MANAGING FOR EXCELLENCE IN DESIGN AND BUILD CONSTRUCTION FIRMS

An analysis of the design and production interface in integrated construction firms and project coalitions

by

Michael Addo-Ashong

B.Sc. Design Dipl. Arch. R.I.B.A.

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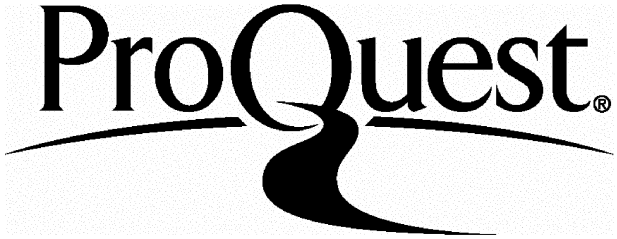

Managing for Excellence in

Design and Build Construction Firms

for Francis Wellington and Marie Louise

"...it is often conveniently forgotten that
some of the finest architecture in this country
was produced before there was any rigid separation
between architects and builders, and that in some
countries in which they have never been separated
very notable modern architecture is produced".

Marian Bowley, 1966.

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ABSTRACT

The report examines **design** and **build** as a major and expanding procurement system in the UK construction industry. The procedures of four typical D&B firms are studied and analysed to assess the nature of the **interface** between design and production. The inherent strengths and weaknesses are identified and proposals made for the development of **management systems** that individual firms could utilise to enhance the **quality** of process and product. The proposed management systems are designed to form the basis of an operational manual that firms could develop to guide the management of procedures within their design and construction departments. Issues such as planning, implementation, monitoring, evaluation, motivation, system audits and reviews as well as the delegation of roles and responsibilities are discussed.

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PREAMBLE

In recent years, the UK construction industry has seen the growth in use of various systems of building procurement. The "traditional system" has had to compete with the emerging systems such as management contracting, construction management, project management, fast-tracking and design and build.

The slump in construction activity during the late 1980's and early 90's revealed a disproportionate decline in the market share of the various procurement systems. Whereas most of them demonstrated a significant decline, design and build consistently continued to increase it's market share which grew from 17% in 1990 to 20% in 1991 and 22% in 1992 (i.e., for total building and civil works turnover; ref., Contract Journal, 2nd July 1992). All indications seem to point to the fact that design and build will soon break the 25% threshold in the very near future. This trend is apparently the direct result of clients looking for ways to shed risk and tighten their cost plans in response to the prevailing economic climate of decline and general uncertainty.

If design and build is to continue to enjoy the favour it currently has and increase its market share, then D&B firms must ensure that they continue to satisfy their clients. This could be done by consistently achieving high levels of excellence of both process and product. There are probably several facets to how this may be achieved, however this report focuses on the efficient management and rationalisation of the interface between construction and design activities within design and build firms, as a means of achieving this end, whether the design input is in-house or bought-in. Consequently, the research report examines the hypothesis that

the efficient management and operation of D&B firms depends to a large extent on the interface of the design and production processes within the firm.

The objective of the report is to develop a thorough understanding of how D&B firms operate, analyse their processes in general and the production / design interface in particular and ultimately produce a document that could form the basis of a manual these firms could utilise to assist them consistently achieve the standards required.

CHAPTER ONE

DESIGN AND BUILD IN THE UK CONSTRUCTION INDUSTRY

CHAPTER OUTLINE

This chapter examines design and build as a system of building procurement and the role it plays in the construction industry of the United Kingdom. It charts the historical development of the system, describes its main attributes and assesses its current standing in the light of the more traditional systems of procurement and other systems in current use. The purpose of this discussion is to introduce the reader to the subject at large and begin to place the report as a whole into context.

1.1 Introduction

The production of man's built environment has come to involve various complex processes. The construction industry, like most other major industries in the developed industrialised countries of the world, has evolved into diverse, complex and often confusing systems of production. Many systems of production have been developed over the years to rationalise this complexity and diversity, but with varying levels of success in the different industries.

The UK construction industry in comparison to some of the other major industries in the UK such as the manufacturing, transport and communication industries is often considered to be less sophisticated and rather backward. It is often felt that "of all industries in Britain, construction has one of the worst public images. High cost, poor quality and chaotic work practices are believed by many to be synonymous with building work... like all folk-lore generalisations, such views of the construction industry are based primarily on myth, but they do have close links with many people's experiences of the industry, either as consumers or building workers" (BALL,M.1988).

