throughout the execution of the works

10.6.2.1 <u>Risk Management</u>

No systematic risk management strategy was identified, for the project, when evaluating the evidence provided by the case study. Subscribing to the proposal by Smith (1999) benefit could have been gained from employing a systematic approach to risk management as the project is characterised by some of the criteria cited in par.5.4.4.1.

10.6.3 Case Study 3

[Problems A and B are summaries compiled from case study data. The case study narrative is reported in *Appendix V*, pp. cxiv-cxxi.]

Problem A

The unknown factors encountered in the construction of the building. The vast amount of BWIC [Builder's Work In Connection] associated with the installation of the building services. Protecting finishes was difficult. The conflict generated between building conservation objectives and the requirements of fire legislation.

<u>Observations by the researcher had the project framework been employed:</u>

- ❑ *Site & Materials*

In the awareness that protecting the works can be problematic, temporary works would have been thoroughly discussed by all the project team. It is proposed that key criteria, in the project strategy, to establish historical facts about the building, thoroughly investigate its structure and identify service routes could have aided the project team in evaluating the most effective approach to and extent of the BWIC.

- ❑ *Skills; Health & Safety; Programme; Budget & Financial Matters; Liaison & Communication; Statutory Control*

No observations can be made from the data.

Problem B

The mechanical and electrical work is serviceable but difficult to maintain and should have been given more consideration at the design stage. The lighting and heating provision is inadequate for meeting rooms, at times.

Observation by the researcher had the project framework been employed:

- *Working Methods*

Sufficient time to solve problems, and investigate alternatives, would have been identified as paramount. As a result, more resources dedicated to considering the performance and maintenance of the building services would have been provided at the design stage. This could have aided achieving an optimal solution.

- *Liaison & Communication*

The building services consultant would have talked to the building users, at the outset of the project, in terms of their needs and this could have provided valuable input.

- *Site & Materials*

Inadequate consideration given to the relationship between the building and its services provision would have been flagged up as a source of failure and, as such, matters relating to performance and maintenance could have been identified effectively.

- *Programme*

The project team would have paid special attention to the availability of suitable materials and their procurement periods.

- *Budget & Financial Matters; Statutory Control; Health & Safety*

No observations can be made from the data.

OVERVIEW

It is proposed that reviewing the particular difficulties and characteristics of the project from the outset, within the structure of the project framework, could have conferred benefit with respect to the following:

- Minimising problems relating to short construction periods
- Evaluating user requirements

10.6.3.1 Risk Management

No systematic risk management strategy was identified for the project when evaluating the evidence provided by the case study. Subscribing to the proposal by Smith (1999) benefit could have been gained from employing a systematic approach to risk management as the project is characterised by some of the criteria cited in par.5.4.4.1.

10.6.4 Project Team/ Product Integration In The Three Case Studies

In each of the three case studies, meetings were held between the project team and client organisation. In each case the attendance, structure and content relating to these meetings was organised differently. No data is available in respect of how different approaches impacted on the final outcomes of the project. However, it is proposed that if the format of the proposed project framework was used in conservation refurbishment [in which modern building services were an element of the works] to structure the way input was elicited, from the project team, it could provide a standardised approach to:

- the evaluation and response to potentially arising problems
- exchanging information.

It is suggested that the practice of applying a standard approach could be evaluated, in the development and piloting of the project framework, to ascertain advantages in terms of defining role objectives and goal objectives [par.10.3 refers] and bringing new practitioners into the field.

10.6.5 Benefit And Application Of The Project Framework: A Summary

According to Griffith *et al.* (2000)

"Both management and workforce need systems that are efficient, effective and clear and easy to understand and implement if the benefits are to be achieved and organisational synergy is to be maximised."

It is suggested, by the author, that further development of the operational aspects of the project framework should take special account of these factors. Mindful of the problems encountered in implementing the Co-ordinated Project Information Initiative, (Stockley, 1999) it is recognised that many management subsystems are dismissed because they are perceived to be cumbersome, time-consuming and require a change in approach to established working methods. Clearly, the extent of changes to established working methods, necessitated by use of the project framework, and the readiness with which practitioners might accept the project framework, would have to be ascertained through trial and evaluation. In addition, the disadvantages and benefits in terms of time and cost, in practice, would require analysis. Nonetheless, it is proposed that the project framework, outlined in par.10.5.2, would confer benefit [par.10.5.2.9] and is worthy of research. into its further development, for the following reasons:

❖ *Flexibility*

The project framework is based on 'components' of the 'product' [par.10.5.2] and, as such, could serve as an instrument to aid management of the project process, irrespective of the chosen procurement route or work plan.

❖ *Communication.*

A component of the project framework is dedicated to 'Liaison & Communication'. This necessitates review of communication, within the project process, by the project team. Over time, this approach could become embedded and a beneficial communication culture might evolve for the refurbishment of listed historic buildings, where integrating modern building services is an element of the works

❖ *Clarification of responsibilities*

The project framework is designed for use by the multidisciplinary team. It is not tailored to the needs of a particular discipline. To work effectively input is demanded from all project team members. It is suggested that this approach avoids solving problems in an independent way and, also, informs the respective team members of individual needs and objectives.

❖ *Conservation, Refurbishment, Modern Building Services And Risk*

The project framework proposes an approach to facilitating product team integration and understanding what is to be done. It is suggested, by the author, if the project framework was employed in the management of the project process, it would:

- Aid the realisation of conservation objectives [par2.3; par.5.1]
- Support the practice of best ways in refurbishment management [par.5.4.4.2]
- Advise the project team in making an effective response to the need for modern building services in listed historic buildings [par.5.1]
- Raise awareness relating to the project's risks, in an holistic way [par.5.4.4.1; par.10.5.3.1]

In conclusion, the findings in this study [evidence provided by the pilot study: Chapter 4; questionnaire Chapter 6 & 7, *Appendices II* and *III*; interviews: Chapter 8, *Appendix IV*: case study research: Chapter 9, *Appendix V*] have demonstrated that the refurbishment of listed historic buildings, which involves the design and installation of modern building services, has what Egan (2002) describes as *'repetitive essentials'*. In view of this, it is suggested that the project framework could be adopted as a 'common project framework' for all projects, of this nature, and could provide definition for the process as suggested in par.9.4.4.

10.6.6 A Common Project Framework: An Improvement On Current Practices

The findings of this study have been utilised as a basis to outline, in conceptual terms, a project framework. Additionally, it could be adopted as a *'common project framework'* for use in the refurbishment of listed historic buildings, where the integration of modern building services comprises an element of the works. The benefits of employing the project framework have been identified, *in hypothetical terms*, by considering the problems encountered in the case studies (Chapter 9 and *Appendix V* refer) and suggesting how its use could have ameliorated such problems. Benefits have also been discussed in par.10.6.5. Furthermore, it is proposed by the author that employing the project framework, in the management of the project process, would be an improvement on current practices for the following reasons.

10.6.6.1 <u>Protecting The Interests Of the Building</u>

Feilden (1994) states *'the historic building is the real client or patient'*. The conceptual model [Figure 10.2] embraces this idea and visually represents the 'patient' [the listed historic building] and its treatment [refurbishment, of which the integration of modern building services forms an element of the works] as central. Evidence from this study reveals that current practice is often dominated by cost and time, and problems arise as a result. It is suggested that through employing the project framework decision making, with respect to cost and time, would not be made without giving due consideration of other aspects of the process [defined in the project framework 'components']. This would provide a holistic approach, and, as a consequence, it is proposed could serve the interests of the 'real client or patient' better.

10.6.6.2 <u>Managing Vested And Conflicting Interests</u>

Strike (1994) identifies the factor of vested and conflicting interests in the early stages of the conservation project: '.... *the historian nothing changed, the archaeologist clean and pointed* *walls...'*. Reyers & Mansfield (2000) talk about the contest of opposing philosophies of the developers and preservers that ultimately results in *'a balance of subjective judgement but rarely professional unanimity'*. Issues relating to independent approaches and inflexible stances, in current practice, were identified in this study. It is suggested that problems relating to individual attitudes and objectives could be ameliorated through use of the project framework. It advises team members of the necessary ethos and approach to integrate them with the 'product' [the refurbishment of the listed historic building and the integration of modern building services] and each other.

10.6.6.3 <u>Communication</u>

Sharpe (1999) observes,

"With conservation works, the clear and established divide between architect and builder can cause problems unless both are proficient in the application of their respective skills and have formed proper lines of communication."

Evidence from the practitioners interviewed in this study, and examination of the case studies, shows that communication problems occur during the process of integrating modern building services into listed historic buildings. As stated, in par.10.6.5, benefit could be gained through employing the project framework: the project team would *necessarily* address liaison and communication. Clark (2001) states,

"The delivery of information should be grounded in a pragmatic approach tailored towards providing information when and where it is needed."

It is suggested that the electronic communication infrastructure, proposed in par.10.5.4, could aid communication by providing such a pragmatic approach. No other model, to satisfy this need and tailored to the requirements of the integration of modern building services into listed historic buildings, has been identified in the evidence elicited in this research.

10.6.6.4 <u>Decision Making And Problem Solving</u>

Powys, (1981) observes that when working with listed historic buildings, matters and problems arise, which require prompt decisions. O'Reilly (1987) adds to this by stating that prompt response to proposals and queries, put to the project team, *must* be ensured. In the opinion of Feilden (1994) expensive mistakes are made due to bureaucratic delays. The findings of this research indicated that no specific approach is employed, presently, to address delays in decision making although regular meetings were cited as crucial. It is proposed that current practice would benefit from an initiative to facilitate timely communication; this could be gained through employing the project framework in electronic format. It would provide a vehicle for posing questions, eliciting responses and recording dates and delivery of information.

10.6.6.5 Risk Management

Concerning risk in building conservation work, Warren (1996) declares there should be '*Minimal risk of significant loss, of damage or uncertainty in performance through intervention, selection of materials or through the calibre of operative*'. Evidence from this study [par.7.5.1 refers] indicated that no systematic risk management strategy was employed in the project process of integrating modern building services into listed historic buildings. This factor needs to be addressed. It is envisaged that the proposed project framework would be developed to include a clearly defined approach to encourage a collective risk style, improve risk communication, establish equitable risk sharing and deepen an understanding of marginal risks and their interdependencies [par.10.5.3.1 refers]. In view of this, it is suggested that adopting the project framework, for use in the project process, would be an improvement on the current risk management practice.

10.6.6.6 Database For Future Projects

Kay (1991) suggests that records of what has been done are useful in future projects that are similar but have different teams. Smith (1999) recognises the benefit of historical data to assist future risk management procedures. No system was identified in the findings of this study to archive information and provide a database of information[1] to aid future projects. Although a database for historical data has not been suggested, as part of the project framework, it is envisaged that a wealth of information concerning the project would be recorded in electronic format, through its use. Through electronic means, it is suggested it might be possible to save appropriate data gleaned from completed projects, compile a database dedicated to all aspects of the project, and its process, and contribute to this good practice.

10.7 SUMMARY

This chapter has discussed issues relating to the multidisciplinary team and the plan of work when integrating modern building services into listed historic buildings. A project framework has

[1] Guide To Building Services For Historic Buildings [CIBSE, 2002] provides information by illustrating 22 case studies. The content is, however, limited to design and workmanship.

been outlined in conceptual terms, based on the findings of this study, and its application and benefit have been discussed.

CHAPTER 11

In Conclusion

11.0 INTRODUCTION

The unfolding path of enquiry has been narrated in the previous chapters of this thesis. Based on the empirical data, findings were reported and propositions were suggested. This chapter briefly summarises these findings and notes the propositions that flow from them; it discusses the difficulties encountered in eliciting and interpreting the data and, also, highlights the limitations of the enquiry. Recommendations relating to the project process, and its management, are put forward and areas worthy of further research are suggested.

11.1 A BRIEF RÉSUMÉ

The study was started at the beginning of 1994. It began by a review literature relating to conservation in the built environment. To provide provenance to the study, current day principles of conservation and the legislation to protect historic buildings were identified. Refurbishment was identified as an approach to conserving listed historic buildings, either in need of update or requiring conversion to a new use. Risks relating to 'conservation refurbishment' were discussed. The need for modern building services in listed historic buildings was outlined, approaches to design and workmanship were described and the interrelationship between conservation, refurbishment, risk and modern building services stated. A research methodology was devised based on theoretical principles. Its aim was to be useful, credible, cost-effective, fair and ethical and, also, to elicit data that would add to the body of knowledge relating to the process of integrating modern building services into listed historic buildings. The data is arrayed in the appendices [see Nos. *II, III, IV, V*] annexed at the back of this thesis. The collected data was examined to ascertain facts about the project process and these will now be discussed.

11.2 REVIEW OF FINDINGS

The research strategy was divided into three separate stages, each one adopting a different methodology. The first stage involved eliciting data from a pilot study; the second stage yielded data through conducting a questionnaire survey, followed by open-ended interviews; in the third stage a multiple case study methodology examined three individual projects.

11.2.1 Stage I: Pilot Study

Overview

A pilot study [Chapter 4 refers] was undertaken to identify the characteristics that portrayed the refurbishment of listed historic buildings. To elicit this information, interviews were conducted with ten practitioners experienced in undertaking building conservation work. A content analysis of the interviews was undertaken and the data compiled, in respect of refurbishment characteristics, using the following categories: *'Programme'*, *'Skills, Working Hours & Working Methods'*, *'Liaison & Communication'*, *'Health & Safety'*, *'Budget & Financial Matters'*, *'Statutory Control'*, *'Site & Materials'* and *'Contract'*.

Data relating to risk, and its management, was compiled in categories, *viz.* *'Programme'*, *'Technological'*, *'Conservation'*, *'Environmental/Health & Safety'* and *'Budget & Financial'*.

The findings can be summarised as follows:

- The refurbishment of listed historic buildings demands the input of a highly skilled, multidisciplinary team.
- The project should be approached in a holistic way and requires the contribution of the individual disciplines from the early stages, in the project.
- Problems encountered in the refurbishment of listed historic buildings often arise out of uncertainty; this exposes the project to risk.
- Integrating modern building services into listed historic buildings is an element of building conservation work that is frequently high-cost and problematic.

11.2.2 Stage II: Questionnaire Survey: Degree of Difficulty & Frequency Of Occurrence

Overview

Forty-five individual characteristics were identified in relation to the integration of modern building services into listed historic buildings [Chapter 6 refers]. These were rated for frequency of occurrence and degree of difficulty by architects, buildings services consultants, quantity surveyors, building surveyors, structural engineers, mechanical & electrical contractors and main contractors. The data was analysed by employing the categories devised for content analysis in the pilot study [par.11.2.1 refers].

The findings can be summarised as follows:

- The process of integrating modern building services into listed historic buildings can be identified by a set of refurbishment characteristics.

- Some of the most difficult and most frequent of these characteristics were identified by questionnaire respondents, *viz.* constraints imposed by the structure of the building and the limited space for integrating the building services within this structure; pricing the works; cost control; programming & scheduling the works.

Propositions

The data supported the propositions that:

- The process of integrating modern building services into listed historic buildings has its own discrete refurbishment characteristics and these may be some of the most difficult and frequent.
- There is some commonality in the degree of difficulty and frequency of occurrence of the characteristics encountered in the general refurbishment process and integrating modern building services into listed historic buildings.
- Some professionals in the construction industry have very definite ideas about the boundaries of roles and responsibilities for the individual members of the project team.

11.2.3 Stage II: Questionnaire Survey: Likelihood & Acceptability Of Risk

Overview

Those taking part in the questionnaire survey [par.11.2.2 refers] were also asked about the likelihood and acceptability of certain adverse events taking place in the process of integrating modern building services into listed historic buildings [Chapter 7 refers]. Perceptions relating to risk, and details of how risk was managed in the project process, were sought.

The findings can be summarised as follows:

- Respondents used different approaches to manage risk in the project process of integrating modern building services into listed historic buildings. These varied from experience and intuition, on the one hand, to the use of more explicit procedures such as risk questionnaires and risk registers, on the other. The study identified no systematic risk management strategy, tailored for use in the project process.
- Perceptions held by the interviewed practitioners, regarding the likelihood and acceptability of adverse events taking place, showed some variability.

Propositions

The data supported the following propositions:

- Experience, intuition, checking and established good practice, largely, form the basis for managing risk when integrating modern building services into listed historic buildings.

- ❑ Management of risk, whether deemed strategic or not, adheres to no common framework.
- ❑ Certain disciplines view risk, and its management, to be more within the scope of their role than others.
- ❑ Generally, catastrophic events were perceived to be remote and unacceptable whilst less threatening events were deemed more frequent and more acceptable.

11.2.4 Stage II: Open-Ended Interviews

Overview

Open-ended interviews were conducted after the respondents had completed the questionnaire. Interviewees were asked to identify factors that contributed to success and, also, problems that posed threats to such success [Chapter 8 refers].

The findings can be summarised as follows:

- The use of a holistic and strategic approach; knowledge and understanding of the building; suitably trained, experienced and organised personnel; good communication; well thought-out works programmes; realistic financial and time resources; appropriate contract documents and tender documentation were identified as factors that contribute to the successful outcome of integrating modern building services into listed historic buildings.
- Insufficient and/or unavailable information; variable technical knowledge; personality issues; time overruns; inadequate financial resources and poor quality documentation were identified as problems encountered in the project process.

Proposition

The data supported the following proposition:

- ❑ The meeting of time, cost and quality objectives is inextricably linked with the composition of the project team and how it manages and organises itself.

11.2.5 Stage III: Case Study Research

Overview

Three case studies were investigated to take account of the whole project, rather than reviewing opinions based on the professional experience of practitioners, generally [Chapter 9 refers]. The data was examined with a view to identifying any repetitive characteristics that might exist, from project to project, and what lessons, if any, were to be learned from previous projects.

The findings can be summarised as follows:

- The elicited data reinforced the findings identified in the pilot study, questionnaire survey and interviews. It also supported the premise that integrating modern building services into listed historic buildings is characterised by 'repetitive essentials'.

The data supported the following proposition:

Proposition

- Benefit would have been derived if more attention had been placed on the building services element of the works, before the work commenced on site.

11.3 DIFFICULTIES & LIMITATIONS

The study topic was multi-faceted. Emphasis was not placed on any one aspect of the process of integrating modern building services into listed historic buildings, in order that an appreciation of the bigger picture might be gained. Any study that evaluates a system rather than focusing on an individual element within that system, will, of necessity be broad rather than deep. [Difficulties and limitations imposed by the method of data collection, and analysis of the raw data, were identified in the individual chapters of this thesis].

By way of summary the main difficulties and limitations were as follows:

- Identifying a representative sample population of practitioners and building conservation projects was problematic. The data needed to be sufficient for making a realistic contribution to the understanding of the process.
- Eliciting data that was not biased. Respondents were assured of anonymity but disclosure of some information may have been deemed by interviewees to be prejudicial to themselves, their consultancy/business or their clients and hence responses were selective.
- The long time length of the research questionnaire and the follow-on research interview. Although economic in terms of cost, the research instrument was mentally demanding for both the respondent and the interviewer. It is suggested benefit would be gained from exploring the project categories [e.g: Programme, Liaison & Communication etc.] individually, and in a more in-depth way. Findings could then be related to the process as a whole, to provide context and relevance.
- Processing the data. The amount of information amassed was enormous. Although a framework for analysis was devised before the study began, interpreting the data was complex. The findings and propositions were best related, chapter by chapter, following the unfolding path of the enquiry. Recording the elicited data in

appendices was decided to be the optimal arrangement for arraying the data. It is suggested that the data recorded in the appendices provides an information source for future research initiatives.

- Only general propositions could be made relating to the process of integrating modern building services into listed historic buildings. Construction projects, by their very nature, are individual and building conservation projects are no exception.

11.4 OVERVIEW OF THE WHOLE STUDY

Research into the integration of modern building services into listed historic buildings has established that the process is capable of definition by its constituent characteristics. Certain characteristics tend to be more difficult and more frequent than others. Evidence suggests that risk analysis and risk management techniques employed in such work are, generally, intuitive and arbitrary and no common systematic approach is employed. Factors that contribute to the successful outcome of this element of building conservation work were identified and, also, factors that threatened such success. Analysis of the case studies supports the proposition that the process of the integration of modern building services into listed historic buildings, as part of the refurbishment process, has repetitive essentials. The study concludes by utilising the research data to outline a project framework to aid 'product team integration' and 'understanding what is to be done'.

11.5 RECOMMENDATIONS

Integrating modern building services into listed historic buildings poses problems and risk. Furthermore, failures can occur in the project process and its work stages. Based on the findings of this study, the following recommendations are suggested as ways of facilitating the likelihood that desired project outcomes are achieved.