One feature of the construction industry that has differed from other major industries such as the motor car industry, aircraft industry and manufacturing in general is the segregation of design and production. Whereas an integrated approach is the norm in these other industries, in construction, design and production activities are usually the responsibility of different, autonomous organisations. There are various reasons that have led to the way the construction industry has developed, however these are not within the scope of this paper. In recent years, some significant attempts have been made to achieve higher levels of

integration in the UK construction industry in order to achieve some of the benefits this has produced for the other major industries, but in a manner that suits peculiar characteristics of the construction industry.

1.2 Building Procurement Systems in the UK Construction Industry

There are three broad categories of building procurement systems in common use within the UK construction industry. The classification used in this study is based on the work done by J.W.E. Masterman (1992) outlined below;

(i) separated and co-operative procurement systems, where responsibility for the design and construction aspects of the project are the responsibility of separate organisations. This system will be referred to as the "traditional system" in this research paper.

(ii) integrated procurement systems, where design and construction become the responsibility of one organisation, usually a contractor and the client has one organisation to deal with.

(iii) management-oriented procurement systems, where the emphasis is placed upon overall management of the design and construction of the project with the latter element usually being carried out by works contractors and the management contractor having the status and responsibilities of a consultant.

1.3 Characteristics and Main Features of Design and Build

The most important feature of D&B is the single point of responsibility it offers. Unlike the more traditional forms of building procurement in which the responsibility for design and construction is borne by different organisations, D&B firms undertake responsibility for both of these, although the design activity may actually be executed by a professional service firm. In general terms, clients are more comfortable dealing with a single organisation than with a host of separate ones each with their particular area of specialisation and responsibility. The "one head to pat, one butt to kick philosophy" (Contract Journal, 1992 D&B survey, David Nunn report) the system offers is consequently seen to be one the most important in winning clients over to D&B.

Another feature of D&B that potential clients find attractive is the fact that it offers a higher level of price certainty than the more traditional forms of building procurement. D&B contracts are essentially lump-sum contracts that the contractor is obliged to adhere to. Failure to do so could result in the contractor covering the cost of any extra expenditure. This is so because whereas in the traditional forms of procurement the client's quantity surveyor does the taking-off and responsibility for this lies with the client, in D&B the contractor takes full responsibility for measurement of building elements and subsequently to build to the Contract Sum tendered for. This arrangement enables the client to be fairly confident of his/her financial commitments regarding the project before actually commencing on site.

A feature of D&B giving it significant competitive advantage is its ability to involve the

construction team in the design process at an early stage. This differs significantly from the traditional forms of building procurement which by and large involve the design being virtually completed and measured before being handed over to the selected contractor for implementation on site. The advantage with the contractor's early involvement is that they can contribute to the production of buildable design details and building elements.

Related to the above features is the possibility of making early starts on site which is more easily achievable when the design and production teams are part of one organisation or are working as one team and can therefore easily coordinate fast-track construction procedures enabling the construction to commence before design is completed.

1.4 Variants of Design and Build Systems.

The emergence of alternative procurement systems has resulted in a host of different permutations of management and project coalitions. Depending on what criterion are applied, D&B may be classified in one of two ways.

It may be classified according to the organisational structure of the main "producing" parties involved which may all be integrated into one single organisation to create "pure design build", or the contractor may only have a core of building specialists, operatives, structural engineers and quantity surveyors. In this instance all architectural and specialist design expertise is bought-in as required. This form of D&B is termed "integrated design and build". The third variation according to this classification is termed "fragmented design and build"

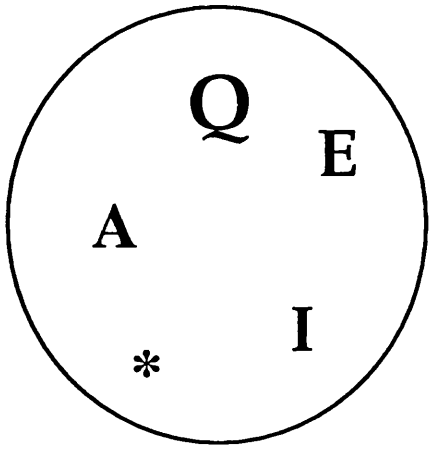
whereby the builder assembles project coalition teams to suit the various contracts he may be involved in (S.ROWLINSON, 1987). [Figure 1.1]

Another classification of D&B may be related to "the proportion of the design undertaken by the client's consultants which is included in the enquiry" (D.E.L. JANSSENS, 1991). This classification produces six types of D&B as follows and illustrated in Figure 1.2.

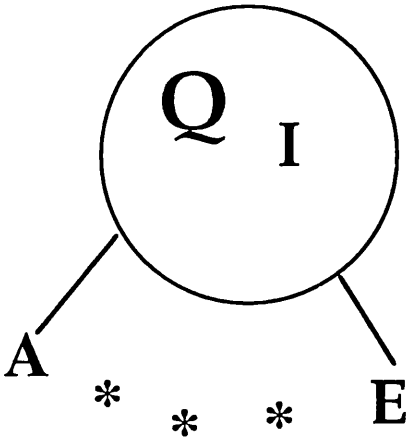
i. Develop and Construct
ii. Design-Build (single-stage tender)
iii. Design-Build (two-stage tender)
iv. Negotiated Design-Build
v. Design and Manage
vi. Turnkey

The first two are generally referred to as employer-led design systems and basically involve the client engaging his/her own designers to develop the project to scheme-design stage and possibly obtain planning permission before bringing in the contractor to develop the scheme design into working drawings for use on site. In type (ii) above, only the sketch design is done and as such the contractor is brought in at a slightly earlier stage than in develop and construct.

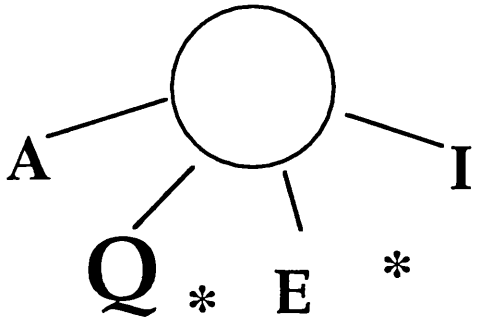
The latter four types are described as contractor-led design systems and in these the contractor is responsible for developing the design. This may be done with in-house design specialists or by professional service firms who in these circumstances would be working for the contractor.



pure design build



integrated design build



fragmented design build

○	Builder
Q	Quantity Surveyor
I	Services Engineer
E	Structural Engineer
A	Architect
*	Subcontractor