1. The Project Team

The refurbishment of listed historic buildings is a multidisciplinary activity. Evidence has shown that project team members, although proficient in their own area of expertise, may pay inadequate attention to how their role interconnects and impacts on those of the other team members. In some cases, certain practitioners dismissed the activities undertaken by other disciplines as 'outside their domain' and, as such, failed to recognise the importance of employing a holistic approach to managing the project and executing the works. It is strongly recommended that each project team member should have a core understanding of:

- the contribution made by their fellow team members
- how actions and decisions made, throughout the duration of the project, are interrelated

The need for training, for individuals and organisations in the field of building conservation work, has been identified in this study. It is recommended that training programmes should include a component dedicated to deepening understanding of the relationship between project team members and the interrelationship of their respective roles.

2. The Plan Of Work

Successful synchronisation of the building services element of the work, within the overall plan of work for the refurbishment of the listed historic building, is crucial. Evidence shows that this is not always achieved and failures in the project process occur as a result. From the findings of this study, it is recommended that the timing of:

- appointments for building services consultants

and

- letting contracts for mechanical and electrical work [design and/or installation]

must be carefully considered at the inception of the project; building services consultants should be engaged as early on as possible.

After reviewing the evidence in the case studies, cited in this report, it was proposed that benefit could have been derived if more attention had been paid to the building services element of the works before the works commenced on site. It is recommended, therefore, that the project team should focus attention on the design, specification and procurement of modern building services for the listed historic building *before* the main contractor takes possession of the site.

3. Managing The Project To Promote Success

The process of integrating modern building services into listed historic buildings, as part of the refurbishment process, can be identified by a set of characteristics. This study suggests that the management of the process, by the multidisciplinary project team, could be aided through improved understanding of these characteristics and by raising awareness with regard to 'repetitive essentials'. In this report, the refurbishment project is divided into a framework of eight components. Recommendations are stated below relating to each of these constituent parts. The recommendations are relevant and important to the successful management of all projects concerning the integration of modern building services into listed historic buildings and, as such, can be regarded as repetitive essentials.

- Skills, Working Hours &Working Methods

Select consultants, contractors and subcontractors who are experienced in conservation refurbishment, understand the construction of historic buildings and can anticipate likely problems.

- Liaison & Communication

Establish a communication infrastructure that ensures that information flows from the top to the bottom of the team organisation and vice versa. Create a team dynamic conducive to trust. Employ a holistic approach to decision making and regulate the timeliness of responses to questions, raised by the project team.

- Site & Materials

Thoroughly investigate the history of the building and its construction before making any decisions relating to building services proposals. Early on, identify service routes that avoid conflict with features and interiors. Specify materials and systems that are sympathetic to the cultural, aesthetic and physical properties of the building.

- Programme

Allow more time for activities, in conservation refurbishment, than that normally allocated to similar activities in non-conservation refurbishment. Place emphasis on forward planning and quantify the time factor in lead-in periods. Flag up delays immediately. Assess variations promptly and take account of their impact on the works programme.

- Budget & Financial Matters

Prepare timely budget estimates. Allocate realistic financial resources for investigative work into the construction of the building and its history. Cost control is easier if the design and specification is complete at the tender stage – provide the optimal level of detail whenever possible; include a schedule of rates in the tender documentation for areas of work that cannot be exactly quantified. Carry out a financial investigation on prospective consultants and contractors.

- Health & Safety

Work in close liaison with the planning supervisor [if applicable].

- Statutory Control

Sort out all issues relating to statutory control and English Heritage, early on in the project.

- Contract

Resolve all precontract problems before letting the contract. Ensure contract documentation is as full as possible. Name preferred specialist subcontractors in the contract documents. Do not amend standard forms of contract.

4. Managing Risk

Conservation projects have been identified as 'risky'. Evidence identified in this study has shown that the nature and scope of the work involved in the integration of modern building services into listed historic buildings warrant systematic risk analysis. Data elicited, in this investigation, indicates that some practitioners rely on their intuition and personal experience to identify and respond to project risk. It is recommended that a systematic and holistic approach to risk management should be employed to:

a. interrelate individual risk management strategies, employed by project team members, within a standardised infrastructure
b. establish equitable approaches to risk sharing
c. deepen the understanding of the impact of marginal risks and their interdependencies
d. improve risk communication
e. clarify and publicise responsibilities to all the project team

5. Guidance For The Project Team

The research revealed that problems in the process arise out of inexperience; poor co-ordination, communication and instruction; lack of information; inappropriate level of specification; ill-timing; inflexibility, financial issues; time factors. It is recommended that guidance, specifically relating to the integration of modern building services into listed historic buildings, should be provided for practitioners and clients, to help manage these problems. It is suggested that the project framework proposed in Chapter 10 [par.10.5.2] could offer such guidance.

SUMMARY

Recommendations have been made with respect to the project team, the plan of work, management of the project process and guidance for project team members. All of these recommendations support the central aim of successfully conserving the listed historic building and securing its future for posterity.

11.6 AREAS WORTHY OF FURTHER RESEARCH

The data elicited in this research has provided information about the process of integrating modern building services into listed historic buildings. The path of enquiry has also led to proposals about the process. Furthermore, it offers suggestions to aid practitioners in this area of work. It is recommended, by the author, that the following areas are worthy of further research and these will now be outlined.

1. Development Of A Common Project Framework

The conceptual model [par.10.5.2 refers] outlines a project framework for integrating modern building services into listed historic buildings. It is proposed that further investigation should be undertaken into how this framework could be developed to:

- be appropriate to all work of this nature and hence 'a common project framework'. based on 'repetitive essentials'
- complement the management subsystems employed in refurbishing listed historic buildings and the integration of modern building services as part of the refurbishment process
- operate electronically
    i. to maximise the scope for communication throughout the project
    ii. provide a source of information that could be utilised in building databases containing historical data and of benefit to future projects.

2. Improving Risk Management And Risk Communication

In Chapter 7, par.7.7, it was suggested that further research might explore the following to make a positive contribution to risk management in the integration of modern building services into listed historic buildings, *viz.*

- the development of a common risk management framework for use in these projects.
- risk communication:
    - investigation into how it is presently done
    - how it can achieve balanced and proportionate appraisal of the impact of marginal risks and their overall impact on the project.

3. Understanding Team Communication

Effective communication was identified as an important factor in the process of integrating modern building services into listed historic buildings, in Chapters 4, 5, 7, 8, 9 and 10. In par.10.4.3 the attitude of team members and their relationship, within the project team, was briefly discussed and recognised as a potential source of difficulty. In view of this, it is suggested that the following are topics worthy of further research.

- investigation into the project team culture and dynamic
- the significance of former working relationships in the project team
- bringing new practitioners into the project team

11.7 FINAL SUMMARY

The research undertaken for the requirements of the Doctor Of Philosophy has been reported in this thesis. The nature of the study adopted a naturalistic form of enquiry. The findings revealed information about the characteristics of the process of integration of modern building services into listed historic buildings. Factors were also identified relating to risk, success and threats to such success, within the project process. The study concludes by suggesting, in conceptual terms, a model for aiding 'product team integration' and 'understanding of what is to be done' in the project process. In the final chapter, recommendations are stated concerning the successful management of the project process. Furthermore, areas worthy of further research are suggested in relation to the development of a Common Project Framework, improving risk management and risk communication, and understanding team communication.

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APPENDIX I

QUESTIONNAIRE SURVEY
(Blank Format)

QUESTIONNAIRE SURVEY - OBU/J/2

Justine Nichols
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Oxford Brookes University
Gipsy Lane Campus
Headington
Oxford OX3 0BP

Date:

QUESTIONNAIRE BRIEF

The context and parameters of this survey are as follows:-

All questions relate to the operational problems encountered during the construction phase of the refurbishment of historic buildings. Only those problems occurring as a result of the integration of modern building services (mechanical, electrical etc.) are to be considered when answering the questions. Please return completed questionnaire by 29th January 1995. Please refer to Guidance Notes OBU/J/G before filling in Sections 2 and 3.

1 PROFESSIONAL ROLE OF RESPONDENT

As a member of the building team, which of the following positions do you generally hold?

1.1 Contractor

		Role in Organisation (e.g. Project Manager, etc.)
General Contractor:	Lead ☐	
	Sub ☐	
Specialist Contractor:	Lead ☐	
	Sub ☐	

1.2 Consultant

		Role in Organisation (Partner, Director, etc.)
Architect	□	
Services Engineer	□	
Quantity Surveyor	□	
Structural Engineer	□	
Conservation Officer	□	
Other: Please specify	□	

1.3 Client

		Role in Organisation (Owner, Custodian, Developer)
Local Authority	□	
English Heritage	□	
National Trust	□	
Public	□	
Trust	□	
Crown	□	
Private	□	
Other: Please specify	□	

2 GENERAL INFORMATION

2.1 Considering building services refurbishment, which of the following categories of owners or custodians does your work involve you with?

Local Authority	☐	Crown	☐
English Heritage	☐	Private	☐
National Trust	☐	Trust	☐
Public	☐	Other: Please specify	☐

2.1.1 Is there a main category that you undertake work for or with?

Yes	☐
No	☐

2.2 Thinking about the end use of the refurbishment historic building, which of the following have you been involved with?

Public Use		**Private Use**	
Commercial (e.g. office)	☐	Residential	☐
Tourism/Cultural (e.g. museum)	☐	Other: Please specify:	☐
Light Industrial (e.g. warehouse)	☐		
Other: Please specify:	☐		

2.2.1 Do you specialise in any particular category?

Yes	☐	Please specify:
No	☐	

2.3.1 Please give details of three of the principal projects you have worked on/been involved with.

Building Listing Category	Approximate Contract Value £	Brief Details of the Building Services Refurbished	Comments

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3 REFURBISHMENT CHARACTERISTICS

(Before commencing this section, please refer to Guidance Notes OBU/J/G Section 2 – *Definitions and Parameters* (paragraphs 2.1, 2.2, 2.3, 2.4 and 2.5 refer)

Based on your personal working experience and relating to the integration of modern building services into historic structures, please rank the following refurbishment characteristics for frequency and difficulty. Where applicable please tick the C (cost) or T (time) boxes or indicate N/A.

3.1 Programme

3.1.1 Influence of tenant on regular progress of works.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	□	□	□	□		C □
Frequency	□	□	□	□		T □
						N/A □

3.1.2 Variation or change to order of works.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	□	□	□	□		C □
Frequency	□	□	□	□		T □
						N/A □

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.1.3 Time prediction for completion of works.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.1.4 Influence of conservation objectives on regular progress of the works.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.1.5 Programming and scheduling of works.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.2 Skills, Working Hours and Methods

3.2.1 Restrictions on working hours.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.2.2 Long and unsociable working hours.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.2.3 Selection and recruitment of the work force

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.2.4 Restriction on working methods (e.g. hot work).

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.2.5 Coping with employee stress and absenteeism.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.2.6 Restriction on plant usage.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.2.7 Productivity control and maintenance.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.2.8 Quality control and assurance.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.3 Liaison and Communication

3.3.1 Supervision of the works

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.3.2 Liaison with tenant or occupier.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.3.3 Liaison with Building Control.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.3.4 Liaison with Planning Officer.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.3.5 Liaison with Fire Protection Officer.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.3.6 Liaison with English Heritage Inspector.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.4 Health and Safety

3.4.1 Dust control

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.4.2 Noise control.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.4.3 Handling and disposal of hazardous/toxic substances.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.4.4 Handling and disposal of site rubbish.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.4.5 Protecting the general public.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.4.6 Maintaining safety standards and welfare standards.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.5 Budget/Financial Matters

3.5.1 Cost control

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.5.2 Pricing the works.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	□	□	□	□		C □
Frequency	□	□	□	□		T □
						N/A □

3.5.3 Remuneration.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	□	□	□	□		C □
Frequency	□	□	□	□		T □
						N/A □

Please tick which of the following are applicable to your assessment of 3.5.3:

Interim/Stage Payments	□
Contra charges/Set Off	□
Other: Please Specify:	□

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.6 Statutory Control

3.6.1 Building regulations.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.6.2 Planning permission

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.6.3 Listed building consent.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.6.4 Fire protection requirements.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.7 Site and Materials

3.7.1 Site access.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.7.2 Storage of building materials/plant.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.7.3 Site security.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.7.4 Protecting the works and adjacent buildings.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.7.5 Materials handling.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.7.6 Material supply.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.7.7 Plant supply.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.7.8 Spatial constraints imposed by the building.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.7.9 Structural constraints of the building.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	□	□	□	□		C □
Frequency	□	□	□	□		T □
						N/A □

3.7.10 Keeping the site tidy.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	□	□	□	□		C □
Frequency	□	□	□	□		T □
						N/A □

3.7.11 Maintaining existing services.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	□	□	□	□		C □
Frequency	□	□	□	□		T □
						N/A □

Difficulty/Frequency Table			
1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

3.7.12 Decanting the building for commencement of work.

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

3.8 Contract

3.8.1 Contract documentation/arrangement

	1	2	3	4	Comments (Where Applicable)	
Difficulty	☐	☐	☐	☐		C ☐
Frequency	☐	☐	☐	☐		T ☐
						N/A ☐

Please tick which of the following are applicable to your assessment of 3.8.1:

Fairness of terms and conditions	☐
Suitability of terms of contract (bespoke on standard)	☐
Administration of contract conditions	☐
Other: Please Specify:	☐

3.9 Concerning the integration of modern building services into historic structures, are there any operational problems that you have encountered, which have not been listed so far?

No ☐

Yes ☐ *Please specify:*

....
....
....
....
....
....
....
....

4 **RISK** (Please see Guidance Notes (OBU/J/G – paragraph 3.1)

4.1 Most projects have a degree of uncertainty and, therefore, the building, the client, the contractor, the consultants and other interested parties may be exposed to risk. Within the context of this study, considering the likely risk that may be encountered in your work, or your involvement as an interested party, do you apply or use any form of risk management strategy?

Yes ☐ *Please describe:*

....
....
....
....
....
....
....
....

No ☐ *If "No", how do you consider the risks, inherent in such projects, are best managed?*

....
....
....
....
....
....
....

4.2 Please **REFER TO GUIDANCE NOTES OBU/J/G** Section 3 "Risk" **BEFORE** completing this table.

Base **ALL** assessments on:

(a) your personal working experience;
(b) within the parameters set out in Guidance Notes par 3.2, 2.1 and 2.2;
(c) using the rank values assigned to the various description categories in the "Likelihood" table (Guidance Notes par 3.2.1).

TABLE 4.2.1(a) LIKELIHOOD			
Risk Type	**Consequence**	**Likelihood**	**Comments**
Budget	**Bankruptcy (Client)**		
	Bankruptcy (Contractor)		
	Substantial claim (by contractor)		
	Substantial damages (in favour of client)		
	Contingency consumed		
	Accommodated as part of contingency/insurance excess		
	So minor as to be regarded without consequence		

TABLE 4.2.1(b) LIKELIHOOD			
Risk Type	**Consequence**	**Likelihood**	**Comments**
Programme	**Complete programme reorganisation required**		
	Completion date over run		
	Delay causing down time of plant		
	Disruption to other trades		
	Minor hold ups		
Technological	**Structural integrity of the building undermined**		
	Quality standards not met		
	Latent defects		
	Abortive works		
	Materials/skills not readily available		
	Superficial damage to building fabric		
	Minor damage/problems that can await repair		

TABLE 4.2.1(c) LIKELIHOOD			
Risk Type	**Consequence**	**Likelihood**	**Comments**
Environmental /Health and Safety	**Death**		
	Serious pollution hazard		
	Lost time injury or illness		
	Injury/illness requiring first aid at work		
	Minor events e.g. apology letter only required		
Conservation	**Significant loss of historic fabric**		
	Intervention which is not reversible/minimal		
	Loss of visual amenity		
	Minor/superficial damage to building fabric		

4.3 Please **REFER TO GUIDANCE NOTES OBU/J/G** Section 3 “Risk” **BEFORE** completing this table.

Base **ALL** assessments on:

(a) your personal working experience;
(b) within the parameters set out in Guidance Notes par 3.3, 2.1 and 2.2;
(c) using the rank values assigned to the description categories in the “Acceptability” table (Guidance Notes par 3.3.1).

Table 4.3.1(a) ACCEPTABILITY		**“ACCEPTABILITY”**		
Risk Type	**Consequence**	**Risk**	**Consequence**	**Comments**
Budget	**Bankruptcy (Client)**			
	Bankruptcy (Contractor)			
	Substantial Claim (by contractor)			
	Substantial damages (in favour of client)			
	Consumed contingency			
	Accommodated as part of contingency/insurance excess			
	So minor as to be regarded without consequence			

Table 4.3.1(b)	ACCEPTABILITY	"ACCEPTABILITY"		
Risk Type	Consequence	Risk	Consequence	Comments
Programme	Complete programme reorganisation required			
	Completion date over run			
	Delay causing down time of plant			
	Disruption to other trades			
	Minor hold ups			
Technological	Structural integrity of the building undermined			
	Quality standards not met			
	Latent defects			
	Abortive works			
	Materials/skills not readily available			
	Superficial damage to building fabric			
	Minor damage/problems that can await repair			

Table 4.3.1(c) ACCEPTABILITY		"ACCEPTABILITY"		
Risk Type	**Consequence**	**Risk**	**Consequence**	**Comments**
Environmental /Health and Safety	**Death**			
	Serious pollution hazard			
	Lost time injury or illness			
	Injury/illness requiring first aid at work			
	Minor events (e.g. apology letter only required)			
Conservation	**Significant loss of historic fabric**			
	Intervention which is not reversible			
	Aesthetic draw back			
	Minor/superficial damage to building fabric			

Thank you for taking part in this survey. If you have any further comments to make on the subject area and/or the questionnaire, please write in the box below.

Comments:

If you require further information regarding this questionnaire, or more about the study area, please do not hesitate to contact me.

If you would be willing to answer any queries relating to the completed questionnaire, please leave a telephone contact number in the box below.

Code:	Number:

Justine Nichols (Mrs)

Tel: *Oxford (01865) 483360*
Fax: *Oxford (01865) 483387*

Guidance Notes OBU/J/G: For Use With Questionnaire Survey

INTRODUCTION

This questionnaire survey has been designed to investigate specific problems and risk experienced by members of the building team, involved in heritage refurbishment. As part of a PhD study, it provides the basis for further research, the findings of which it is hoped will be of value to those working in the construction industry and historic building/structure conservation.

1 **Confidentiality and Anonymity**

To ensure anonymity, all information given by those taking part in this survey will be treated in a confidential manner. No specific project, person or organisation will be mentioned in the processed data, unless *express permission* is given by the respondent.

2 **Definitions/Parameters**

2.1 **Modern building services** will include heating, lighting, hot & cold water supply systems, electrical installations, ventilation and air conditioning, fire protection and security measures.

2.2 **Refurbishment Characteristics**, for the purpose of this study, will be considered to be, only those encountered, once the contract has been let and the lead contractor has taken possession of the site.

2.3 **Frequency** means the rate of occurrence of a particular refurbishment characteristic.

2.4 **Difficulty** means hard to deal with, do, or practise. If the difficulties arising from a particular refurbishment characteristic are not in resolving the problems itself, but are difficult in terms of the cost or time available, please rank either of the latter two on the same rank value basis (1-4) and also tick the C (Cost) or T (Time) box in the adjacent column.

2.4.1 **Difficulty/Frequency Rank Value Table**

1	2	3	4
Very Difficult	Difficult	Fairly Difficult	Not Difficult
Very Frequent	Frequent	Fairly Frequent	Not Frequent

2.5 **Not Applicable (N/A)** Where a particular characteristic is not encountered, by the respondent during the execution of his/her work or his/her involvement in heritage refurbishment, please tick the N/A box.

3 Risk

3.1 Definition

Risk and uncertainty: Uncertainty is that which cannot be accurately known or predicted. Risk is the chance of an adverse event. Risk can be said to be a measure of the likelihood of a specific unwanted event and its unwanted consequences or loss.

Likelihood x Consequence = Risk

3.2 Likelihood

This refers to the probability of such an event occurring in building conservation projects and specifically those associated with the integration of modern building services.

Please use the "Likelihood Rank Value" table 3.2.1 when making your assessment. If you feel you are unable to make a valid judgement, please write **DK** in the comments section of the table.

3.2.1 Likelihood Rank Value Table

Likelihood	**Description**	**Rank Value (value to be entered in questionnaire)**
Frequent	Very common, occurs in nearly all projects	1
Probable	More likely to occur than not, but not in most projects	2
Occasional	It happens now and then, but is not a regular occurrence	3
Remote	Slight chance; possible, but not likely	4
Improbable	Very unlikely	5

3.3 Acceptability

This refers to how acceptable the respondent considers it would be to take the risk of such an event occurring. Please use rank values in Acceptability Rank Value table 3.3.1 and record your assessment under the **acceptability:risk** column.

You may consider the risk or its management is outside the scope of your role within the building team. If so, please base your assessment on how acceptable you would consider it would be for such an event to occur in a project you were involved with. Use the same rank value table 3.3.1 and record your assessment in the **acceptability:consequence** column.

3.3.1 Acceptability Rank Value Table

Acceptability	Description	Rank Value (value to be entered in questionnaire)
Unacceptable	Intolerable, must be eliminated or transferred	1
Undesirable	To be avoided if reasonably practicable. Detailed investigation required, and monitoring essential	2
Acceptable	Can be accepted, providing the risk is managed	3
Negligible	No further consideration needed	4

3.4 Comments

Comments are invited under both "likelihood" and "acceptability" and would be most useful.

4 Completion Date

It would be appreciated if those wishing to take part in this survey completed the questionnaire, as soon as possible. The last date for receiving completed questionnaires for inclusion in the survey is 29th January 1995.

References

Godfrey, P. (1994) *The Control of Risk* 7th Annual Conference Risk Management and Procurement in Construction, CIRIA, UK pp. 2-25.

Young, B & Egbu, C. (1993) *The Characteristics and Difficulties Associated with Refurbishment and the Need for Education and Training from a Management Perspective* 9th Annual Conference, ARCOM, UK pp. 338-347.

APPENDIX II

THE DEGREE OF DIFFICULTY AND FREQUENCY OF OCCURRENCE OF REFURBISHMENT CHARACTERISTICS ENCOUNTERED WHEN INTEGRATING MODERN BUILDING SERVICES INTO LISTED HISTORIC BUILDINGS

List Of Refurbishment Characteristics

L.2.1 Characteristics Identified In the Research By Young, B.A. & Egbu, C. O. (1993)

Contract documentation/arrangement.
Coping with employee stress and absenteeism
Cost control
Decanting building for commencement of works
Dust control
Handling and disposal of site rubbish
Handling and disposal of toxic/hazardous substances
Influence of tenant on progress of works
Keeping the site tidy
Liaison with the tenant or occupier
Long and unsociable working hours
Maintaining existing services
Maintaining safety and welfare standards
Materials handling
Materials supply
Noise control
Plant supply
Pricing the works
Productivity control and maintenance
Programming and scheduling the works
Protecting the general public
Protecting the works and adjacent buildings
Quality control & maintenance
Restriction on plant usage
Restrictions on working hours
Selection and recruitment of workforce
Site access
Site Security
Statutory Control*
Storage of building materials and plant
Supervision of the works
Time prediction for completion of works
Variation or change to the order of the works

L.2.2 Additional Characteristics Identified By Pilot Study (Chapter 4 refers.)

Building regulations*
Fire protection regulations*
Influence of conservation objectives on the progress of the works
Liaison with building control*
Liaison with fire protection officer*
Liaison with planning officer*
Listed building consent*
Liaison with English Heritage inspector
Planning permission*
Remuneration
Restriction on working methods
Spatial constraints of the building
Structural constraints of the building

***Note:** Statutory control, an individual characteristic in the list L.2.1 has been subdivided into 8 characteristics, for the purposes of questionnaire survey OBU/J/2, as starred in L.2.2

Refurbishment Characteristics Subdivision: **Programme**

Question No:3.1.1 ***Influence of tenant on regular progress of works***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**12**	**34**
Average Score	2.800	2.935
Standard Deviation	0.961	0.964
% that answered **the question**	86%	86%
% that answered **N/A**	14%	14%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	31%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	26%	
Additional Comments: Depends on client. Working around occupants needs careful planning. Constant complaints about noise.		

Question No: 3.1.2 ***Variation or change to order of the works***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**13**	**3**
Average Score	2.809	2.264
Standard Deviation	1.000	0.994
% that answered **the question**	97%	97%
% that answered **N/A**	3%	3%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	43%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	43%	
Additional Comments: Materials required at short notice cause problems. Has different impact in different stages of the project. Varies from contract to contract. More likely when inadequate design by building services consultant. Usually due to unknown in building construction. Exacerbated by pressure of time and resources.		

Question No: 3.1.3 ***Time prediction for completion of works***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**11**	**13**
Average Score	2.794	2.588
Standard Deviation	0.808	0.891
% that answered **the question**	97%	97%
% that answered **N/A**	3%	3%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	26%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	23%	
Additional Comments: Very difficult to get right. Difficulties due to inadequate design of building services. Always pressure on building services installation. Cannot predict unforeseen work		

Refurbishment Characteristics Subdivision: **Programme**

Question No: 3.1.4 ***Influence of conservation objectives on regular progress of the works***

	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**14**	**37**
Average Score	2.818	3.000
Standard Deviation	1.102	1.031
% that answered **the question**	94%	94%
% that answered **N/A**	6%	6%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	29%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	26%	
Additional Comments: Not normally too bad. Must get consultant and conservation officer together early. Samples of work have cost implications. Problems created when opening up not carried out in preconstruction phase. Conservation work costs more and takes longer. Conservation objectives run the work rather than vice versa.		

Question No: 3.1.5 ***Programming and scheduling works***

	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**6**	**16**
Average Score	2.714	2.643
Standard Deviation	1.013	1.026
% that answered **the question**	80%	80%
% that answered **N/A**	20%	20%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	20%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	14%	
Additional Comments: Difficult to keep to. Flow of information is crucial between consultant/client and M/E contractor.		

Refurbishment Characteristics Subdivision: **Skills, Working Methods & Working Hours**

Question No: 3.2.1 ***Restrictions on working hours***

	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**41**	**40**
Average Score	3.419	3.226
Standard Deviation	0.923	1.055
% that answered **the question**	89%	89%
% that answered **N/A**	11%	11%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	26%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	23%	
Additional Comments: Noise disruption factor. Sometimes restrictions are imposed by the client		

Question No: 3.2.2 ***Long & unsociable working hours***

	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**43**	**44**
Average Score	3.625	3.688
Standard Deviation	0.707	0.693
% that answered **the question**	91%	91%
% that answered **N/A**	9%	9%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	20%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	9%	
Additional Comments: Interruption in work patterns is more of a problem. Local Authority requirements.		

Question No: 3.2.3 ***Selection and recruitment of the work force***

	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**16**	**20**
Average Score	2.852	2.703
Standard Deviation	0.949	1.031
% that answered **the question**	80%	77%
% that answered **N/A**	20%	23%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	20%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	17%	
Additional Comments: Critical aspect is experience of foreman. Always difficult. cannot just let anyone loose on the job. Depends on contractor and site agent. Select the right people at the tender stage. More experienced services engineers are needed		

Refurbishment Characteristics Subdivision: **Skills, Working Methods & Working Hours**

Question No: 3.2.4 ***Restriction working methods (e.g. hot work)***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**20**	**27**
Average Score	2.983	2.817
Standard Deviation	1.104	1.303
% that answered **the question**	86%	86%
% that answered **N/A**	14%	14%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	17%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	14%	
Additional Comments: Set out restrictions in contract documents. Apply strict procedures. Must be a closely controlled practice.		

Question No: 3.2.5 ***Coping with employee stress and absenteeism***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**44**	**45**
Average Score	3.739	3.739
Standard Deviation	0.541	0.689
% that answered **the question**	66%	66%
% that answered **N/A**	34%	34%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	NIL	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	
Additional Comments: Builders' holidays can be a problem. The contractor's responsibility.		

Question No: 3.2.6 ***Restriction on plant usage***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**19**	**36**
Average Score	2.967	2.967
Standard Deviation	0.765	0.850
% that answered **the question**	86%	86%
% that answered **N/A**	14%	14%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	17%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	14%	
Additional Comments: Difficult when it crops up. Set out details in contract documents. Problems due to noise and vibration.		

Question No: 3.2.7 ***Productivity control and maintenance***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**30**	**22**
Average Score	3.111	2.722
Standard Deviation	0.900	1.018
% that answered **the question**	51%	51%
% that answered **N/A**	49%	49%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	9%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	8%	
Additional Comments: If M/E contractors work, within the constraints of quality assurance, not usually a problem. Contractor's problem. Contractor's responsibility.		

Question No: 3.2.8 ***Quality control and assurance***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**15**	**4**
Average Score	2.833	2.267
Standard Deviation	1.053	1.015
% that answered **the question**	86%	86%
% that answered **N/A**	14%	14%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	23%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	14%	
Additional Comments: Building services consultant relied on heavily. Trade sequence important. Regular site meetings between parties. Right choice of contractor is essential. Achieving this varies widely from job to job and contractor to contractor.		

Refurbishment Characteristics Subdivision: **Liaison & Communication**

Question No: 3.3.1 ***Supervision of the works***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**25**	**7**
Average Score	3.065	2.355
Standard Deviation	0.929	0.984
% that answered **the question**	89%	89%
% that answered **N/A**	11%	11%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	11%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	11%	
Additional Comments: Can be lots of odds and ends. Depends on works problem. OK providing contractors are willing to listen and be directed. Depends on choice of contractor...tend to stick to the same 3 or 4		

Question No: 3.3.2 ***Liaison with Tenant or Occupier***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**34**	**31**
Average Score	3.217	2.867
Standard Deviation	0.762	1.066
% that answered **the question**	86%	86%
% that answered **N/A**	14%	14%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	6%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	20%	
Additional Comments: Normally only contact between tenant/occupier and architect. Listed buildings are frequently occupied. Dealt with at pre-contract stage.		

Question No: 3.3.3 ***Liaison with Building Control***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**42**	**30**
Average Score	3.500	2.857
Standard Deviation	0.793	1.113
% that answered **the question**	80%	80%
% that answered **N/A**	20%	20%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	9%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	
Additional Comments: Depends on local authority. Normally building services consultant should deal directly with Building Control. Know your regulations. Can be difficult to achieve current day standards. Very prescriptive, less able to apply common sense.		

Refurbishment Characteristics Subdivision: **Liaison & Communication**

Question No:3.3.4 ***Liaison with Planning Officer***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**26**	**29**
Average Score	3.077	2.840
Standard Deviation	1.017	1.179
% that answered **the question**	71%	71%
% that answered **N/A**	29%	29%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	14%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	14%	
Additional Comments: Depends on sensitivity. Planners prefer museum pieces rather than living buildings. Have regular meetings with L.A. Liaison with conservation officer has cost implications		

Question No: 3.3.5 ***Liaison with Fire Protection Officer***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**29**	**38**
Average Score	3.107	3.051
Standard Deviation	1.000	1.072
% that answered **the question**	83%	83%
% that answered **N/A**	17%	17%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	17%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	
Additional Comments: It is critical to ensure that the contractor complies with fire officer's requirements. Usually fire officer's requirements are well defined in advance.		

Question No: 3.3.6 ***Liaison with English Heritage Inspector***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**27**	**35**
Average Score	3.077	2.962
Standard Deviation	1.164	1.216
% that answered **the question**	74%	74%
% that answered **N/A**	26%	26%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	9%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	3%	
Additional Comments: They normally have no concept of time and related costs. Very important. Building services consultant does not have much interaction with EH officer.		

Refurbishment Characteristics Subdivision: **Health & Safety**

Question No: 3.4.1 ***Dust Control***

	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**21**	**28**
Average Score	3.000	2.821
Standard Deviation	0.903	1.020
% who answered **the question**	80%	80%
% who answered **N/A**	20%	20%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	9%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	3%	
Additional Comments: Set out in contract documents. CDM regulations are requiring more of designers and contractors time. Need special provision in project specification.		

Question No: 3.4.2. ***Noise Control***

	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**22**	**39**
Average Score	3.000	3.053
Standard Deviation	1.018	1.074
% that answered **the question**	80%	80%
% that answered **N/A**	20%	20%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	11%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	9%	
Additional Comments: Difficult if building occupied. Set out in contract documents. Depends on site location		

Question No: 3.4.3 ***Handling and disposal of hazardous/toxic substances***

	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**23**	**41**
Average Score	3.038	3.231
Standard Deviation	1.076	0.863
% that answered **the question**	74%	74%
% that answered **N/A**	26%	26%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	23%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	11%	
Additional Comments: Specialist subcontractor's work. Unforeseen asbestos is a problem. Asbestos, lead and PCB's difficult. Asbestos is a frequent problem		

Refurbishment Characteristics Subdivision: **Health & Safety**

Question No: 3.4.4 ***Handling and disposal of site rubbish***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**40**	**6**
Average Score	3.417	2.333
Standard Deviation	0.881	1.167
% that answered **the question**	69%	69%
% that answered **N/A**	31%	31%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	9%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	3%	
Additional Comments: Set out in contract documents. Difficult in city locations. Contractor must be nagged. Depends on management ability of the contractor. Usually specified in contract documents so rarely a problem.		

Question No: 3.4.5 ***Protecting the general public***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**39**	**23**
Average Score	3.392	2.750
Standard Deviation	0.875	1.266
% that answered **the question**	80%	80%
% that answered **N/A**	20%	20%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	14%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	
Additional Comments: Temporary works frequently difficult. Plan ahead. Contractor's responsibility. Can be difficult when materials and plant are being delivered.		

Question No: 3.4.6 ***Maintaining safety and welfare standards***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**38**	**26**
Average Score	3.370	2.815
Standard Deviation	0.884	1.241
% that answered **the question**	77%	77%
% that answered **N/A**	23%	23%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	3%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	9%	
Additional Comments: Lifting floorboards to put in building services, continually creates hazards. Main contractor's overall responsibility. Over familiarity is the danger. Varies enormously from job to job and contractor to contractor.		

Refurbishment Characteristics Subdivision: **Budget & Financial Matters**

Question No: 3.5.1 *Cost Control*		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**2**	**8**
Average Score	2.469	2.379
Standard Deviation	0.975	1.111
% that answered **the question**	94%	94%
% that answered **N/A**	6%	6%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	20%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	
Additional Comments: Keep cost ledgers. Domestic sub contractors difficult. Usually large budgets are required for quality. Difficult due to unknowns.		

Question No: 3.5.2 *Pricing the works*		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**1**	**1**
Average Score	2.446	2.250
Standard Deviation	0.832	0.967
% that answered **the question**	80%	80%
% that answered **N/A**	20%	20%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	6%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	NIL	
Additional Comments: Difficult due to unknowns. Frequently difficult in conservation work. Contingencies are difficult to price. Quantity surveyor's role. Problems occur because M/E works generally are not billed and so variations have to be negotiated.		

Question No: 3.5.3 *Remuneration*		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**4**	**2**
Average Score	2.581	2.258
Standard Deviation	0.992	1.032
% that answered **the question**	86%	86%
% that answered **N/A**	14%	14%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	9%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	9%	
Additional Comments: Slow. Can't charge bigger fees for conservation work. Difficult clients will not pay. Consultants should be selected on quality and experience rather than cost. Competitive fees are a problem. Churches are particularly difficult.		

Question No: 3.5.3 ***Remuneration (Additional Section)***

- **Comments re: <u>Interim /Stage Payments</u>**

Interim stage payments are not generally a problem.
Final stage payments are more difficult.

- **Comments re: <u>Contra Charges/Set off</u>**

Not difficult or frequent.

- **Comments re: <u>Other</u>**

Final payment is a problem.
Final accounts are a problem.
Negotiated fees can be difficult.
Fees are a problem if fixed - best on a time related basis.
Fees are difficult frequently.
Difficult to get fee levels right for every job.

Refurbishment Characteristics Subdivision: **Statutory Control**

Question No: 3.6.1 *Building Regulations*

	Degree of difficulty	Frequency of occurrence
Ranking position (greatest = **1**, least = **45**)	**36**	**19**
Average Score	3.266	2.703
Standard Deviation	0.803	1.099
% who answered **the question**	91%	91%
% who answered **N/A**	9%	9%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	9%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	

Additional Comments: Make strategic decisions from the outset. There are cost implications to complying. Compromise must be reached.

Question No: 3.6.2 *Planning Permission*

	Degree of difficulty	Frequency of occurrence
Ranking position (greatest = **1**, least = **45**)	**32**	**42**
Average Score	3.190	3.238
Standard Deviation	0.928	1.091
% who answered **the question**	60%	60%
% who answered **N/A**	40%	40%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	9%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	

Additional Comments: Can be a problem. Give client good advice, it minimises problems. Very specific depends on local authority. Building services consultants don't get involved.

Question No: 3.6.3 *Listed Building Consent*

	Degree of difficulty	Frequency of occurrence
Ranking position (greatest = **1**, least = **45**)	**18**	**33**
Average Score	2.950	2.900
Standard Deviation	0.999	1.210
% who answered **the question**	57%	57%
% who answered **N/A**	43%	43%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	6%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	3%	

Additional Comments: Usually dealt with by architect. Not a matter for building services consultant. Services are rarely an issue.

Refurbishment Characteristics Subdivision: **Statutory Control**

Question No: 3.6.4 ***Fire Protection Requirements***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**8**	**21**
Average Score	2.740	2.703
Standard Deviation	1.059	1.137
% that answered **the question**	80%	80%
% that answered **N/A**	20%	20%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	17%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	3%	
Additional Comments: Standards are constantly being raised. Depends on change of use.		

Refurbishment Characteristics Subdivision: **Site and Materials**

Question No: 3.7.1 ***Site Access***

	Degree of difficulty	Frequency of occurrence
Ranking position (greatest = **1**, least = **45**)	**9**	**11**
Average Score	2.741	2.481
Standard Deviation	1.023	1.155
% that answered **the question**	77%	77%
% that answered **N/A**	23%	23%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	14%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	14%	

Additional Comments: Occasionally very difficult. Difficult for delivery of materials and plant. Difficult in city areas. Depends on site. Main contractor's responsibility

Question No: 3.7.2 ***Storage of building materials/plant***

	Degree of difficulty	Frequency of occurrence
Ranking position (greatest = **1**, least = **45**)	7	**10**
Average Score	2.714	2.464
Standard Deviation	1.150	1.201
% that answered **the question**	80%	80%
% that answered **N/A**	20%	20%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	9%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	

Additional Comments: Can be a lot of waste. Difficult in city areas. Difficult in old buildings. Difficult due to space restrictions. Contractor needs to be well organised. Depends on site.

Question No: 3.7.3 ***Site Security***

	Degree of difficulty	Frequency of occurrence
Ranking position (greatest = **1**, least = **45**)	**24**	**25**
Average Score	3.040	2.800
Standard Deviation	1.060	1.190
% that answered **the question**	71%	71%
% that answered **N/A**	29%	29%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	14%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	NIL	

Additional Comments: Less difficult when owner on the site. Matter for the main contractor. Depends on building contents. Children living locally can be a problem.

Refurbishment Characteristics Subdivision: **Site and Materials**

Question No: 3.7.4 ***Protecting the works and adjacent buildings***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**17**	**14**
Average Score	2.857	2.629
Standard Deviation	0.891	1.043
% that answered **the question**	80%	80%
% that answered **N/A**	20%	20%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	17%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	
Additional Comments: Adjacent owners often see this as an opportunity to make a claim. Protection will be specified by the architect.		

Question No: 3.7.5 ***Materials handling***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**28**	**15**
Average Score	3.080	2.640
Standard Deviation	0.954	1.186
% that answered **the question**	71%	71%
% that answered **N/A**	29%	29%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	9%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	
Additional Comments: City centre sites can be a problem. Main contractor's responsibility.		

Question No: 3.7.6 ***Materials supply***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**37**	**32**
Average Score	3.315	2.870
Standard Deviation	0.749	1.015
% that answered **the question**	77%	77%
% that answered **N/A**	23%	23%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	11%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	9%	
Additional Comments: Depends on materials. Usually reclaimed /second hand materials difficult. Need to be available before specifying. Matching materials can be a problem. More difficult if the construction programme is short.		

Refurbishment Characteristics Subdivision: **Site and Materials**

Question No: 3.7.7 ***(Site) Plant supply***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**45**	**43**
Average Score	3.760	3.400
Standard Deviation	0.597	1.080
% that answered **the question**	71%	71%
% that answered **N/A**	29%	29%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	3%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	NIL	
Additional Comments: No Comments		

Question No: 3.7.8 ***Spatial constraints of the building***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**3**	**5**
Average Score	2.483	2.293
Standard Deviation	0.986	0.940
% that answered **the question**	83%	83%
% that answered **N/A**	17%	17%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	20%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	14%	
Additional Comments: Hiding building services is difficult. Articulation of the building services within the building requires a lot of forward planning. Challenging, requires the correct strategy at the outset.		

Question No: 3.7.9 ***Structural constraints of the building***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**5**	**9**
Average Score	2.621	2.379
Standard Deviation	0.893	0.820
% that answered **the question**	94%	94%
% that answered **N/A**	6%	6%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	20%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	20%	
Additional Comments: Can be very difficult. Consider floor loadings. Needs monitoring and constant communication with structural engineer.		