Figure 1.1 - The Design and Build Organisation Source: S Rowlinson

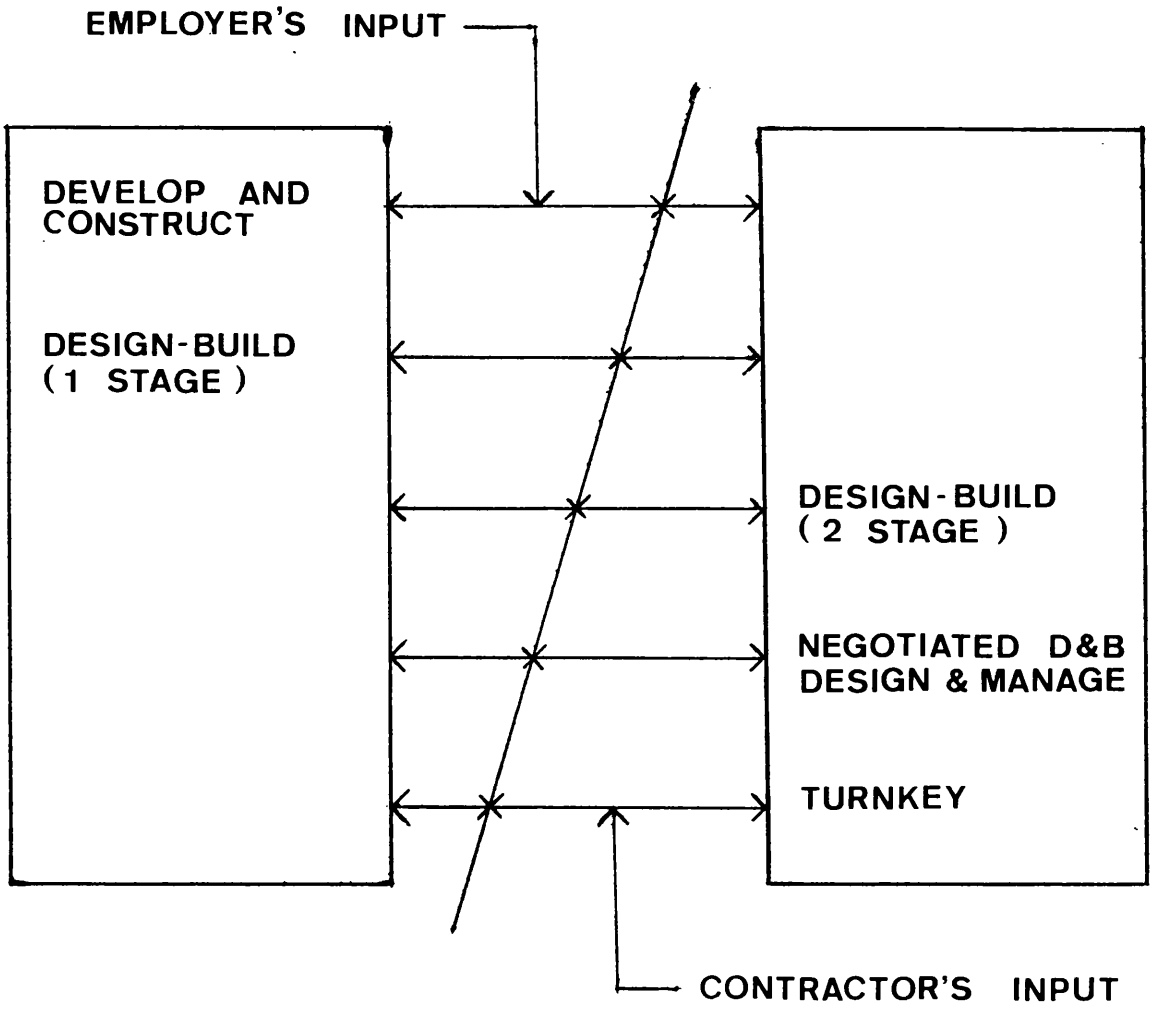


Figure 1.2 - Design and Build Variations, classified according to the relationship between the Employer's input and the Contractor's input. (Arrowed lines are indicative and not exactly to scale).

Source: D.E.L. Janssens.

For the purpose of this report, design and manage projects shall not be considered because the contractor is only indirectly responsible for actual construction work and sub-lets all site operations to works contractors. Similarly, turnkey projects are also not considered because they involve not only design and construction but also fitting-out and commissioning of major industrial projects (usually overseas) such as steel works, car plants and power stations not normally in the category of the day-to-day building work generally regarded as design and build.

1.5 Historical Development and Current Trends in D&B Contracting.

Many great historic buildings were built by integrated teams of designers and builders and these may be considered to be the forerunners of design and build. However, as pointed out by Janssens (1991), it must be emphasised that the building industry of today has gone through a significant evolutionary process and design and build as we know it now is a very different system to any forms of it that may have existed in the latter medieval period leading up till the nineteenth century. This difference is seen most in the commercial and technological environments prevailing now, the contractual arrangements employed as well as the speed of projects carried out today.

The present form of design and build first began to appear after the Second World War on a very limited scale, and only made a significant impact late in the 1950's. Although a few firms were led by designers who had offered to take on the risk of carrying out the construction as well, firms offering the service - then known as "Package Deal Contracting" -

were mainly contracting firms that had developed in-house design departments. This form of contracting however did not gain much ground and there are quite a few reasons for this.

One reason of importance is the fact that there were no recognised independent forms of contract to cater for this sector of the market. All that existed had been produced by the federation of building contractors and this was considered not to look after the client's interests and enabled the contractor to lower specifications and cut corners.

Package deal contracting was also fairly unknown and many prospective clients were wary of using this route of procurement which they thought was untested and potentially unsuitable for their needs. Related to this was the fact that contractors had built up their experience in the traditional forms of contracting and therefore not mastered the techniques of tendering for the complete package service. Contractors also found it extremely difficult to market this "novel" service and most clients were unlikely to opt for it on their own initiative, and thus the onus was on the contractors to persuade the prospective client despite their own lack of a "proven track record".

Another reason for the initial limited success of package deal contracting may be related to the fact that most architects and engineers were unaccustomed to working for or under the direction of a building contractor. The architect in particular was used to fulfilling the role of the project team leader, and dealing directly with the client, as well as supervising or at least inspecting the work of the contractor.