Refurbishment Characteristics Subdivision: **Site and Materials**

Question No: 3.7.10 ***Keeping the site tidy***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**35**	**12**
Average Score	3.238	2.524
Standard Deviation	1.044	1.289
% that answered **the question**	63%	63%
% that answered **N/A**	37%	37%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	6%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	3%	
Additional Comments: No problem with a good contractor. Fire hazard. Should be reviewed at monthly site meetings. Depends on site personnel. Detail in contract documents. The contractor's job.		

Question No: 3.7.11 ***Maintaining existing services***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**10**	**18**
Average Score	2.767	2.700
Standard Deviation	1.104	1.087
% that answered **the question**	86%	86%
% that answered **N/A**	14%	14%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	11%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	9%	
Additional Comments: Can be very awkward. Depends on site. Detail in contract documents. No records, often. Difficult to trace. Difficult if the building is occupied.		

Question No: 3.7.12 ***Decanting the building for the commencement of the works***		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45**)	**33**	**17**
Average Score	3.190	2.667
Standard Deviation	1.030	1.197
% that answered **the question**	63%	63%
% that answered **N/A**	37%	37%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	6%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	6%	
Additional Comments: More temporary works required. A matter for the building occupant/ owner.		

Refurbishment Characteristics Subdivision: **Contract**

Question No: 3.8.1 *Contract documentation/arrangement*		
	Degree of difficulty	**Frequency of occurrence**
Ranking position (greatest = **1**, least = **45)**	**31**	**24**
Average Score	3.156	2.774
Standard Deviation	0.920	1.203
% that answered **the question**	91%	91%
% that answered **N/A**	9%	9%
% that ticked the **time box** indicating this characteristic had an impact on time in the project	6%	
% that ticked the **cost box** indicating this characteristic had an impact on cost in the project	11%	
Additional Comments: Difficult in every contract. Need experience to produce good documentation. Not a problem if addressed well in advance.		

Question 3.8.1 *Contract documentation/arrangement (Additional section)*

- **Comments re: <u>Fairness of terms and conditions</u>**

Very difficult, frequently. Main contractors impose their own conditions.

- **Comments re: <u>Suitability of terms of contract</u>**

Difficult. Don't tamper with standard clauses. Should allow for flexibility. Each contract is different and needs to be looked at very carefully..

- **Comments re: <u>Administration of contract conditions</u>**

Contracts are often only referred to when there are problems

- **Comments re: <u>Other</u>**

Compromise arrangements, if details are not available in the contract documentation, cause inefficiency and delay.

Table DRC.1.1 Comparison between the most difficult refurbishment characteristics (top 20%) when integrating modern building services into historic buildings: All Disciplines/Young.B.A. & Egbu.C.O. (1993)

***All Disciplines*: Questionnaire OBU/J/G**				***General Refurbishment*: Young, B.A & Egbu,C.O**	
Rank position	CHARACTERISTIC	Av.	St. Dev	**Rank Position**	CHARACTERISTIC
1 Response rate 8 0%	**Pricing the works**	2.446	0.831	1/33	**Cost control**
2 Response rate 91%	**Cost control**	2.469	0.975	2/33	**Dust control**
3 Response rate 91%	**Spatial constraints of the building**	2.483	0.986	3/33	**Influence of tenant on regular progress of work**
4 Response rate 89%	**Remuneration**	2.581	0.992	4/33	**Pricing the works**
5 Response rate 91%	**Structural constraints of the building**	2.621	0.893	5/33	**Variation/change order to the works**
6 Response rate 94%	**Programming and scheduling works**	2.714	1.013	6/33	**Noise Control**
7 Response rate 77%	**Storage of materials and plant**	2.714	1.150	7/33	**Site Security**
8 Response rate 77%	**Fire protection requirements**	2.741	1.059	8/33	**Storage of building materials and plant**
9 Response rate 77%	**Site access**	2.741	1.022	9/33	**Site access**

Table FRC.1.1 Comparison between the most frequent (top 20%) refurbishment characteristics when integrating modern building services into historic buildings: All Disciplines/Young , B.A & Egbu, C.O (1993)

All Disciplines: Questionnaire OBU/J/G				***General Refurbishment:* Young, B.A & Egbu,C.O**	
Rank position	CHARACTERISTIC	Av.	St. Dev.	**Rank Position**	CHARACTERISTIC
1 Response rate 80%	**Pricing the works**	2.250	0.967	1/33	**Variation/change order to the works**
2 Response rate 89%	**Remuneration**	2.258	1.031	2/33	**Keep site tidy**
3 Response rate 99%	**Variation/change order to the works**	2.264	0.994	3/33	**Cost control**
4 Response rate 86%	**Quality control and assurance**	2.266	1.015	4/33	**Maintaining site safety & welfare standards**
5 Response rate 83%	**Spatial constraints of the building**	2.293	0.940	5/33	**Programming and scheduling the works**
6 Response rate 69%	**Handling & disposal of site rubbish**	2.333	1.167	6/33	**Quality control and assurance**
7 Response rate 89%	**Supervision of the works**	2.354	0.984	7/33	**Dust control**
8 Response rate 91%	**Cost control**	2.379	1.111	8/33	**Time prediction for completion of the works**
9 Response rate 94%	**Structural const. of the building**	2.379	0.820	9/33	**Storage of building materials & plant**

Table DRC.1.2 Comparison between the least difficult refurbishment characteristics (bottom 20%) when integrating modern building services into historic buildings: All Disciplines/Young & Egbu (1993)

***All Disciplines*: Questionnaire OBU/J/G**				***General Refurbishment*: Young, B.A & Egbu,C.O**	
Rank position	**CHARACTERISTIC**	**Av.**	**St. Dev**	**Rank Position**	**CHARACTERISTIC**
37 Response rate 77%	**Materials supply**	3.315	0.749	25/33	**Long & unsociable working hours**
38 Response rate 77%	**Maintaining site safety & welfare standards**	3.370	0.834	26/33	**Restriction in plant usage**
39 Response rate 80%	**Protecting the general public**	3.393	0.875	27/33	**Supervision of the works**
40 Response rate 68%	**Handling & disposal of site rubbish**	3.417	0.881	28/33	**Liaison with tenant/occupier**
41 Response rate 86%	**Restriction in working hours**	3.419	0.923	29/33	**Selection & recruitment of the workforce**
42 Response rate 80%	**Liaison with building control**	3.500	0.793	30/33	**Materials supply**
43 Response rate 91%	**Long & unsociable working hours**	3.625	0.707	31/33	**Coping with employee stress and absenteeism**
44 Response rate 66%	**Coping with employee stress and absenteeism**	3.739	0.541	32/33	**Building regulations and other statutory control**
45 Response rate 74%	**Plant supply (site)**	3.760	0.597	33/33	**Plant Supply (site)**

Table FRC.1.2 Comparison between the least frequent refurbishment characteristics (bottom 20%) when integrating modern building services into historic buildings: All Disciplines/Young & Egbu (1993)

***All Disciplines*: Questionnaire OBU/J/G**				***General Refurbishment*: Young, B.A & Egbu,C.O**	
Rank Position	**CHARACTERISTIC**	**Av.**	**St. Dev**	**Rank Position**	**CHARACTERISTIC**
37 Response rate 90%	**Infl. of cons. objs. on reg. prog of works**	3.000	1.031	25/33	**Restriction in working hours**
38 Response rate 86%	**Liaison with fire protection officer**	3.051	1.071	26/33	**Building regulations and other statutory control**
39 Response rate 86%	**Noise control**	3.053	1.074	27/33	**Decanting the building for commencement of work**
40 Response rate 94%	**Restriction in working hours**	3.225	1.055	28/33	**Long & unsociable working hours**
41 Response rate 77%	**Handling/disp. of toxic/ hazard. subs.**	3.230	0.863	29/33	**Handling & disposal of hazardous/ toxic substances**
42 Response rate 60%	**Planning permission**	3.238	1.091	30/33	**Plant Supply (site)**
43 Response rate 71%	**Plant Supply (site)**	3.400	1.080	31/33	**Selection & recruitment of the workforce**
44 Response rate 91%	**Long & unsociable working hours**	3.689	0.692	32/33	**Restriction in plant usage**
45 Response rate 66%	**Employee stress & absenteeism**	3.739	0.689	33/33	**Employee stress & absenteeism**

Table DRC.1.3 Comparison between the most difficult refurbishment characteristics (top 20%) when integrating modern building services into historic buildings: Main Contractors/Architects

Main Contractors				Architects			
Rank position	CHARACTERISTIC	Av.	St. Dev	Rank position	CHARACTERISTIC	Av.	St. Dev
1 Response rate100%	Cost Control	1.600	0.548	1 Response rate 60%	Restriction on working methods	2.167	1.258
2 Response rate 80%	Pricing the works	1.875	0.629	2 Response rate 100%	Variation/change to order of the works	2.300	0.837
3 Response rate100%	Site Access	2.200	1.643	3 Response rate 100%	Restriction on plant usage	2.600	0.548
4 Response rate 100%	Spatial constraints of the building	2.200	1.304	4 Response rate 60%	Influence of tenant on regular progress of works	2.667	1.154
5 Response rate100%	Programming and scheduling the works	2.400	0.894	5 Response rate 60%	Pricing the works	2.667	0.577
6 Response rate100%	Remuneration	2.400	1.341	6 Response rate 80%	Remuneration	2.750	0.500
7 Response rate100%	Structural constraints of the building	2.400	1.341	7 Response rate 80%	Fire protection requirements	2.750	0.957
8 Response rate100%	Contract documents/ arrangement	2.400	1.140	8 Response rate 100%	Influence of cons. objs. on reg. prog. of works	2.800	1.095
9 Response rate 100%	Variation/change to order of the works	2.600	1.140	9 Response rate 100%	Cost Control	2.800	0.758

Table FRC.1.3 Comparison between the most frequent (top 20%) refurbishment characteristics when integrating modern building services into historic buildings: Main Contractors/Architects

Main Contractors				Architects			
Rank position	CHARACTERISTIC	Av.	St. Dev	Rank position	CHARACTERISTIC	Av.	St. Dev
1 Response rate 100%	Cost Control	1.200	0.447	1 Response rate 80%	Liaison with English Heritage inspector	1.750	0.957
2 Response rate 80%	Pricing the works	1.250	0.500	2 Response rate 80%	Spatial constraints of the building	1.750	0.500
3 Response rate 100%	Supervision of the works	1.400	0.548	3 Response rate 100%	Variation/change to order of the works	2.000	0.707
4 Response rate 100%	Variation/change to order of the works	1.600	0.548	4 Response rate 80%	Remuneration	2.000	0.816
5 Response rate 100%	Productivity control & maintenance	1.600	0.548	5 Response rate 40%	Decanting building for comm. of works	2.000	0
6 Response rate 100%	Site Access	1.600	1.342	6 Response rate 100%	Contract documents/ arrangement	2.000	1.225
7 Response rate 100%	Keeping the site tidy	1.600	0.894	7 Response rate 100%	Liaison with planning officer	2.200	1.304
8 Response rate 100%	Programming & scheduling the works	1.800	1.095	8 Response rate 60%	Materials supply	2.333	1.528
9 Response rate 100%	Quality control & assurance	1.800	1.304	9 Response rate 100%	Liaison with building control	2.400	1.342

Table DRC.1.4 Comparison between the most difficult refurbishment characteristics (top 20%) when integrating modern building services into historic buildings: Building Services Consultants/ Mechanical & Electrical Contractors

Building Services Consultants				*Mechanical & Electrical Contractors*			
Rank position	CHARACTERISTIC	Av.	St. Dev	**Rank position**	CHARACTERISTIC	Av.	St. Dev
1 Response rate 100%	**Remuneration**	1.800	0.837	1 Response rate 80%	**Influence of tenant on reg. progress of work**	2.000	0.895
2 Response rate 100%	**Handling/ disposal of haz./toxic substances**	2.000	1.224	2 Response rate 100%	**Programming and scheduling the works**	2.000	1.414
3 Response rate 100%	**Cost Control**	2.000	0.707	3 Response rate 100%	**Structural constraints of the building**	2.100	0.447
4 Response rate 40%	**Planning permission**	2.000	0	4 Response rate 100%	**Site access**	2.200	0.577
5 Response rate 40%	**Listed building consent**	2.000	0	5 Response rate 100%	**Spatial constraints of the building**	2.250	0.837
6 Response rate 100%	**Maintaining existing services**	2.000	1.000	6 Response rate 100%	**Storage of building materials & plant**	2.400	0.547
7 Response rate 60%	**Decanting building for comm. of works**	2.000	0	7 Response rate 100%	**Materials handling**	2.400	0.489
8 Response rate 100%	**Time prediction for completion of works**	2.200	1.0 95	8 Response rate 80%	**Liaison with tenant/occupier**	2.500	0.707
9 Response rate 100%	**Pricing the works**	2.200	0.837	9 Response rate 100%	**Site security**	2.500	0.629

Table FRC.1.4 Comparison between the most frequent (top 20%) refurbishment characteristics when integrating modern building services into historic buildings: Building Services Consultants/ Mechanical & Electrical Contractors

Building Services Consultants				*Mechanical & Electrical Contractors*			
Rank position	CHARACTERISTIC	Av.	St. Dev	**Rank position**	CHARACTERISTIC	Av.	St. Dev
1 Response rate 60%	**Decanting building for comm. of works**	1.333	0.577	1 Response rate100%	**Site Access**	1.800	0.836
2 Response rate 100%	**Remuneration**	1.400	0.548	2 Response rate 80%	**Variation/change to order of the works**	2.000	0.816
3 Response rate 80%	**Liaison with fire protection officer**	1.750	0.500	3 Response rate 100%	**Storage of building materials & plant**	2.000	1.225
4 Response rate 100%	**Restriction on working methods**	1.800	1.304	4 Response rate 100%	**Pricing the works**	2.200	0.837
5 Response rate 100%	**Variation/change to order of the works**	2.000	1.414	5 Response rate 100%	**Structural constraints of the building**	2.3 00	0.447
6 Response rate 100%	**Time prediction for completion of works**	2.000	0.707	6 Response rate 100%	**Programming and scheduling the works**	2.400	1.140
7 Response rate 100%	**Selection /recruit. of the workforce**	2.000	1.414	7 Response rate 100%	**Materials handling**	2.400	1.140
8 Response rate 80%	**Restriction on plant usage**	2.000	0.816	8 Response rate 80%	**Restriction on working methods**	2.500	1.732
9 Response rate 100%	**Quality control and assurance**	2.000	0.707	9 Response rate 100%	**Time prediction for completion of works**	2.600	0.548

Table NR/D1 Nil responses by discipline and refurbishment category: degree of difficulty

DISCIPLINE → / Characteristic Category ↓	Main Contractors	Mechanical & Electrical Contractors	Quantity Surveyors	Building Surveyors	Structural Engineers	Building Services Consultants	Architects
Programme	0/25	2/25	3/25	2/25	4/25	2/25	2/25
Skills, Working Hours/Methods	0/40	6/40	10/40	8/40	19/40	5/40	11/40
Liaison & Communication	2/30	8/30	12/30	3/30	7/30	6/30	3/30
Health & Safety	0/30	5/30	4/30	2/30	25/30	8/30	5/30
Budget & Financial Matters	1/15	0/15	0/15	1/15	9/15	0/15	3/15
Statutory Control	11/20	5/20	7/20	0/20	10/20	6/20	1/20
Site & Materials	1/60	7/60	8/60	8/60	38/60	20/60	19/60
Contract	0/5	1/5	0/5	0/5	2/5	0/5	0/5
TOTAL (max=225)	15/225	34/225	44/225	24/225	113/225	47/225	44/225

Table NR/F1 Nil responses by discipline and refurbishment category: frequency of occurrence

DISCIPLINE → / Characteristic Category ↓	Main Contractors	Mechanical & Electrical Contractors	Quantity Surveyors	Building Surveyors	Structural Engineers	Building Services Consultants	Architects
Programme	0/25	2/25	3/25	2/25	4/25	2/25	2/25
Skills, Working Hours/Methods	0/40	6/40	10/40	8/40	19/40	5/40	11/40
Liaison & Communication	2/30	8/30	12/30	3/30	7/30	6/30	3/30
Health & Safety	0/30	5/30	4/30	2/30	25/30	8/30	5/30
Budget & Financial Matters	1/15	0/15	0/15	1/15	8/15	0/15	3/15
Statutory Control	11/20	5/20	7/20	0/20	10/20	6/20	1/20
Site & Materials	1/60	7/60	8/60	8/60	38/60	19/60	19/60
Contract	0/5	1/5	0/5	0/5	2/5	0/5	0/5
TOTAL (max=225)	15/225	34/225	44/225	24/225	113/225	47/225	44/225

Note: For guidance with tables, Table NR/D1and Table NR/F1

Scores for each discipline calculated as follows, as an example: total possible number of responses in a category, say 5 (questions) x 5 (number of respondents interviewed in discipline) = 25.

Therefore, number of nil answers (x) in the characteristic category would be represented as x/25.

Q 3.9 Concerning the integration of modern building services into historic structures, are there any operational problems you have encountered, that have not been listed so far?

Table SUM.1 Summary of responses to question 3.9 in questionnaire survey: OBU/J/2

DISCIPLINE	Frequency/Difficulty Refurbishment Characteristics Not Listed In Questionnaire Instrument (Questionnaire Respondents' Comments)
Main Contractors	Access through the building for the building services. Location and size of plant rooms. Difficulties arising from lift installations.
Mechanical & Electrical Contractors	Co-ordination of one building service with another and with the structure of the building. Waiting for new work to dry out (water content of building fabric). Finding adequate room for the larger items of building services plant. Drilling through unknown structures.
Quantity Surveyors	No comments.
Building Surveyors	Inability to carry out a full investigation of the existing building. Concealing cables and pipework. No comment BUT building services installations should be kept simple.
Structural Engineers	Getting bulky building services plant through existing spaces. Installing building services without damaging the existing finishes Noise and vibration control.
Building Services Consultants	Difficulty in co-ordination of one building service with another. Obtaining an adequate opening up survey in the preconstruction phase. Absence of records of the existing building. Decisions about whether to renew or re-use existing systems The need for more attention and detail throughout the project Improving the performance of the building e.g. energy conservation, user satisfaction etc.
Architects	The need to reduce the building services because they will not fit into the building. Difficulties are often presented when the building services consultant's drawings are diagrammatic only. Finding space to incorporate air conditioning ducts is problematic.

APPENDIX III

RISK: ATTITUDES AND PERCEPTIONS

ANALYSIS OF RISK WHEN INTEGRATING MODERN BUILDING SERVICES INTO LISTED HISTORIC BUILDINGS: LIKELIHOOD & ACCEPTABILITY

Introductory notes

Section 4, of the questionnaire survey, sought to identify the risk management strategies used by respondents and to elicit their perception regarding the likelihood and acceptability of risk, when integrating modern building services into listed historic buildings. The 'Likelihood Rank Value' table and the 'Acceptability Rank Value' table are detailed in the Guidance Notes OBU/J/G. [The questionnaire and guidance notes are contained in Appendix 1.]

When manipulating the data, percentages have been rounded up, or down, to the nearest decimal place {further accuracy may mislead the reader by suggesting a high level of accuracy and inadvertently generating a spurious conclusion}. Each figure is not to be relied upon as a statistical figure but as an indicator, in a more loose sense, with regard to the proportion of the building team that are likely to hold a particular perception. Standard deviation, where tabulated, is to be used only as an indicator re: the spread in responses.

TABLE AR/AC1

ACCEPTABILITY OF TAKING RISK WHEN INTEGRATING MODERN BUILDING SERVICES INTO LISTED HISTORIC BUILDINGS

Relating to the identified adverse events in the questionnaire the table below illustrates, by discipline and by risk area

- The percentage of responses (denoted by AR%) where risk and its management, relating to these risk areas, were deemed by the respondent to be within the scope of their role as a member of the building team.
- The percentage of responses (denoted by CR%) where risk and its management, relating to these risk areas, were deemed by the respondent to be outside the scope of their role as a member of the building team. These respondents based their judgment, when making a response, on the acceptability of the consequence of the specified adverse events.