In spite of the above mentioned factors, a fair amount of work was done through package deal

contracting. Its main strength was the single point responsibility it offered and the concept of a predetermined lump-sum for contracts. The late 1980's and early 1990's saw changes in the construction industry and economy at large which seem to have favoured the development of design and build. These include the emergence from the recession of the early 80's which compelled a new need for commercialism and economy of resources and time. Furthermore, cost guarantees and project time restrictions were being demanded of the construction industry, which together with the publication of an independent form of contract for D&B, increased levels of sub-contracting in the industry and changing attitudes of consultants, eventually led to a significant increase in the level of contracting work done along the D&B route of procurement. Design and build has continued to increase its market share, even in the declining U.K. construction market of the early 1990's. This grew from 17%in 1990 to 20% then 22% in 1991 and 1992 respectively. It is expected to exceed the 25% threshold in the very near future (Contract Journal, 2 July 1992), [Figure 1.3].

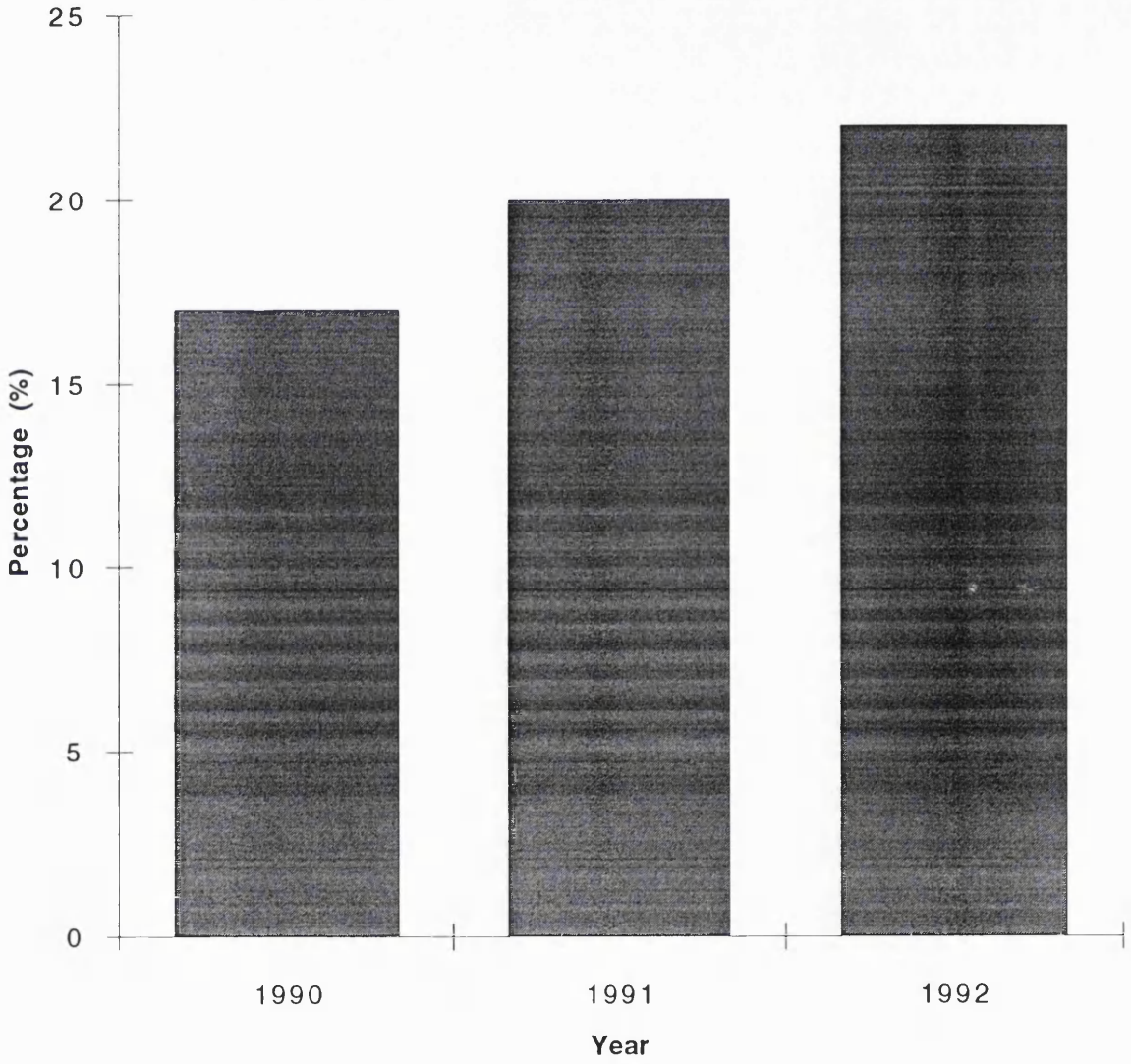


Figure 1.3 - Design and Build Market Share Source; New Builder 1993, June

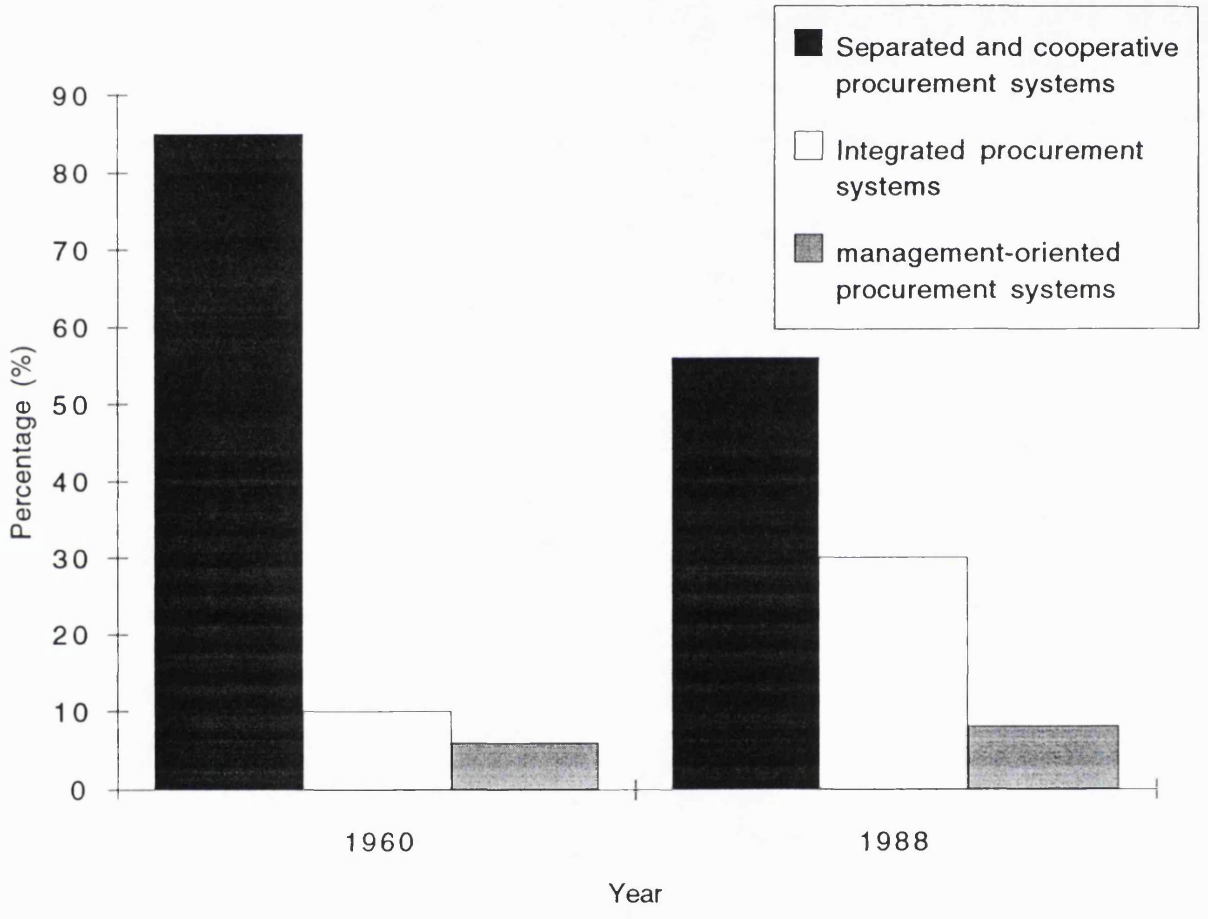


Figure 1.4 - Change in level of use of procurement systems; 1960 and 1988
Source; JWE Masterman

References

1. Ball, M. (1988) Rebuilding Construction - Economic change and the British construction industry, Routledge: London.

2. Bowley, M. (1966) The British Building Industry - Four studies in response and resistance to change, Cambridge University Press.