Risk Area >>	BUDGET		PROGRAMME		TECHNOLOGICAL		ENVIRONMENTAL HEALTH/SAFETY		CONSERVATION		AVERAGE % of one discipline over all risk areas	
Discipline	AR%	CR%	AR%	CR%	AR%	CR%	AR%	CR%	AR%	CR%	AR%	CR%
Main Contractors	**68**	32	**80**	20	**80**	20	**80**	20	**80**	20	**78**	22
Mechanical & Electrical Contractors	**40**	60	**40**	60	**37**	60 (3%DK)	**40**	60	**40**	60	**39**	61
Quantity Surveyors	**80**	20	**40**	60	**40**	60	**40**	60	**40**	60	**48**	52
Building Surveyors	**52**	40 (8% DK)	**60**	40	**40**	57 (3% DK)	**60**	40	**60**	40	**50**	50
Structural Engineers	**12**	88	**nil**	100	**23**	77	**40**	60	**40**	60	**19**	81
Building Services Consultants	**80**	20	**60**	40	**40**	60	**40**	60	**40**	60	**52**	48
Architects	**64**	28 (8%DK)	**76**	20 (4%DK)	**74**	20 (6%DK)	**80**	20	**80**	20	**75**	25
AVERAGE of all disciplines in one risk area	**57**	43	**51**	49	**48**	52	**54**	46	**49**	51		

TABLE LB1

LIKELIHOOD OF A SPECIFIC ADVERSE EVENT AND ITS UNWANTED CONSEQUENCE OR LOSS RELATING TO BUDGET

Likelihood, in this table, refers to the probability of an adverse event arising when integrating modern building services into historic buildings. Respondents were asked to rank how likely they considered that each of the tabulated events were to arise under five headings: frequent, probable, occasional, remote and improbable. The percentage is calculated from the number of respondents (all disciplines) that held a particular perception from one of these five headings.

ADVERSE EVENT >>>>>>	BANKRUPTCY (Client)	BANKRUPTCY (Contractor)	SUBSTANTIAL CLAIM (by Contractor)	SUBSTANTIAL DAMAGES (in favour of Client)	TOTAL CONTINGENCY CONSUMED
Frequent: Very common, occurs in nearly all projects	nil	3%	17%	nil	57%
Probable: More likely to occur than not, but not in most projects	nil	17%	23%	6%	32%
Occasional: It happens now and then, but is not a regular occurrence	26%	54%	26%	11%	11%
Remote: Slight chance; possible but unlikely	37%	14%	23%	43%	nil
Improbable: Very unlikely	34%	9%	11%	40%	nil
DK (Don't know)	3%	3%	nil	nil	nil
Standard deviation (Rank values 1-5)	0.8	0.9	1.3	0.9	0.7

TABLE LP2

LIKELIHOOD OF A SPECIFIC ADVERSE EVENT AND ITS UNWANTED CONSEQUENCE OR LOSS EVENTS RELATING TO PROGRAMME

Likelihood, in this table, refers to the probability of an adverse event arising when integrating modern building services into historic buildings. Respondents were asked to rank how likely they considered that each of the tabulated events were to arise under five headings: frequent, probable, occasional, remote and improbable. The percentage is calculated from the number of respondents (all disciplines) that held a particular perception from one of these five headings.

ADVERSE EVENT >>>>>>	COMPLETE PROGRAMME RE-ORGANISATION REQUIRED	COMPLETION DATE OVER RUN	DELAY CAUSING DOWN TIME OF PLANT	DISRUPTION TO OTHER TRADES	MINOR HOLD UPS
Frequent: Very common, occurs in nearly all projects	9%	20%	9%	11%	60%
Probable: More likely to occur than not, but not in most projects	28%	46%	17%	57%	22%
Occasional: It happens now and then, but is not a regular occurrence	26%	22%	31%	26%	9%
Remote: Slight chance; possible but unlikely	34%	6%	28%	3%	6%
Improbable: Very unlikely	3%	6%	9%	nil	nil
DK (Don't know)	nil	nil	6%	3%	3%
Standard deviation (Rank values 1-5)	1	1.1	1.1	0.7	0.9

TABLE LTM3

LIKELIHOOD OF A SPECIFIC ADVERSE EVENT AND ITS UNWANTED CONSEQUENCE OR LOSS IN TECHNOLOGICAL MATTERS

Likelihood, in this table, refers to the probability of an adverse event arising when integrating modern building services into historic buildings. Respondents were asked to rank how likely they considered that each of the tabulated events were to arise under five headings: frequent, probable, occasional, remote and improbable. The percentage is calculated from the number of respondents (all disciplines) that held a particular perception from one of these five headings.

ADVERSE EVENT >>>>	STRUCTURAL INTEGRITY UNDERMINED	QUALITY STANDARDS NOT MET	LATENT DEFECTS	ABORTIVE WORKS	MATERIALS/ SKILLS NOT READILY AVAILABLE	SUPERFICIAL DAMAGE TO BUILDING FABRIC	MINOR DAMAGE/ PROBLEMS THAT CAN AWAIT REPAIR
Frequent: Very common, occurs in nearly all projects	nil	3%	3%	9%	3%	9%	14%
Probable: More likely to occur than not, but not in most projects	nil	20%	11%	14%	11%	26%	23%
Occasional: It happens now and then, but is not a regular occurrence	17%	34%	26%	45%	32%	40%	37%
Remote: Slight chance; possible but unlikely	52%	29%	46%	26%	40%	17%	20%
Improbable: Very unlikely	31%	14%	14%	6%	11%	8%	3%
Made no response	nil	nil	nil	nil	3%	nil	3%
Standard deviation (Rank values 1-5)	0.7	1.1	1	1	1	1.1	1.1

TABLE LEHS4

LIKELIHOOD OF A SPECIFIC ADVERSE EVENT AND ITS UNWANTED CONSEQUENCE OR LOSS RELATING TO ENVIRONMENT AND HEALTH & SAFETY

Likelihood, in this table, refers to the probability of an adverse event arising when integrating modern building services into historic buildings. Respondents were asked to rank how likely they considered that each of the tabulated events were to arise under five headings: frequent, probable, occasional, remote and improbable. The percentage is calculated from the number of respondents (all disciplines) that held a particular perception chosen from one of these five headings.

ADVERSE EVENT >>>>>>	DEATH	SERIOUS POLLUTION HAZARD	LOST TIME INJURY OR ILLNESS	INJURY/ILLNESS REQUIRING FIRST AID	MINOR EVENTS (e. g. APOLOGY: LETTER ONLY REQUIRED)
Frequent: Very common, occurs in nearly all projects	**nil**	**3%**	**3%**	**3%**	**17%**
Probable: More likely to occur than not, but not in most projects	**nil**	**20%**	**nil**	**23%**	**17%**
Occasional: It happens now and then, but is not a regular occurrence	**nil**	**34%**	**40%**	**31%**	**23%**
Remote: Slight chance; possible but unlikely	**29%**	**29%**	**29%**	**23%**	**29%**
Improbable: Very unlikely	**71%**	**14%**	**23%**	**11%**	**9%**
Made no response	**nil**	**nil**	5%	9%	5%
Standard deviation Rank values 1-5	0.5	0.6	0.9	1.1	1.3

TABLE LC5

LIKELIHOOD OF A SPECIFIC ADVERSE EVENT AND ITS UNWANTED CONSEQUENCE OR LOSS RELATING TO CONSERVATION

Likelihood, in this table, refers to the probability of an adverse event arising when integrating modern building services into historic buildings. Respondents were asked to rank how likely they considered that each of the tabulated events were to arise under five headings: frequent, probable, occasional, remote and improbable. The percentage is calculated from the number of respondents (all disciplines) that held a particular perception from one of these five headings.

ADVERSE EVENT >>>>>>	SIGNIFICANT LOSS OF HISTORIC FABRIC	INTERVENTION WHICH IS NOT REVERSIBLE	AESTHETIC DRAWBACK	MINOR/SUPERFICIAL DAMAGE TO BUILDING FABRIC
Frequent: Very common, occurs in nearly all projects	nil	nil	3%	9%
Probable: More likely to occur than not, but not in most projects	6%	9%	nil	17%
Occasional: It happens now and then, but is not a regular occurrence	17%	31%	26%	31%
Remote: Slight chance; possible but unlikely	37%	43%	40%	34%
Improbable: Very unlikely	40%	17%	31%	9%
Made no response	nil	nil	nil	nil
Standard deviation (Rank values 1-5)	0.9	0.9	0.9	1.1

TABLE AB1

ACCEPTABILITY OF TAKING RISKS THAT MAY LEAD TO ADVERSE EVENTS RELATING TO BUDGET

- The responses indicate the attitude each respondent considered appropriate in terms of taking the risk that the tabulated adverse event may occur.
- The responses are the collective answers of all the disciplines.
- The answers of interviewees who considered risk and its management to be within the scope of their role as a member of the building team are tabulated as % e.g. **50%**
- In brackets e.g. *(50% CR)* are the responses of those interviewed that perceived the risk and risk management in this area to be outside their role. These respondents elected to answer in terms of the acceptability of the consequence.

ADVERSE EVENT >>>>>>	BANKRUPTCY (Client)	BANKRUPTCY (Contractor)	SUBSTANTIAL CLAIM (by Contractor)	SUBSTANTIAL DAMAGES (in favour of Client)	TOTAL CONTINGENCY CONSUMED
Unacceptable: Intolerable – must be eliminated or transferred	**74%** *(76% CR)*	**47%** *(38% CR)*	**16%** *(19 % CR)*	**37%** *(25% CR)*	**nil** *(12%CR)*
Undesirable: To be avoided if reasonably practicable. Detailed investigation required	**16%** *(12% CR)*	**37%** *(38% CR)*	**68%** *(62 % CR)*	**26%** *(63% CR)*	**nil** *(12% CR)*
Acceptable: Can be accepted, providing the risk is managed	**nil** *(12% CR)*	**16%** *(24 % CR)*	**16%** *(19% CR)*	**26%** *(12% CR)*	**95%** *(45% CR)*
Negligible: No further consideration needed	**nil** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*	**5%** *(31% CR)*
Made no response	**10%** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*	**11%** *(nil CR)*	**nil** *(nil CR)*

TABLE AP2

ACCEPTABILITY OF TAKING RISKS THAT MAY LEAD TO ADVERSE EVENTS RELATING TO PROGRAMME

- The responses indicate the attitude each respondent considered appropriate in terms of taking the risk that the tabulated adverse event may occur.
- The responses are the collective answers of all the disciplines.
- The answers of interviewees who considered risk and its management to be within the scope of their role as a member of the building team are tabulated as % e.g. **50%**
- In brackets e.g. *(50% CR)* are the responses of those interviewed that perceived the risk and risk management in this area to be outside their role. These respondents elected to answer in terms of the acceptability of the consequence.

ADVERSE EVENT >>>>>>	**COMPLETE PROGRAMME RE-ORGANISATION REQUIRED**	**COMPLETION DATE OVER RUN**	**DELAY CAUSING DOWN TIME OF PLANT**	**DISRUPTION TO OTHER TRADES**	**MINOR HOLD UPS**
Unacceptable: Intolerable – must be eliminated or transferred	**18%** *(17% CR)*	**12%** *(6% CR)*	**6%** *(11% CR)*	**nil** *(11% CR)*	**nil** *(5% CR)*
Undesirable: To be avoided if reasonably practicable. Detailed investigation required	**35%** *(55% CR)*	**41%** *(61%CR)*	**18%** *(50% CR)*	**35%** *(50% CR)*	**18%** *(22% CR)*
Acceptable: Can be accepted, providing the risk is managed	**35%** *(28% CR)*	**47%** *(33% CR)*	**53%** *(39% CR)*	**59%** *(39% CR)*	**53%** *(56% CR)*
Negligible: No further consideration needed	**12%** *(nil CR)*	**nil** *(nil CR)*	**6%** *(nil CR)*	**nil** *(nil CR)*	**24%** *(17% CR)*
Made no response	**nil** *(nil CR)*	**nil** *(nil CR)*	**17%** *(nil CR)*	**6%** *(nil% CR)*	**5%** *(nil CR)*

TABLE ATM3

ACCEPTABILITY OF TAKING RISKS THAT MAY LEAD TO ADVERSE EVENTS RELATING TO TECHNOLOGICAL MATTERS

- The responses indicate the attitude each respondent considered appropriate in terms of taking the risk that the tabulated adverse event may occur.
- The responses are the collective answers of all the disciplines.
- The answers of interviewees who considered risk and its management to be within the scope of their role as a member of the building team are tabulated as % e.g. **50%**
- In brackets e.g. *(50% CR)* are the responses of those interviewed that perceived the risk and risk management in this area to be outside their role. These respondents elected to answer in terms of the acceptability of the consequence.

ADVERSE EVENT >>>>	STRUCTURAL INTEGRITY UNDERMINED	QUALITY STANDARDS NOT MET	LATENT DEFECTS	ABORTIVE WORKS	MATERIALS/ SKILLS NOT READILY AVAILABLE	SUPERFICIAL DAMAGE TO BUILDING FABRIC	MINOR DAMAGE/ PROBLEMS THAT CAN AWAIT REPAIR
Unacceptable: Intolerable – must be eliminated or transferred	**74%** *(75% CR)*	**28%** *(59% CR)*	**28%** *(29% CR)*	**6%** *(18% CR)*	**6%** *(17% CR)*	**nil** *(18% CR)*	**nil** *(12% CR)*
Undesirable: To be avoided if reasonably practicable. Detailed investigation required	**21%** *(25% CR)*	**72%** *(35% CR)*	**50%** *(47% CR)*	**72%** *(76% CR)*	**72%** *(59% CR)*	**50%** *(65% CR)*	**33%** *(47% CR)*
Acceptable: Can be accepted, providing the risk is managed	**nil** *(nil CR)*	**nil** *(6% CR)*	**16%** *(24% CR)*	**22%** *(6% CR)*	**11%** *(24% CR)*	**44%** *(12% CR)*	**44%** *(29% CR)*
Negligible: No further consideration needed	**nil** *(nil CR)*	**nil** *(nil CR)*	**6%** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*	**6%** *(5% CR)*	**17%** *(12% CR)*
(Don't Know) **DK**	**5%** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*	**11%** *(nil CR)*	**nil** *(nil CR)*	**6%** *(nil CR)*

TABLE EHS 4

ACCEPTABILITY OF TAKING RISKS THAT MAY LEAD TO ADVERSE EVENTS RELATING TO ENVIRONMENT AND HEALTH & SAFETY

- The responses indicate the attitude each respondent considered appropriate in terms of taking the risk that the tabulated adverse event may occur.
- The responses are the collective answers of all the disciplines.
- The answers of interviewees who considered risk and its management to be within the scope of their role as a member of the building team are tabulated as % e.g. **50%**
- In brackets e.g. *(50% CR)* are the responses of those interviewed that perceived the risk and risk management in this area to be outside their role. These respondents elected to answer in terms of the acceptability of the consequence.

ADVERSE EVENT >>>>>>	DEATH	SERIOUS POLLUTION HAZARD	LOST TIME INJURY OR ILLNESS	INJURY/ILLNESS REQUIRING FIRST AID	MINOR EVENTS (e.g. APOLOGY LETTER ONLY REQUIRED)
Unacceptable: Intolerable – must be eliminated or transferred	**100%** *(88%CR)*	**84%** *(88%CR)*	**21%** *(12%CR)*	**5%** *(6%CR)*	**21%** *(12%CR)*
Undesirable: To be avoided if reasonably practicable. Detailed investigation required	**nil** *(12%CR)*	**16%** *(12%CR)*	**68%** *(57%CR)*	**69%** *(63%CR)*	**42%** *(38%CR)*
Acceptable: Can be accepted, providing the risk is managed	**nil** *(nil CR)*	**nil** *(nil CR)*	**11%** *(25%CR)*	**26%** *(19%CR)*	**37%** *(25%CR)*
Negligible: No further consideration needed	**nil** *(nil CR)*	**nil** *(nil CR)*	**nil** *(6%CR)*	**nil** *(12%CR)*	**nil** *(25%CR)*
Made no response	**nil** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*

TABLE AC5

ACCEPTABILITY OF TAKING RISKS THAT MAY LEAD TO ADVERSE EVENTS RELATING TO CONSERVATION

- The responses indicate the attitude each respondent considered appropriate in terms of taking the risk that the tabulated adverse event may occur.
- The responses are the collective answers of all the disciplines.
- The answers of interviewees who considered risk and its management to be within the scope of their role as a member of the building team are tabulated as % e.g. **50%**
- In brackets e.g. *(50% CR)* are the responses of those interviewed that perceived the risk and risk management in this area to be outside their role. These respondents elected to answer in terms of the acceptability of the consequence.

ADVERSE EVENT →	SIGNIFICANT LOSS OF HISTORIC FABRIC	INTERVENTION WHICH IS NOT REVERSIBLE	AESTHETIC DRAWBACK	MINOR/SUPERFICIAL DAMAGE TO BUILDING FABRIC
Unacceptable: Intolerable – must be eliminated or transferred	**78%** *(65%CR)*	**33%** *(24% CR)*	**17%** *(24% CR)*	**nil** *(18% CR)*
Undesirable: To be avoided if reasonably practicable. Detailed investigation required	**22%** *(35%CR)*	**50%** *(76% CR)*	**78%** *(65% CR)*	**56%** *(52% CR)*
Acceptable: Can be accepted, providing the risk is managed	**nil** *(nil CR)*	**11%** *(nil CR)*	**5%** *(11% CR)*	**33%** *(12% CR)*
Negligible: No further consideration needed	**nil** *(nil CR)*	**6%** *(nil CR)*	**nil** *(nil CR)*	**11%** *(18% CR)*
Made no response	**nil** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*	**nil** *(nil CR)*

TABLE LA1

Additional comments made by respondents when completing the likelihood and acceptability tables in questionnaire OBU/J/2

RISK AREA ↓	**ADDITIONAL COMMENTS LIKELIHOOD & ACCEPTABILITY**
Budget	Bankruptcy is more frequent when the Construction Industry is in recession. Some contractors safeguard themselves by investigating all private clients and obtaining credit references. Consultants frequently take clients at face value but carry out a financial assessment on contractors. Main contractors take risks to make money. Grey areas in design and unknown factors in the building's construction lead to claims and damages. Finding asbestos in the building is a common cause for claims. The contingency sum is frequently consumed and more so when the budget for the project is low.
Programme	Complete programme re-organisation occurs particularly in refurbishment projects. Realistic programmes by contractors are essential with allowances for unforeseen problems, a common occurrence in refurbishment. Minor hold ups are more likely to be in the architectural work than in the building services installation. Disruption to other trades and down time of plant is a problem to be dealt with by the contractor.
Technological	Maintaining the structural integrity of the building over-rides the building services requirements. Selecting the right contractor for the project contributes to reducing risk and also helps eliminate problems relating to resources and skills. Quality varies from job to job but careful monitoring and adequate inspection substantially reduce quality problems. Most commonly, quality standards are not met in the building's finishes.
Environmental, Health & Safety	Construction, Design and Management Regulations, 1994 can help reduce adverse events. Welfare on site is the responsibility of the contractor, as a rule.
Conservation	Intervention which is not reversible occasionally happens but usually to elements of minor importance.

TABLE RMS. 1 **RISK MANAGEMENT STRATEGY**

The table below summarises the responses to question 4.1 in Questionnaire Survey OBU/J/2

DISCIPLINE [5 respondents in each discipline]	**Used a risk management strategy**	**Summary of respondents' description of their risk management strategy**	**Didn't use a risk management strategy**	**Summary of description of ways of managing risk (respondents that didn't use a risk management strategy)**
Architects	2/5	Experience of consultants. Get work checked by others. Office quality plan to review every stage of the design process. Intuitive assessment plus provisional sums.	3/5	Intuitive forms of risk assessment decision making. Provisional sums and contingencies. Frequent site inspection. Good communication with all parties.
Mechanical & Electrical Contractors	4/5	Risk assessment prepared for each contract e.g. welding. Contractors Association tick sheet specified by client.	1/5	Personal experience considered at tender stage.
Quantity Surveyors	1/5	Experience.	4/5	Educate client. Adjust contingency. Proper investigation. Consider problems at design stage. Budgeting allowances.
Building Surveyors	4/5	Experience. Planning projects identifying problems. Consider every aspect and qualify what you are saying. Suitable contingency based upon survey. Overall project is reviewed and risks assessed and reported to clients at all stages of the project.	1/5	Contingency. Intuition and previous experience.
Structural Engineers	4/5	Contingency. Allow for degree of uncertainty in building structure. Precontract opening up survey. Anticipation and experience. Careful monitoring of design changes.	1/5	Double checking.
Building Services Consultants	4/5	Precontract opening up survey. Survey work confirming assumptions. Using people with proven track record. Contingencies/provisional sums. Risk assessment at various stages of the project.	1/5	
Main Contractors	3/5	Contingencies. Financial awareness. Quality control. Transfer as much risk as possible. Avoid high risk projects with unfair terms. Fire Safety plan. Risk assessment re: asbestos.	2/5	Intuition & experience. Establish clear ground rules before you start the work.

APPENDIX IV

KEY POINTS RAISED AT INTERVIEW

INTRODUCTORY NOTES

- This appendix contains the content analysis of 35 interviews carried out during 1995.
- The 35 individuals that took part in the questionnaire survey, also took part in the interview survey.
- The interview was carried out directly after the questionnaire.
- The interviewees comprised of 5 each of the following disciplines:

    - **architects**
    - **mechanical & electrical contractors**
    - **quantity surveyors**
    - **building surveyors**
    - **structural engineers**
    - **building services consultants**
    - **main contractors**

- The results have been reported utilising the same analytical framework devised for the questionnaire, *viz.*

    - **programme**
    - **skills, working methods and working hours**
    - **liaison & communication**
    - **health & safety**
    - **budget & financial matters**
    - **statutory control**
    - **site and materials**
    - **contract**

- These headings have been placed in descending order on the basis of the number of *success* factors identified at interview.
- Statements that interviewees did not *clearly* attribute to 'success' or 'problems' are listed under 'general points'.
- Success factors, problem factors and general points have been abbreviated to **S**, **P**, and **G**, respectively in **Tables KP1** and **KP2**.
- Abbreviations have been used for the disciplines as follows: architects **(AR)** mechanical/electrical contractors **(MEC)** quantity surveyors **(QS)** building surveyors **(BS)** structural engineers **(SE)** building services consultants **(BSC)** main contractors **(MC)**.

Table KPI

KEY POINTS RAISED AT INTERVIEW, BY DISCIPLINE

DISCIPLINE	Architects			Mechanical & Electrical Contractors			Quantity Surveyors			Building Surveyors			Structural Engineers			Building Services Consultants			Main Contractors		
	S	P	G	S	P	G	S	P	G	S	P	G	S	P	G	S	P	G	S	P	G
Skills, working hours and methods	5	9	0	2	0	1	2	2	0	7	2	2	2	2	1	5	2	7	8	4	3
Liaison & Communication	11	0	0	2	5	4	1	4	0	7	2	0	2	2	0	4	2	2	2	3	0
Site and materials	1	3	1	2	6	7	2	4	4	6	5	3	3	5	2	3	4	2	0	9	0
Budget & Financial Matters	4	0	0	0	0	0	0	0	1	3	2	1	1	1	1	0	6	2	0	1	2
Programme	1	2	0	4	2	1	2	0	0	0	2	0	1	1	1	0	3	0	1	3	1
Contract	1	0	0	1	0	0	4	1	0	0	2	0	1	2	0	0	2	0	0	2	1
Statutory Control	0	1	0	0	0	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0
Health & Safety	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	*23*	*15*	*1*	*11*	*13*	*14*	*11*	*12*	*5*	*24*	*16*	*6*	*10*	*14*	*5*	*12*	*20*	*13*	*11*	*22*	*7*
Grand Total	39			38			28			42			29			45			40		

Table KP2

KEY POINTS RAISED AT INTERVIEW, BY DESCRIPTION CATEGORY

DISCIPLINE	Skills, Working Hours and Working Methods			Liaison & Communication			Site and Materials			Budget & Financial Matters			Programme			Contract			Statutory Control			Health & Safety		
	S	P	G	S	P	G	S	P	G	S	P	G	S	P	G	S	P	G	S	P	G	S	P	G
Architects	5	9	0	11	0	0	1	3	1	4	0	0	1	2	0	1	0	0	0	1	0	0	0	0
Mechanical & Electrical Contractors	2	0	1	2	5	4	2	6	7	0	0	0	4	2	1	1	0	0	0	0	0	0	0	1
Quantity Surveyors	2	2	0	1	4	0	2	4	4	0	0	1	2	0	0	4	1	0	0	1	0	0	0	0
Building Surveyors	7	2	2	7	2	0	6	5	3	3	2	1	0	2	0	0	2	0	1	1	0	0	0	0
Structural Engineers	2	2	1	2	2	0	3	5	2	1	1	1	1	1	1	1	2	0	0	1	0	0	0	0
Building Services Consultants	5	2	7	4	2	2	3	4	2	0	6	2	0	3	0	0	2	0	0	1	0	0	0	0
Main Contractors	8	4	3	2	3	0	0	9	0	0	1	2	1	3	1	0	2	1	0	0	0	0	0	0
Total	*31*	*21*	*14*	*29*	*18*	*6*	*17*	*36*	*19*	*8*	*10*	*7*	*9*	*13*	*3*	*7*	*9*	*1*	*1*	*5*	*0*	*0*	*0*	*1*
Grand Total	66			53			72			25			25			17			6			1		

SKILLS, WORKING HOURS AND WORKING METHODS

Success Factors (31 points)

- ✓ Select a contractor who has a total understanding of the total process. (AR)
- ✓ Select a contractor who can anticipate likely problems. (AR)
- ✓ Select a contractor who is experienced in the field of work. (AR)
- ✓ Select a contractor, for whom you have prior knowledge i.e. who has a proven track record with your organization or you have worked with before. (AR)
- ✓ The design should suit the building - the building should not be modified, unless absolutely essential, to accommodate the design. (AR)
- ✓ Mechanical and electrical contractors should use their own direct labour force. (MEC)
- ✓ Mechanical /electrical contractors must be experienced in building conservation projects. (MEC)
- ✓ General and specialist contractors must be chosen from a selective tender list. (QS)
- ✓ All main contractors and subcontractors must provide examples of previous work. (QS)
- ✓ The designer must be sympathetic to the building to integrate the building services easily. (BS)
- ✓ The main contractor should be selected on the basis of quality and cost. (BS)
- ✓ Keep building services solutions simple. ((BS)
- ✓ The contractor must be able to understand the specification. (BS)
- ✓ A good main or subcontractor will look at *your* solution to a problem. (BS)
- ✓ Request to know who the subcontractors are. (BS)
- ✓ Select the right subcontractors - they frequently know the work better than the main contractor. (BS)
- ✓ Use a multidisciplinary approach. (SE)
- ✓ The contractor must be sympathetic to the building and the nature of the work. (SE)
- ✓ The key to a good project is the design team. (BSC)
- ✓ Careful monitoring and regular checks ensure good quality control and a satisfactory end product. (BSC)
- ✓ Ensure the project team has a genuine interest in historic buildings and does not focus solely on the commercial rewards. (BSC)
- ✓ Provide an economical final solution. (BSC)
- ✓ Any design solution must take account of the visual impact of the new building services. (BSC)
- ✓ Use approved subcontractors. (MC)
- ✓ Select subcontractors that are experienced in building conservation work. (MC)
- ✓ Select subcontractors that understand the construction of old buildings. (MC)
- ✓ Only use skilled craftsmen. (MC)
- ✓ Only use experienced operatives. (MC)
- ✓ Be open to alternative and/or innovative solutions. (MC)
- ✓ Maintain the quality of the work by providing an adequate level of control. (MC)
- ✓ The design solution must be well thought out by a multidisciplinary team. (MC)

Problem Factors (21 points)

- Many general contractors do not take time to solve problems and investigate alternatives. (AR)
- There is a dearth of mechanical and electrical engineers who specialize in conservation work. (AR)
- Building services engineers infrequently have the expertise to know what is sensitive to the building and adopt a 'black and white' approach. (AR)
- The technical knowledge of conservators is often minimal. (AR)
- The technical knowledge of planners is often minimal. (AR)
- Reconciling the client's requirements and conservation objectives is often problematic. (AR)
- Working drawings for the building services are frequently incomplete when the contractor takes possession of the site. (AR)
- Producing a design to ensure user satisfaction is acceptable is not always achieved. (AR)
- Reconciling the requirements of functionality and conservation objectives is often difficult. (AR)
- The design is often left to the mechanical and electrical contractor but it should be undertaken in conjunction with the building services engineer. (QS)
- Building services consultants are often impractical and rely on mechanical /electrical contractors. (QS)
- Certain contractors claim they can do the work when they cannot. (BS)
- Main and subcontractors frequently resolve problems in the way that is easiest for them. (BS)
- There are no specialist courses in building conservation for building services engineers and structural engineers. (SE)
- Structural engineers are often only called in when things go wrong. (SE)
- Quality workmen are a limited resource. (BSC)
- Architects aren't trained adequately in building services engineering. (BSC)
- There are insufficient training schemes for apprentices. (MC)
- Mechanical/electrical contractors generally look for the easy way out. (MC)
- Detailing and specification are frequently inadequate, particularly in economic recession. (MC)
- The mechanical and electrical work is often a major problem area for the main contractor. (MC)

General Points (14 points)

- The best mechanical and electrical contractors use a direct labour force that have a knowledge and understanding of building conservation work. (MEC)
- Building conservation is a complicated aspect of refurbishment work. (BS)
- Domestic building services (plumbing, lighting and heating) are generally easy in historic buildings. (BS)
- The solution is often challenging requiring an inventive approach - therefore, the work is very interesting. (BSC)
- Integrating modern building services into historic buildings is more involved than in general refurbishment. (BSC)

- The building services consultants's input depends upon whether he is engaged on the basis of full duties, abridged duties or performance duties. (BSC)
- A simple solution may be cheaper to install but it frequently takes greater time, in the design phase, than a more standard approach to building services provision. (BSC)
- Design, frequently involves co-ordinating new and existing building services. (BSC)
- Integrating building services into listed historic buildings requires special attention to detail and necessitates extra care. (BSC)
- Building services consultants have to get to know the building, its original construction, later changes and existing building services. (BSC)
- Structural engineers, involved in building conservation projects, must have a sound knowledge of the construction of historic buildings. (SE)
- UK main contractors are considered a 'lesser breed'. (MC)
- Sorting out problems with the building services design and installation may take more time than the installing the services themselves. (MC)
- It is preferable for the mechanical/electrical contractors to do their own BWIC (Builders Work In Connection). (MC)

LIAISON & COMMUNICATION

<u>Success Factors</u> (29 points)

- ✓ Build up a relationship with the client and contractor. (AR)
- ✓ Start talking with other disciplines and the client as early on in the project as possible. (AR)
- ✓ Use practitioners where there is already a well-established relationship in this type of work. (AR)
- ✓ Negotiate, meet in the middle with the Statutory Authorities, when ever possible. (AR)
- ✓ Ensure the brief is adequate and well understood. (AR)
- ✓ Work with practitioners with the same philosophic approach. (AR)
- ✓ The architect should be a facilitator and get the team interested in the project. (AR)
- ✓ The architect should have a proactive rather than a passive approach. (AR)
- ✓ The architect must have breadth of vision. (AR)
- ✓ Structural and building services engineers should work together. as early as possible, in the project. (AR)
- ✓ Gelling of the team is essential and is facilitated by the strength of the lead consultant. (MEC)
- ✓ The flow of information in both directions (up and down) is absolutely critical. (MEC)
- ✓ Consultants and the contractor must have detailed discussions with the mechanical/electrical contractor about routing building services. (QS)
- ✓ The general contractor must understand the culture of the lead consultant's organization. (BS)
- ✓ The general contractor must be able to work with consultants (co-operation and participation). (BS)
- ✓ The input of the client is essential and useful. (BS)
- ✓ There must be trust between consultants and contractors. (BS)
- ✓ Know the client and what he needs (BS)
- ✓ Each member of the project team must be able to appreciate the aims and objectives of its individual constituent members and adopt an interdisciplinary approach. The style of work is quite identifiable. (BS)
- ✓ Ensure the brief provides the basis for understanding the project. (BS)
- ✓ Know what the client wants. (SE)
- ✓ Use a holistic approach and ask each other the right questions. [Client, consultants and contractors.] (SE)
- ✓ The building services engineer must work with the architect and other disciplines early on because other works will affect the building services provision - the flow of information is very important. (BSC)
- ✓ The nature of the work involves working closely with the other members of the project team - all must be aware of the others' needs, concerns and problems - patience and sympathy are paramount. (BSC)
- ✓ Building services engineers should talk to both the owners and users of the building. (BSC)
- ✓ A good relationship between the architect and contractor is crucial. (BSC)
- ✓ Consult with the building surveyor at full and regular site meetings. (MC)

- ✓ The architect must understand the disciplines and iron out problems, early on, if objectives are not the same. (MC)

Problem Factors (18 points)

- o People often delay in making up their minds. (MEC)
- o There is often a feeling of mistrust on projects - everybody seeks to cover their own back. (MEC)
- o No matter how good the main contractor and the consultants are, if problems occur and goodwill is lost, then their job becomes problematic. (MEC)
- o Personalities often have a negative influence on the project. (MEC)
- o People are not always available to make decisions and this can be crucial. (MEC)
- o Occupied historic buildings pose additional problems. Communication between the project manager and client is paramount. (QS)
- o Clients have unrealistic requirements and need to be 'educated'. (QS)
- o Clients cannot visualize or understand drawings, generally. (QS)
- o Many clients are not clear about their requirements. (QS)
- o Building conservation work needs more supervision. (BS)
- o Liaison with the Local Authority, Fire Officer and English Heritage can be very difficult. (BS)
- o Sometimes there can be an impasse with English Heritage. (SE)
- o There should be a fuller brief at the onset. (SE)
- o Contractors cannot be trusted, generally, and this makes inspection of the work onerous - contractors argue every point, which becomes time consuming. (BSC)
- o Co-ordination of drawings, extent of instruction on drawings and clear-cut lines of who is doing what, are frequently insufficient. (BSC)
- o Frequently the architect does not have all the information at the time the work goes to tender. (MC)
- o Contractors find a lack of communication between building services consultants and structural engineers. It is the job of the architect to co-ordinate. (MC)
- o Clients do not understand the importance of engaging building services engineers, early on. (MC)

General Points (6 points)

- ❖ Established working relationships are beneficial to the dynamic of the project team. (MEC)
- ❖ Communication between the disciplines in building conservation/integrating modern building services requires more time than general refurbishment. (MEC)
- ❖ Everything pivots around the main contractor. (MEC)
- ❖ The quality of working relationships with interior designers can be variable. (MEC)
- ❖ Good working relationships between the building services consultants and the building services installers have deteriorated over the last three years [1995]. (BSE)
- ❖ The allocation of time spent on preparing drawings/ tender documentation versus site activities requires rethinking. (BSE)

SITE AND MATERIALS

Success Factors (17 points)

- ✓ Use small ducts and pipes, where ever possible, to minimize the architectural impact. (A)
- ✓ Follow the sequence of the building when marking out notches, holes etc for ducts, pipes and wires. (MEC)
- ✓ Carefully consider the weight of building services plant and consult with the building services engineer. (MEC)
- ✓ Seek to adapt existing building services rather than increasing/integrating more services. (QS)
- ✓ The design solution must consider *the building as a whole*; a piecemeal approach should not be applied. (QS)
- ✓ Avoiding running building services where there will be a conflict with features and internal work that have to be preserved. (BS)
- ✓ Keep solutions simple when routing pipework. (BS)
- ✓ Apply a flexible approach to locating plant and consider zoning as an option. (BS)
- ✓ Undertake a thorough precontract survey of the building. (BS)
- ✓ If the design is on a conceptual/performance basis then employ vigilant quality control, on site. (BS)
- ✓ Establish a balance between fire protection installations and passive fire management strategies. (BS)
- ✓ Carry out an opening up exercise to establish floor/ceiling arrangements so that service routes can be designed to cause minimum intervention and interference to the structure. (SE)
- ✓ A thorough investigation of the building's structure is essential. (SE)
- ✓ Establish historical facts about the building and look for alterations carried out throughout the lifetime of the building. (BSC)
- ✓ Always try and identify problems concealed in the structure before the contractor takes possession of the site. (BSC)
- ✓ Go through the building and take photographs. (BSC)
- ✓ Identify issues relating to materials (plant and components) storage, early on. (BSC)

Problem Factors (36 points)

- o Lack of interstitial spaces in old buildings. (AR)
- o Unknown in the building construction. (AR)
- o User satisfaction in building services provision is often appalling. (AR)
- o The main problem is space and fitting in the building services sympathetically. (MEC)
- o Access is a big problem when integrating large components. (MEC)
- o Modern building services/systems are not always suitable for historic buildings. Architects and clients sometimes make unrealistic requirements and forget it is an old building. (MEC)
- o Stripping out old services can be a major problem. (MEC)
- o Rubble and debris in voids and spaces can be a fire risk. (MEC)

- Frequently, there is a limited knowledge of the construction of the building. (QS)
- Horizontal and vertical integration of the building services is often difficult. (QS)
- There are often problems at the interface of new and existing systems. (QS)
- Routing of pipe runs is a main problem area. (QS)
- The building frequently imposes severe spatial constraints. (BS)
- The original building fabric (e.g. paneling) may appear to be, cosmetically, in good condition but not reusable once dissembled. (BS)
- Fixed horizontal separation can cause difficulty for routing building services. (BS)
- Investigation is limited without damaging the building or employing very expensive techniques. (BS)
- Unknown factors in the building's construction are a major risk. (BS)
- The major problems for the structural engineers re: integrating modern building services are: - air conditioning, weight of building services plant, ductwork and insulation, finding adequate interstitial spaces. (SE)
- Investigation can be limited if the building is occupied. (SE)
- Old buildings were not designed with modern building services in mind. (SE)
- Educated assumptions have to be made about the construction of the building. (SE)
- There are generally very few records kept relating to alterations and maintenance. (SE)
- Old buildings require a great deal of survey work. (BSC)
- Disposal of asbestos can be a problem. (BSC)
- Records of existing building services systems are often absent. (BSC)
- In many instances, fire officers make a subjective interpretation of the requirements and these are difficult to accommodate within the building structure/layout. (BSC)
- Protection of the existing (structure, fabric, systems) is problematic. (MC)
- Temporary works can be difficult. (MC)
- Structural and spatial problems are most difficult when integrating modern building services. (MC)
- The structure of the building can be unpredictable. (MC)
- Materials are sometimes not readily available. (MC)
- Pipe routes and cable runs are a major headache. (MC)
- Some designs for the building services are not user friendly. (MC)
- The mechanical and electrical work is often the main problem for the contractor. (MC)
- Contractors are always coming up against the unknown in the building. (MC)

<u>General Points</u> (19 points)

- The solution to building services is influenced by the condition of the building. (AR)
- All contractors must know the building structure. (MEC)
- Abortive work is rare (changes are normally due to variations). (MEC)
- A varied amount of building services are used in old buildings. (MEC)
- Sometimes, some of the old system must be retained to minimise intervention and loss of decorations. (MEC)
- Previous alterations are often uncovered during the installation of the building services. (MEC)
- Every job is different. (MEC)
- Building services can't go just anywhere. (MEC)

- Passive solutions to building services requirements can be less intrusive. (QS)
- Conservation and economy can go well together. (QS)
- Building services are a growth area: fire protection, security, controlled environments and IT provision. (QS)
- Integrating modern building services into historic buildings is a complex process. (QS)
- Achieving modern building services requirements without compromising conservation objectives for the building is a challenge. (BS)
- Achieving modern building services with appropriate aesthetics requires innovation. (BS)
- Contractors often have a better idea of the BWIC (Builders Work In Connection). (BS)
- Refurbishing historic buildings is very interesting work. (SE)
- Structural engineers frequently rely on their knowledge of construction. (SE)
- Consider the benefits of fabrication off site. (BSC)
- Installations must co-ordinate with the structure of the building and meet the criterion of aesthetics. (BSC)

BUDGET & FINANCIAL MATTERS

<u>Success Factors</u> (8 points)

- ✓ Prepare timely budget estimates. (AR)
- ✓ Allow for opening-up surveys and investigation into the building and its history, in the budget sum. (AR)
- ✓ Check the preliminaries are not unreasonable; look for front loading. (AR)
- ✓ Estimate a realistic contingency sum, possibly as much as 10%. (AR)
- ✓ Always carry out a financial investigation on the contractor. A bond should be provided to cover losses and/or additional costs should another contractor need to be appointed. (BS)
- ✓ The objectives of the project team should not merely focus on financial reward. The end product is key. (BS)
- ✓ Cost control is easier if the design and specification is complete at the tender stage. (BS)
- ✓ Ensure a schedule of rates is included in any tender documentation where the work cannot be exactly quantified. (SE)

<u>Problem Factors</u> (10 points)

- o In building conservation projects, building surveyors commonly have to price their fees on inadequate information. (BS)
- o The contractor may out price himself, if he knows the work and the quality that is required. (BS)
- o Firm tenders based on loose or approximate quantities place onus on the contractor. The higher risk to the contractor will reflect a higher price in his bid. (SE).
- o Clients often ignore the need for an appropriate contingency. (BSC)
- o Economic forces are forcing bids for consultants' services lower. Less time is available for the project and the client may not get the best value for money. (BSC)
- o Building services consultants are frequently asked to make a quotation for their professional services, with minimal information. The consultant who is prepared to take the biggest risk often secures the work. (BSC)
- o Less time preparing tender documentation creates a greater likelihood that information will be incomplete, at the tender stage. This frequently leads to more claims. (BSC)
- o Feasibility studies and costing exercises: the effort that goes into the building services solution is suppressed by financial constraints. (BSC)
- o Problems can arise when the lead discipline can exercise a life/death role over other disciplines. The lead consultant's competitive bid will be compiled from bids sought from other disciplines. These consultants frequently have insufficient time to prepare adequately before providing a competitive fee bid. (BSC)
- o Mechanical and electrical works are often a major cost element in refurbishing historic buildings. It is also the element where design is frequently incomplete. Realistic bids can only be produced if the contractor is given adequate information. (MC)