3. Chartered Institute of Building (1988) Design and Build, CIOB Supplement Number Two, Unwin Brothers Ltd: Surrey.

4. Janssens, D.L.E. (1991) Design-Build Explained, Macmillan: London.

5. Masterman, J.W.E. (1992) An Introduction to Building Procurement Systems, E. & F. Spon: London.

6. Nunn, D. (1992) The 1992 Design and Build Survey, Contract Journal.

7. Rowlinson, S. (1987) Design build - its development and present status, CIOB Occasional Paper No. 36.

CHAPTER TWO

THE SIGNIFICANCE OF THE DESIGN / PRODUCTION INTERFACE AND THE CONCEPTS OF EXCELLENCE, QUALITY AND VALUE

CHAPTER OUTLINE

This chapter sets out firstly to define the problem addressed in this research report and then secondly to establish the criteria by which the research findings shall be evaluated. The importance of the design / production interface will be discussed and the general theory relating to the concepts of quality and value will be described in the context of the research paper. A series of relevant definitions and discussions are presented in the chapter.

2.1 The Problem Defined

Although Design and Build has in recent years continued to grow in popularity, the system has not been without its critics. The traditional image of the D&B product has been one of sub-standard quality. Furthermore, the D&B contractor is thought to be in the position of being able to "cut corners" so as to reduce costs and make savings at the expense of the client and the quality of the product. The issue of product quality has emanated from the general perception that the D&B contractor is unable to produce quality designs and as such the system is only suitable for very simple, basic standardised building types, as well as "straightforward fast track projects with a minimum design element" (New Builder Special Features, 11 June 1993). To some extent, this "problem" has been resolved by D&B contractors engaging architects to carry out design work on their behalf. However the image has not been totally dispelled and many clients are advised by the consultants they employ not to go down this procurement route if the project concerned is complex and has a significant design content.

It is only after at least a decade in which design and build has shown itself capable of successfully executing these complex and intricately designed projects that its perception shall change. During this "probationary" period, the system must consistently achieve a high level of excellence to demonstrate its maturity and capability. One area where a major contribution may be made to the overall performance is the interface between design and production. **This research paper examines the hypothesis that the efficient operation of a D&B firm depends to a large extent on the nature of the interface between the firm's construction department and design department, be this in-house or bought-in design input.**

2.2 The Significance of the Design / Production Interface

The relationship between the design and construction departments in an integrated construction firm is arguably the most unique and important feature of the organisation and its processes. Whereas these processes are usually performed by separate organisations, the D&B option enables a single organisation or coalition to provide the required service. Although this creates certain inherent advantages, for example the increased ease of communication between the various parties involved in the process, it also places a huge burden of responsibility and risk on the contractor. In order to remain profitable, efficient and competitive therefore, all effort must be made to "get things right" the first time around. A few factors that make this interface important are reviewed below.

The D&B contractor unlike the contractor in the more traditional systems has no safeguard against unbuildable design details since his team has produced them. The inability to blame the architect or specialist sub-contractor for a detail that does not work means that the D&B contractor's design team and construction team must work closely with one another to ensure that all details produced are actually buildable.

In a similar manner, the D&B contractor has no safeguard against the late provision of details during the construction phase. Hence to ensure the timely provision of design information, the D&B contractor must implement effective design information management systems and this calls for deliberate and careful supervision of the interface of the design and construction departments.