General Points (7 points)

- The quantity surveyor envisages, anticipates and identifies possible problems and allocates appropriate provisional sums, accordingly. (QS)
- Lump sum bids for professional services are becoming more commonplace. (SE)
- Maintenance costs and running costs are all part of the picture. (BS)
- Often large provisional and contingency sums are used. (BSC)
- Consultants frequently submit bids, for their professional services, based purely on performance requirements and an outline scheme for the building services. (BSC)
- The value of preliminaries is often high in building conservation work. (MC)
- Building services may represent up to a half of the value of the contract sum. (MC)

PROGRAMME

Success Factors (9 points)

- ✓ Deal with variations promptly and be aware of their impact on the programme. (AR)
- ✓ The installer must allow more time than would be necessary, in general refurbishment, to look for appropriate and acceptable routes to integrate the building services. (MEC)
- ✓ Pre-planning is essential, look in advance as much as possible. In old buildings, problems present themselves as the project progresses. (MEC)
- ✓ The work of the main contractor and the mechanical/electrical contractors can have a knock on and/or ripple effect either way. Flag up delays as soon as they occur and the reasons why. This saves time and money in the long run. (MEC)
- ✓ Materials procurement schedules are essential. Often specialist items have waiting lists and this necessitates forward planning. (MEC)
- ✓ Look at the criteria and activities re: programming the works and prioritise. (QS)
- ✓ Have a strategy; think about the problems and how to make allowances for them in the programme. (QS)
- ✓ Contractors must have experience in planning and programming building conservation work. (SE)
- ✓ Get the lead-in periods, right. (MC)

Problem Factors (13 points)

- o Producing detailed drawings once the contract has been let (traditional procurement route) may hold up the project and cause down time. (AR)
- o Situations and the requirements of clients/ and or consultants can change. (AR)
- o Many clients have unrealistic requirements; their time scale requirements are far too short. (MEC)
- o Sometimes when dealing with old buildings, new building services plant has to be taken apart and reassembled in situ. (MEC)
- o Phased completion can be problematic. (BS)
- o Unknown factors in the building's construction can often reveal things (e.g. archaeological finds, asbestos), which hold up the programme. (BS)
- o Lead-in periods can pose problems especially if the contract period is too short. (SE)
- o Architect's drawings are often only ready at the last minute. This pushes the building services designer into a tight corner, time wise, and doesn't give the quantity surveyor sufficient time to make cost estimates. (BSC)
- o Normally the building services consultant is brought in too late. (BSC)
- o Less time spent in the pre-contract phase (traditional procurement) on planning, inspection and investigation leads to more technical queries and programme hold - ups in the postcontract phase. (BSC)
- o Frequently there are time overruns because not enough thought is given to the project, in the beginning. (MC)

- Co-coordinating with the mechanical/electrical contractor can be a problem unless details are provided at preorder meetings. (MC)
- Poor co-ordination between structural engineers and building services engineers can hold up the programme. (MC)

General Points (3 points)

- Listed buildings take twice as long as a general rule. (MEC)
- Lead-in periods integrating modern building services into historic buildings are generally longer then in new build. (SE)
- Programming the works heritage refurbishment is complex. (MC)

CONTRACT

Success Factors (7 points)

- ✓ Ensure the type of contract is appropriate to the work that is to be undertaken. (AR)
- ✓ Assess tenders when they come in. Only expend time on those projects that are physically possible, realistic and attractive. (MEC)
- ✓ Avoid letting the contract until any arising precontract problems have been resolved. (QS)
- ✓ Name a selected/preferred list of specialist subcontractors in the contract documentation. (QS)
- ✓ Ensure the tender documents convey as much information as possible. (QS)
- ✓ Do not amend standard forms of contract. (QS)
- ✓ Contract documents must be carefully structured. (SE)

Problem Factors (9 points)

- o Contractors do not always read the preliminaries. (QS)
- o Anomalies may arise in the contract documents. (BS)
- o Factors relating to the building, frequently, come to light *after* the contract has been let. (BS)
- o Too much detail can prove to be inefficient. It reduces the scope for continuity in the design process on site and can make contractors wary if the documentation is expensive to price. (SE)
- o Frequently, detailing cannot be started until the after the contract is awarded. (SE)
- o Lines of responsibility: - No clear line of who is doing what and who is legally responsible. (BSC)
- o Installation drawings are often not prepared until after the contract has been let. [Traditional procurement] (BSC)
- o Can be difficult to get estimates from subcontractors when the tender documentation is sketchy or brief. (MC)
- o Risk is 'dumped' on the main contractor. (MC)

General Points (1 point)

- ❖ Competitive tendering may not necessarily be the best way to get good quality work and value for money. (MC)

STATUTORY CONTROL

Success Factors (1 point)

- ✓ Sort out all the issues relating to Statutory Control early on. (BS)

Problem Factors (5 points)

- o Achieving fire protection requirements is often a problem. (AR)
- o Fire legislation protects the building users and/or occupants but does not protect the building. (QS)
- o Fire protection measures: it is difficult to establish a balance between the legal requirements to protect people and the building conservation objectives. (BS)
- o English Heritage does not give guidelines. They either approve or reject proposals. (SE)
- o Fire officers do not comment on drawings, they only acknowledge the receipt of them. (BSC)

HEALTH & SAFETY

General points (1 point)

- Health and safety is a key issue in this type of work. The safety of operatives working in voids must be considered (e.g. are they strong enough to carry the weight of workmen?). Continued risk assessment must be carried out each week. (MEC)

APPENDIX V

CASE STUDY NARRATIVES

CASE STUDY 1

12.0 INTRODUCTION

The following notes reported the findings of an enquiry into the refurbishment process carried out on a listed country house (Grade I) with specific reference to the integration of modern building services.

12.1 CASE STUDY METHODOLOGY

The case study was conducted by

- visiting the site
- interviewing the client and members of the project team
- inspecting construction drawings
- examining the briefing document issued to the building services consultant, by the architect, for the mechanical and electrical component of the work.

The data collection was carried out over a twelve month period in 1996. The contract had been completed and the building was being prepared for opening the following year.

12.2 THE BUILDING

The building, a Jacobean country house was constructed circa 1604. The architect is unknown but the design has been described as 'similar to Longleat but much smaller'. It was designed and built for a Member of Parliament and aspiring entrepreneur, whose fortune was founded in the woollen industry. It remained the country home for subsequent generations until the latter part of the twentieth century. The house and ancillary buildings, which included a brew house and stables, have undergone minimal alteration throughout their lifetime. The buildings were relatively unmodernised, although a lavatory was installed in the main house in the late eighteenth century and a central heating and hot water system was introduced in 1936. The house was rewired in 1970.

12.2.1 Original/Former Use

The building was used as a family home for nearly four hundred years.

12.2.2 New Use

The building is now used for cultural, educational and leisure activities. It provides some staff accommodation and is open to members of the public, on a regular basis.

12.3 THE CLIENT

A charity organisation of long-standing and major custodian of historic buildings.

12.4 THE PROJECT BRIEF

The house was lovingly described as *'a muddle box that had been subject to years of make-do and mending'.* Apart from rebuilding the roof, in the early nineteenth century, the building had undergone little in the way of repair and maintenance. It was in great need of conservation.

The client organisation prepared a conservation report that contained analyses of the building fabric, fittings and structure and concluded with a conservation plan. This provided the basis for developing a project strategy and devising the project brief. The overriding aim was to protect the ambience of the house - the project strategy was based on 'minimal intervention'. This philosophy was emphasised in the briefing document. The building fabric, fixtures, fittings and decoration were carefully documented. In a series of meetings decisions were made, item by item, to either keep, adapt or remove them. The overriding criterion, for both the architectural work and the building services provision, was to do nothing unnecessary.

The briefing document provided to the building services consultant stipulated that:

- physical and visual disturbance were to be limited
- use was to be made of areas where other major works were likely to be carried out
- traps were to be provided for under floor access
- cabling was to be kept to a minimum
- samples of detectors and equipment were to be provided.

12.5 THE DESIGN (Building Services Installations)

- An electric heating system was specified that comprised of local heat emitters for designated areas, with independent controls to maintain temperature and humidity levels, room by room.

- Power and lighting were to be provided using the existing system, repaired and upgraded where necessary. Undesired fittings were to be replaced or removed only where such work would not disrupt items of original joinery.
- The house was to be protected by a fire detection and security system. The installation was required to create minimal disturbance to the existing fabric. Detection equipment was to be as unobtrusive as possible.

A building management system was discounted for the following reasons:
It was considered to be an expensive, non user-friendly, self-policing system that required vast amounts of cabling. Furthermore, it was deemed expensive to repair and maintain.

12.6 PROCUREMENT ROUTE

JCT Prime Cost Contract (using a listing mechanism). The main contractor invited bids from domestic subcontractors on the list (a minimum of three) and controlled the time and price of the individual elements of the work. A contingency sum at 15% was allocated to the budget sum.

12.7 PROJECT TEAM

The following details were based on interviews with the client and the project team.

12.7.1 Selection

The project team comprised of either personnel directly employed by the client or consultants and contractors that were contracted to the client for the duration (or part) of the project.

When appointing consultants and the main contractor, the client required

- ✓ appropriate experience
- ✓ former working relationship with the client organisation
- ✓ supporting evidence of the quality of their work in other heritage refurbishment projects.

In addition to competitive bids for the work, the main contractor's criteria for selecting subcontract labour (specialist contractors, craftsmen and operatives) were:

- ✓ samples of their work

- ✓ knowledge and experience of individuals through former working relationships on previous projects
- ✓ an investigation into their past and whether they were they happy in their work
- ✓ a clear demonstration that they had the relevant knowledge, including that of the local area, if at all possible.

12.7.2 Project Team Composition

a) Project team members in the employ of the client organisation:

- the client representative, a chartered surveyor that acted as land agent
- an historic buildings representative that had a training in Fine Arts
- a project co-ordinator and assistant that were purposely selected with *no* background in the construction industry. The rationale for this criterion was impartiality. No barriers were to prevail which might inhibit asking questions or cause anxiety about 'saving face'

b) Project members contracted to the client for the duration of the project.

- architect
- quantity surveyor
- archaeologist
- building services engineer
- structural engineer
- main contractor

c) External bodies

- conservation officer
- English Heritage advisor

12.8 PROCESS/CO-ORDINATION

Preconstruction phase

Meetings were set up with the client organisation, architect and conservation officer. An outline brief was generated for the mechanical and electrical content of the work and bids from building services consultants were invited. Following his engagement, the building services consultant sent a project questionnaire to the client. Subsequent to meetings with the architect and the client, various proposals and a feasibility study for the building services solution were presented to the client organisation. The design solution, having gained approval, in principle, was developed and cross checked against a design check list re: ventilation, air changes and building capacity versus heat energy output. Further to this, checks were carried out to establish that the utilities (gas, electricity, telecommunications) had been contacted and that the appropriate documentation had been exchanged. A Standard Builders Work Schedule was employed, as a check prior to tender, to ensure that everything had been covered in the specification.

Construction phase

Once the contract had been let, the project co-ordinater and his assistant were present, on site, at all times. Meetings were held with various members of project team, once a week and the architect visited the site at least once or twice a week. The architect issued AI's (Architect's Instructions) as required. A progress report was prepared weekly, by the main contractor, for comparison with the original construction programme. Once a month, the client organisation convened a meeting of the whole project team. The minutes of all meetings were distributed to the team's constituent members and the conservation officer.

12.9 PROJECT REVIEW

An overview of the project is presented under the following headings. The information is based on comments made by the project team at interview.

12.9.1 Challenges

The design for the system to monitor and control the internal environment dictated an untested approach. The over-riding objectives were those of simplicity and the 'feel good factor'. The desired internal temperature was specified at 5% above the external temperature, in order to dehumidify to approximately 60% RH (Relative Humidity). These limits, set by mechanical controls, were required to be overriden by the 'human factor' [described by the project co-ordinator as the 'feel good factor'] when considered necessary. The caretakers of the building needed to be able to adjust the set levels for the internal environment, room by room, following their human senses. i.e. Did it feel too hot, too cold, too damp, too dry?

No 'off the shelf' or standard system existed to satisfy these requirements. Furthermore, it was essential that the design solution limited, to a minimum, the amount of water in the building.

12.9.2 Successes

- The long lead-in period up to tender (between 2 and 3 years) allowed plenty of time for thinking, organisation and preparation and review of project requirements.
- Monthly team meetings, convened from the inception of the project to its completion, provided a forum for discussion and were conducive to the dissemination of information.
- The inter-team relationship - most members of the project team recalled the project experience with warmth and enthusiasm and the 'enjoyment factor' was noted. Overall, goodwill and co-operation prevailed on site, with team members working very well together, in parallel.
- The direction and focus of the project co-ordinator whose vigilance, strong will and impartial but direct questioning helped ensure the best outcome for the building.
- The sensitive preservation of the ambience of the building within the bounds of acceptable disturbance to the historic fabric of the building.
- The project's completion: on time and within budget.
- The successful installation of Fire Protection measures. Subcontractors produced exactly what they were supposed to. They were clear in their objectives, and liaised and communicated effectively.
- Financial savings were achieved by re-examining the need for certain mechanical and electrical work (e.g. the team reviewed the need for certain trace heating and decided against it).

12.9.3 Problems

Most of the major problems in the project were encountered in the building services component of the works. These developed, in the main, as a result of the following:

- The scale of the building services element grew enormously- much more than could have been envisaged from the original interpretation of the brief. It was also much more difficult than anticipated.
- Different team members held different perceptions or had different ideas as to what was needed.
- The architect and client changed their minds many times during the project.
- The higher management responsible for making the final decision had difficulty in visualising the end product (building services).

- Some of the specialist sub-contractors had limited knowledge of some of the building services components that they installed.
- The wiring of storage heaters, in terms of versatility and functional requirements did not provide optimum user satisfaction.
- The electrical subcontractors had differing levels of experience in, and knowledge of, installation work in historic buildings.
- The electrical contractor had insufficient financial resources. These circumstances dictated the way that the job proceeded. Cable was ordered in sufficient quantities for a week, at a time, and electricians were only given minimal information on the same weekly basis. The electrical contractor became insolvent. The newly appointed contractor engaged two previous employees from the bankrupt firm. This provided continuity and retained the acquired knowledge, relating to the building and the project, and helped mitigate such disastrous turn of events.
- No record drawings were kept of the cabling for the security system. (The installers were the same company that became insolvent).
- Due to the unknown in the construction of the building, routing cables for the security system was a problem. The vast amount of cabling it required could not have been envisaged. Furthermore, the floorboards in the house couldn't be lifted until the contractor had taken possession of the site.
- The controller, a combined thermostat and humidistat had not been designed, even as a prototype, when the contract was let. What could have been designed, on paper, was left to be solved on site, six months later. The saving grace was that the architect, main contractor, building services consultant and the mechanical and electrical installers all had some input into the final design. The thermo/humidistat package should have been given to a manufacturer, allowing a procurement period of at least one year.
- The electrical contractors were proficient at domestic wiring but lacked technical knowledge of the specified systems.
- The building services were the most difficult thing and had an enormous impact on the programme and cost.
- The drawings and specification were not always studied carefully enough.
- The BWIC (Builders Work In Connection) was extremely difficult to price.
- Similar communication problems continued to occur in the next phase of the work, in the ancillary buildings.

12.9.4 Key Points

In relation to the project, the following comments were made by the project team,. Site visits and project documentation supported these comments. The points raised have been reported using the subsections devised for questionnaire OBU/J/2:

12.9.4.1 *Programme*

- Project team meetings must be convened <u>every</u> month throughout the duration of the project.
- Time must be allowed for recording everything. The archaeologist must work in conjunction with the main contractor who must allow for this activity in his programme, its impact on cost and other knock on effects.
- Programming services is difficult when the scope of works is not clearly defined.

12.9.4.2 *Skills Working Hours and Working Methods*

- A project strategy should be developed, in the light of, analyses of the building fabric and the conservation plan.
- The building services consultant may be asked to design something he could not have envisaged or has had experience of. Several suitable practitioners should be interviewed as part of the selection process.
- When selecting the main contractor, also select the actual man who will be doing the job.
- Good conservation subcontractors who are capable of working with specialists are essential.
- When you are trying something new you must be prepared for things to go wrong.
- When selecting specialist contractors for specific work items, enquire as to whether they have documented previous similar work, its difficulties and their solutions, as a resource for future projects. Build on their experience.
- The quality of the work and keeping the job on course is dependent on the quality of the main contractor's man in charge.
- Take time with what you are doing.
- Before accepting quotations ensure that drawings exist indicating what has to be done.

- The temptation by architects is often to put things in order. The approach in this project, architecturally and in the building services engineering, was to be minimal and not to do anything unnecessary.
- Get the client to clearly define what he *really* wants.
- Educate the architect.

  [Generally, architects are not interested in the mechanical and electrical work. In the finalised job, the services are largely unseen and therefore, architects do not perceive them to be a problem. Difficulties are generally ironed out by: the building services consultant, the mechanical & electrical installers and the main contractor. This, however, is frequently the cause of projects running late and over budget.]
- Educate contractors (both specialist and main contractors). Often, they are deeply entrenched in existing procedures, methods and organisation.

12.9.4.3 *Liaison & Communication*

- The architect must be chosen for the building, have adequate experience in building conservation work and be prepared to attend <u>all</u> meetings.
- The project co-ordinator, who represents the client on site, must be a strong character and draw the whole project team together.
- People must be led and continually explained to.
- Decisions have to be made relying on the advice of consultants. Questions should be asked *viz.* What is it? Why does it have to be done? Why do we need it?
- Liaison between the project co-ordinator (client) and the site agent (main contractor) is essential on a daily basis.
- Know who people are: don't go on trust, don't go on looks.
- The enjoyment factor is very important. This work can be a lot of fun with a lot of people.....stop and have a quick chat with those on site.
- The success of the project team will be threatened by a weakness in authority.
- Listen to what people are telling you within the overall context of the situation.
- Communicate through all the ranks, work as <u>one of the team</u> and get the whole team to have the same approach.
- Where there are differences in the visions of experts, disciplines and site personnel try and achieve a level of common appreciation and understanding.

- In America, the brief is sorted out completely before any construction is involved. Clients have to be disciplined and make decisions that they are going to stick with. This organisational culture is beneficial.

12.9.4.4 *Health & Safety*

NO SPECIFIC POINTS IDENTIFIED

12.9.4.5 *Budget & Financial Matters*

- The quantity surveyor must have knowledge and experience in conservation pricing and be capable of generating a realistic estimate of the final cost. An appropriate contingency sum should be built into every item. He/she needs to employ a strong, firm approach in negotiation.

12.9.4.6 *Statutory Control*

NO SPECIFIC POINTS IDENTIFIED

12.9.4.7 *Site and Materials*

- An archaeologist must be kept on site at all times - don't bring in this type of consultant after the contractor takes possession of the site.
- Have complete respect for the site.
- Use appropriately skilled local tradesmen and craftsmen, whenever possible, and draw on their knowledge of the local area and availability of resources, including materials.
- Difficulties, on site, may threaten the working relationship between different sub contractors involved in the same problem.
- The security system would have been better if it was a radio rather than hard wired system.
- Quality standards should be monitored by regular site inspections.
- Thorough reading and understanding of the specification and drawings helps eliminate abortive work, on site.

12.9.4.8 *Contract*

- The contract documents play a vital role and should be painstakingly prepared.
- Have a proper contract where the contract can be won by putting in a sensible bid, rather than going in at a very low budget.

12.10 SUMMARY

The data, in Case Study 1, has been analysed by identifying factors that contributed to its success and also created problems. Key points were categorised under the headings devised for the questionnaire survey. Sources of data were site visits, drawings and briefing documentation and interviews with the respective members of the project team.

CASE STUDY 2

13.0 INTRODUCTION

The following notes reported the findings of an enquiry into the refurbishment process carried out on a listed town house (Grade II) with specific reference to the integration of modern building services.

13.1 CASE STUDY METHODOLOGY

The case study was conducted by

- visiting the site
- interviewing the client representative and members of the project team
- inspecting construction drawings
- attending a site meeting

The data collection was carried out over a twelve-month period in 1996/1997. The works had just started on site when the data collection began. The building was occupied, as a residential nursing home, throughout the progress of the works.

13.2 THE BUILDING

The building, a town house is constructed in local materials (natural stone, Stonesfield slates) and exemplifies architecture typical of the vernacular, found in Oxfordshire. Part of the building had been ravaged by fire in the early 1990's.

13.2.1 Original/Former Use

The building was formerly used as accommodation and, also, utilised as a meeting place by the Woollen Guild. It had been altered in parts and modestly extended throughout its lifetime. Prior to refurbishment, the building had been used as a residential nursing home for some years.

13.2.2 New Use

The building continues to be used as a residential nursing home for the elderly. It provides some staff/office accommodation.

13.3 THE CLIENT

The client and owner is a private businessman, whose business activities are in the field of caring for the elderly.

13.4 THE PROJECT BRIEF

The brief was essentially founded in two objectives:

- to conserve and repair the whole building which had suffered fire damage on part of the first floor
- to upgrade the whole building for the purposes of its use as a residential nursing home.

The underpinning conservation philosophy was to protect the existing historic fabric, restore the building, where necessary, in an appropriate way and maintain the structural integrity of the building elements.

Furthermore minimal maintenance, from handover continuing into the long term, was an essential requirement and design consideration.

13.5 THE DESIGN (Building Services Installations)

- A wet central heating system was specified.
- Power and lighting, including emergency lighting, were to be provided as new installations where the existing was either damaged or below the necessary standard.
- A fire detection, security and nurse/alarm call system were specified with the requirements of the elderly occupants of the building in mind.
- Plumbing systems, kitchen and sanitary ware were also specified to cater for the needs of the residents in the nursing home.

13.6 PROCUREMENT ROUTE

The client organisation procured the work of specialist contractors and tradesman as separate work packages. These were co-ordinated and managed by the project leader, a direct employee of the client. The individual elements of the work were let as lump sum contracts based on specification and drawings, or priced schedules of rates.

13.7 PROJECT TEAM

The following details were based on interviews with the client's representative and the project team.

13.7.1 Selection

The project team comprised of personnel directly employed by the client organisation and also consultants and contractors that were contracted to the client for the duration of the contract.

When appointing consultants and contractors the client required

- ✓ a proven track record in building conservation work
- ✓ demonstration of an enjoyment and love of working with historic buildings
- ✓ a genuine interest in the job

13.7.2 Project Team Composition

a) Project team members in the employ of the client organisation

- the project leader

b) project members contracted for the duration of the contract

- architect
- structural engineer
- specialist contractors (all trades including electrical and heating contractors)
- site operatives

c) External bodies

- conservation officer
- building control officer
- fire officer

13.8 PROCESS /CO-ORDINATION

Preconstruction phase

The project leader and architect worked together from the inception of the project. The conservation officer visited the site and areas of special concern were identified. Conservation objectives were set for the project. Further to planning permission and listed building consent being granted, a structural engineer joined the project team. A former working relationship existed between the two disciplines (architect and structural engineer) Meetings were held on an *ad hoc* but regular basis with the architect, structural engineer and project leader.

Construction phase

The project leader managed the construction process (specialist contractors, the trades and operatives) as well as liaising with consultants.

Over the six month period from the start of work, on site, original requirements were amended. These details were identified as a result of studying the original working drawings and revisions.

- <u>Ground Floor</u>

Sluice relocated, assisted bath altered

Kitchen altered

Kitchen altered, electrics added

Liftwell and machine room added

WC moved

Staircase/Atrium, office created, laundry revised

Stair screen altered, boiler altered

- <u>First Floor</u>

Assisted bath altered

Sluice added

Staircase added

Electrics added to balustrade to fire escape

WC altered

Additional bedrooms added

Liftwell & access added

Staircase atrium created

- <u>Second Floor</u>

Staircase added

Electrics added

Glazed fire screen added

Staircase/ Atrium and bedrooms added

The programme for the works divided construction into three phases. The rationale for phasing the work was based on a key criterion: the residents of the nursing home were not to be disrupted or unsettled. Relocation of the elderly was dismissed, as an option. It was considered it would be far too stressful for them.

13.9 PROJECT REVIEW

An overview of the project is presented under the following headings. The information is based on comments made by the project team at interview and observations made at the site meeting.

13.9.1 Challenges

The major challenge was to install new electrical, heating, security and patient alarm systems, sensitively repair and restore the whole building whilst still maintaining and satisfying the special needs of its elderly occupants. Existing systems and services needed to be maintained and operational. Dust, noise and other environmental factors created by the construction works needed very special consideration. During the progress of the works, the staff working in the building and the project leader (for the tradesmen and contractors working on the building) needed to communicate, co-operate and negotiate with each other throughout each day.

13.9.2 Successes

- ✓ The quality of the end product was of a high standard.
- ✓ Satisfying the conservation objectives was straightforward.
- ✓ Given the difficult nature of working on a building that was occupied by residents with special needs, the relationship and co-operation of all those involved in the construction project and those running the nursing home was good. The elderly residents particularly enjoyed watching the activities of the building team

13.9.3 Problems

- Major refurbishment was required to be carried out on a building that was occupied by residents with special needs.
- Visualising and understanding the details in the construction drawings were difficult for the client organization.
- Decisions were made 'off the cuff'.
- The size of the boiler room needed to be increased because the amount and size of equipment was underestimated.
- A main boiler with greater heating capacity was required once the plumbing work started on site. There were also technical problems with the location of the flue.
- The area designated in the building for the kitchen was moved to an alternative part of the building and then moved back again.
- Slight changes made by the client had serious knock on effects for the programme.
- The project was over budget and behind schedule between phases and resulted, finally, in late completion.
- The conflict generated by the benefits and disadvantages of preplanning. Many decisions were borne out of issues cropping up on site, whilst the work was in progress. These could not have been foreseen, particularly with the building being occupied. {Note scale of revisions to construction drawings par.13.8}. The second phase proceeded with outline specification only to allow for flexibility.
- Fire legislation requirements changed during the progress of the project and additional provision was required relating to smoke detectors.
- No strategy or identification procedure, in terms of building conservation, existed other than the overriding objective to retain as much of the original fabric as possible.
- Ambiguities were encountered interpreting conservation objectives and deciding on an appropriate style and then reconciling these with the commercial and financial pressures imposed by the project.
- Members of the project team delayed making up their minds.
- The experience of the client organisation was in managing residential homes for the elderly not in building conservation and refurbishment.
- Due to delayed completion of phase one there was no lead-in time for the second phase.

- Keeping the site clean to the standard required for the building occupants and users was extremely difficult.
- More pipework and cables were required than was originally anticipated due to the dimensions and structure of the building.
- The services installations posed a threat to the aesthetic amenity within the building and had significant unforeseen financial implications.
- The solution to the building services requirements was dictated to by factors other than mechanical and electrical services theory.
- The fact that the building was occupied throughout the works and the physical constraints of the building were overriding criteria.

13.9.4 Key Points

In relation to the project, the following comments were made by the project team,. Site visits and supporting documentation supported these comments. The points raised have been reported using the subsections devised for questionnaire OBU/J/2.

13.9.4.1 *Programme*

- Whenever possible, consider the alternative of relocating the building's occupants. Realistic preplanning and the timing of materials deliveries are then possible.
- Preplanning, which inhibits flexibility, can cause problems if things arise that could not have been anticipated in the feasibility study.
- Decanting the building can remove the need for phased completion as is often the case in occupied buildings; this is less wasteful in terms of operative time on site.

13.9.4.2 *Skills, Working Hours and Working Methods*

- Training for architects in mechanical and electrical work is minimal
- Practitioners and craftsmen/tradesmen involved in building conservation work must love their work and old buildings.
- Project leaders must constantly be vigilant to maintain quality standards on site.
- Only use tradesmen with appropriate skills.
- Only use an architect that has adequate experience in the field of building conservation work.
- Move through the project as slowly as possible whilst remaining commercially feasible and with a degree of flexibility.

- Whenever possible carry out the work in an unoccupied building.
- Select contractors from a 'tried and tested' list to meet required objectives: value for money, reliability, sensitivity and expertise.
- General presumptions in accordance with standard details may cause poor quality end results in building conservation work.
- The likelihood of unacceptable work is lessened when there is a mutual understanding between designers and installers.
- Having established certain standards and codes of practice, build up a body of expertise in the nature of the work.
- Problems are created when the contractor does not look at the drawings properly.

13.9.4.3 *Liaison & Communication*

- Always maintain a regular presence on site, be observant and vigilant and keep thinking ahead.
- Liaise frequently with the conservation officer.
- Know the members of the project team; create a good working relationship so that each trusts the judgment and understands the expectations of the others.
- Good communication between the client and contractors should be regular and frequent.
- Problems are created when the contractor is not helpful.
- Problems are created when the contractors/ subcontractors do not fully understand the role of consultants, responsibilities and liabilities.
- Speak with conviction and authority.

13.9.4.4 *Health & Safety*

NO SPECIFIC POINTS IDENTIFIED

13.9.4.5 *Budget & Financial Matters*

- The actual construction costs are generally cheaper if the building being refurbishing is vacated.
- Problems are created when the contractor does not price the contract properly.

13.9.4.6 *Statutory Control*

- Minimise and avoid unacceptable work by sticking to the parameters, guidelines and requirements set out by the conservation officer.

13.9.4.7 *Site and Materials*

- Generally owners of old buildings have an emotional as well as financial interest in their building.
- Do not be tempted to skimp on building materials.
- Poor quality end results are frequently caused by unforeseen problems on site.
- Building services are frequently a constant source of irritation and poor quality end results are often characterised by factors such as air locks in pipework and noise.
- A regular presence must be maintained on site (daily is preferential) to monitor quality standards.
- Consider the building in a holistic way.
- Contractors and sub contractors must understand the structure of the building.
- Problems are created when the contractor/installer does not know how to integrate the pipework into the existing structure of the old building.
- Problems are more likely when there is inadequate time allocated for investigative surveys, or such work is not practically feasible.
- Sometimes notching structural members is not done correctly and this undermines the structural integrity of the building.

13.9.4.8 *Contract*

- Problems are created when the contractor makes insufficient queries at the tender stage.
- Contractors sometimes do not understand the implications of the forms of contract.

13.10 SUMMARY

The data in Case Study 2 has been analysed by identifying factors that contributed to its success and also created problems. Key points were categorised under the headings devised for the questionnaire survey. Sources of data were site visits, construction drawings, site meetings and interviews with the respective members of the project team.

CASE STUDY 3

14.0 INTRODUCTION

The following notes reported the findings of an enquiry into the refurbishment process carried out on a listed country house (Grade II) with specific reference to the integration of modern building services.

14.1 CASE STUDY METHODOLOGY

The case study was conducted by

- visiting the site
- interviewing the client and members of the project team
- taking photographs as a visual record

The data collection was carried out over a three-month period in 1996. The contract was completed in 1994.

14.2 THE BUILDING

The building, a country house was built for a brewer in the nineteenth century. It has been described as *'a notable building of the Italian villa character with a portico of exceedingly chaste beauty and a collonade on the garden front of considerable extent'*. A stable block was added in 1877/78. The building has undergone some alteration in its lifetime, the most aesthetically unsatisfactory intervention being, the construction of a water tower, on the north west side of the building at roof level.

14.2.1 Original/Former Use

The house was used as the family home until the 2nd World War. In wartime it was requisitioned for use as a hospital and, subsequently used as a rehabilitation centre by the Red Cross. Later, it came into the ownership of a local authority, with a view to conversion to council office accommodation. It reverted to becoming a family home during the late 1950's until the early 1990's when a university took over the long-term lease.

14.2.2 New Use

The building is now used as office accommodation for university senior management personnel and academic departments/schools and also provides meeting and conference rooms. It is regarded as the flagship building of the university.

14.3 THE CLIENT

The client: a higher education establishment.

14.4 THE PROJECT BRIEF

The client wished to take over the building as quickly as possible, time was of the essence and a ten-week contract period was negotiated. Essentially, the brief was to convert the existing rooms into office accommodation and meeting rooms. It entailed the integration of current technology into the building without affecting the internal finishes.

14.5 THE DESIGN (Building Services Installations)

Following a brief site survey, the building services consultants assessed the quality and condition of the existing services and identified vulnerable areas. The mechanical and electrical work fell into the following categories:

- Retrofit, upgrade and renewal of heating and power for the building. This necessitated stripping out much of the existing electrical work and defective pipework. Energy consumption was reviewed and zoning and local thermostatic controls were incorporated into the final design. The existing gravity fed heating system was to be modified to a pumped system. The boilers, in the existing heating system were to be re-commissioned and the original radiators kept. Additional radiators were specified to match the existing.
- Installation of a new fire detection/ alarm system (radio controlled rather than hard wired)
- Upgrade of the security system
- New electrical work for IT provision
- Provision of means of escape in case of fire

The approach, although mindful of conservation objectives, was essentially a commercial one. (Time was spent considering how best the budget should be spent rather than deliberating over items such as where electrical socket outlets should be sited for aesthetic purposes and the style of electrical fitting.)

14.6 PROCUREMENT ROUTE

The contract was let under the JCT 80 form of contract. The tender documentation consisted of a specification and drawings, plus a schedule of rates with annotated photographs. The job was fully designed at the time of going to tender. The main contractor produced his own builder's quantities to price the work. The mechanical and electrical work represented 40% of the contract sum.

14.7 PROJECT TEAM

The following details were based on interviews with the client's representatives and the project team.

14.7.1 Selection

The project team comprised of personnel directly employed by the client organisation and also consultants and contractors that were contracted to the client for the duration of the contract.

When appointing consultants and contractors the client required competent and experienced professionals. The mechanical and electrical consultants were chosen because they had a local office, a former working experience with the architects and experience of working on historic buildings. The involvement of the client was minimal once the brief and budgets had been agreed.

14.7.2 Project Team Composition

a) Project team members in the employ of the client organisation

- representative of the Building and Estates Division of the client organisation

b) Project members contracted for the duration of the contract

- architect and quantity surveyor (multidisciplinary practice)
- building services consultants
- main contractor
- electrical and heating domestic subcontractors contracted to the main contractor

- surveyor who acted as advisor to client organisation and contractor because of his former working knowledge of the building and his former working relationship with the client organisation.

c) External bodies

- conservation officer
- building control officer
- fire officer

14.8 PROCESS /CO-ORDINATION

Preconstruction phase

The client and an appointed quantity surveyor surveyed the site, discussed the proposed office accommodation requirements and provisional costings were forecasted. This provided the basis for the client brief. An architect, from the same multidisciplinary practice as the quantity surveyor, then produced the specification and drawings in conjunction with the building services consultants. All disciplines had former working relationships with each other. Meetings were established on an *ad hoc* basis.

Construction phase

Once the contractor took possession of the site, close supervision of the work was a key factor. Two foremen were allocated to the job for this reason. Any problems or difficulties manifesting themselves due to unknown factors in the building construction needed to be dealt with swiftly by both consultants and contractors. Site meetings with consultants were held on a fortnightly basis. Consultants visited the site approximately three times per fortnight.

14.9 PROJECT REVIEW

An overview of the project is presented under the following headings. The information is based on comments made by the project team at interview and visual observations made on the site.

14.9.1 Challenges

The major challenge was to install new electrical, heating, security and fire detection/alarm systems over a ten-week period, causing the very minimal of disturbance to the interior finishes of the building.

14.9.2 Successes

- ✓ The project was completed within the budget.
- ✓ The project was completed on time.
- ✓ The right people were selected to do the work; the consultants, contractor and subcontractors had all worked together well on previous contracts.
- ✓ The use of annotated photographs as a form of visual communication; they made location of items and their pricing easier.
- ✓ It was a happy job with much goodwill on site.
- ✓ The choice of mechanical and electrical subcontractors (not the cheapest but the main contractor was secure in the knowledge that they had the resources and the expertise).
- ✓ The attitude of compromise and flexibility (by the fire officer and conservation officer) when seeking optimal solutions to resolve conflict in the statutory regulations.
- ✓ Mechanical and electrical subcontractors were proactive and interactive and worked with enthusiasm and came up with innovative ideas.
- ✓ Everybody was interested in getting the job finished to a satisfactory standard.
- ✓ Good teamwork.
- ✓ The design team responded quickly to problems.
- ✓ There were very few variations.

14.9.3 Problems

- ❑ The principal difficulty lay in the routing of pipes and cables. The house needed to be completely re-wired and establishing routes for IT provision was complicated (lack of interstitial spaces). Direct routes were frequently not possible due to the construction of the building and conservation objectives.
- ❑ The required pace of the work- only a ten-week contract period.

- The vast amount of BWIC associated with the installation of the building services.
- Unknown factors in the construction of the building.
- More consideration should have been given to maintenance issues at the design stage.
- Protecting existing finishes was difficult.
- The mechanical and electrical work is serviceable but it is difficult to maintain.
- The lighting provision is inadequate for meeting rooms. Portable up-lighting was introduced as a temporary measure after the contract was completed.
- The heating provision in the major meeting rooms was insufficient in some weather conditions.
- There was conflict between building conservation objectives (minimum intervention and minimal visual disturbance) and the requirements of fire protection and fire management.

14.9.4 Key Points

In relation to the project, the following comments were made by the project team,. Site visits and supporting documentation supported these comments. The points raised have been reported using the subsections devised for questionnaire OBU/J/2.

14.9.4.1 *Programme*

NO SPECIFIC POINTS IDENTIFIED

14.9.4.2 *Skills, working hours and working methods*

- Working closely with the electrical and heating contactors is crucial in solving problems in the installation of building services into historic buildings.
- Working with enthusiasm is very important.
- When capital works are out sourced, maintenance should be discussed thoroughly with the client organisation, at the inception stage of the project and at appropriate intervals, through out the preconstruction and construction phases. [Where is everything and why?]
- Supervision is only as good as the foreman.
- Use the right people to do the job.

- Have a previous working relationship with the subcontractors.

14.9.4.3 *Liaison and Communication*

- Interaction and co-operation between the heating and electrical contractors and the building services consultants is essential.
- Get the Fire Officer and Conservation Officer, on site, *together* to resolve conflicts in legislation through compromise, flexibility and negotiation.
- The building services consultant had no meetings with the conservation officer.

14.9.4.4 *Health & Safety*

NO SPECIFIC POINTS IDENTIFIED

14.9.4.5 *Budget and Financial Matters*

- Prioritise where the money is to be spent in the allocated budget in the early stages of the project. Involve the main contractor whenever possible.

14.9.4.6 *Statutory Control*

- Legislation (PPG 15) relating to building services in listed buildings does not define exactly what should be done. It provides some guidance on pipework and cable runs but principally talks about the overall character of the building not being altered and current day principles of building conservation.
- Legislation relating to fire protection, detection and means of escape were devised to protect the building users and not the building itself.

14.9.4.7 *Site and Materials*

- Provide zone controls where possible to improve monitoring and effect the most efficient energy consumption for the system.
- Carefully evaluate the main contractor's attendance for the building services retrofit and new installations.
- The availability and scope of fire protection measures has increased enormously in the last 30 years.

14.9.4.8 *Contract*

- Carry out a co-ordination check on the tender documentation.
- Handle the job, on site, with emphasis on finishing to a satisfactory standard rather than strictly contractual basis.

14.10 SUMMARY

The data in Case Study 3 has been analysed by identifying factors that contributed to its success, created problems and, also, key points with respect to the project process. Sources of data were site visits and interviews with the respective members of the project team. Photographs were taken, as documentary evidence, for peer review.

APPENDIX VI

PROGRAMME OF STUDY

ACTIVITY	Nov '93	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Literature Review											
Methodology *Exploration of research theory and identification of research techniques & tools. Design of research strategy and research instruments.*											
Data Collection *Pilot Study*											
Data Collection *Questionnaire & Interview*											
Data Collection *Case Studies*											
MPhil Transfer to PhD											
Interaction with the Construction Industry *[Prolonged involvement/ peer debriefing]*											
Writing Up **Word Count** **Main Report: 63,487** **Appendices: 33, 892**											

Table P.1 **The Programme Of Study For The Doctor Of Philosophy: Modern Building Services For Listed Historic Buildings, Problems & Risk**

APPENDIX VII

CONFERENCE PAPERS

Addendum

Since the delivery of the conference paper to 'COBRA' Construction and Building Research Conference, Annual Research Conference, 19-20th September 1996, the data has been re-processed. This has slightly altered the positions of the refurbishment characteristics for 'degree of difficulty' and 'frequency of occurrence' and thus a discrepancy in the results detailed in Table 5.2 **Degree of Difficulty and Frequency of Occurrence** in the thesis, and Table 2.3.2 ***Degree of Difficulty and Frequency of Occurrence*** in the conference paper.

The conclusions drawn from the data have not altered. The top 20% of characteristics have remained constant, albeit in a slightly different order in each table. The table 5.2 entitled **'Degree of Difficulty and Frequency of Occurrence'** in this thesis, par.5.5.2.1 is the most recent and accurate.

Justine Nichols, June 2002.