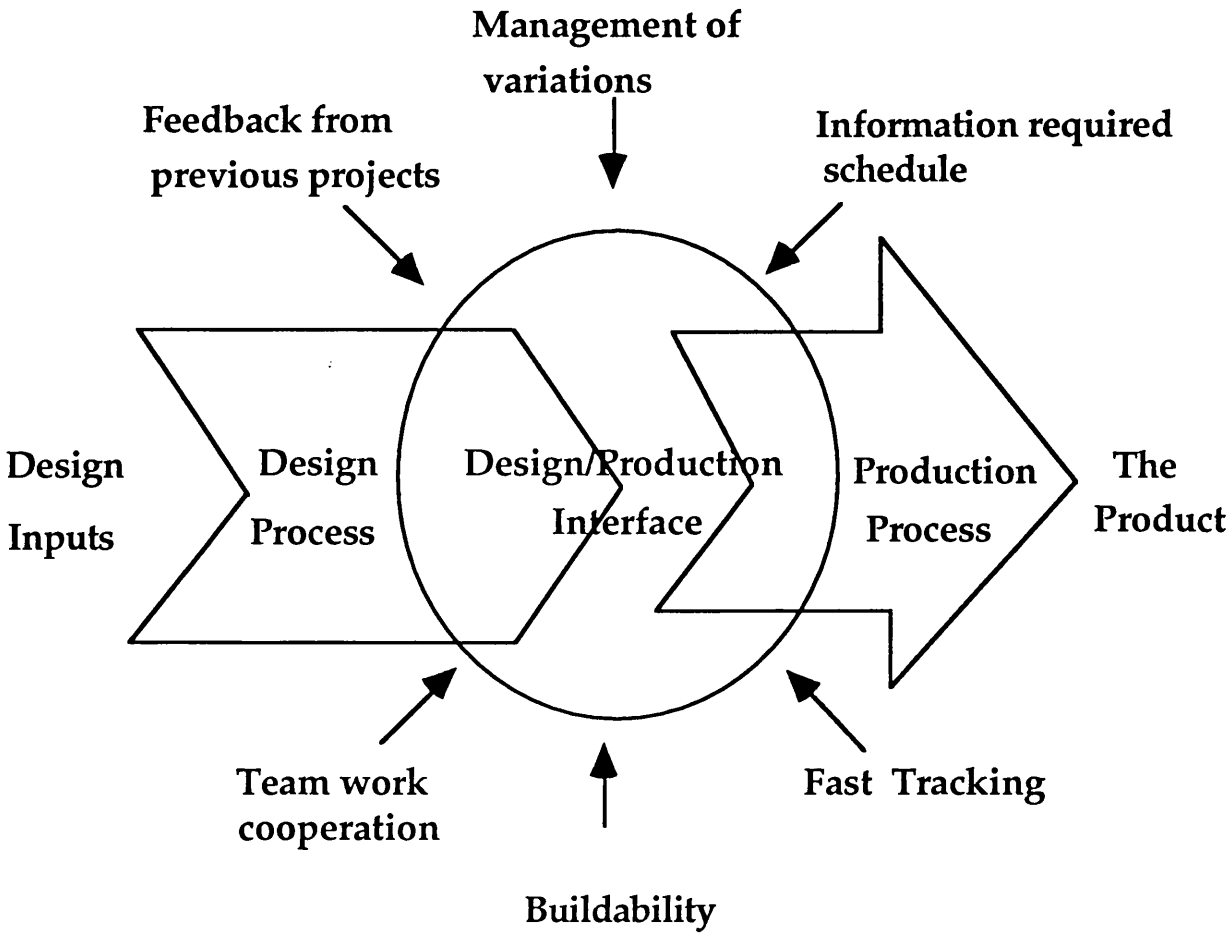


Figure 2.1 - Significance of the Design/Production Interface.

To keep projects on schedule and where possible to shorten project durations with the ultimate aim of making significant savings, D&B offers the possibility of some degree of fast-tracking, by overlapping the early construction phase with the latter design phase. This is only achievable where the interface between construction and design is carefully coordinated.

The systematized and managed interface between construction and design teams / departments in a D&B firm should also help to;

(i) reduce inaccuracies in determining the Contract Sum

(ii) enable a learning process through feedback from experience gained from previous projects and,

(iii) reduce disruptions to work on site that otherwise might be caused by the issuing of various variation orders as often happens in the traditional procurement systems.

The relationship described above is illustrated in Figure 2.1, which shows the point at which all these important aspects come into play.

2.3 Research Objectives

In order to fully understand how the interface between design and production may be efficiently managed, the following objectives have been set for this research report;

2.3.1 To study the operation of design and build as an important building procurement system within the context of the UK construction industry.

2.3.2 To select a set of typical or representative D&B construction firms for study.

2.3.3 To study the operation of these D&B construction firms with particular reference to the interface between their design departments and construction departments.

2.3.4 To carry out an analytical comparison between the operations of the firms with in-house design capability and the other firms that rely exclusively on external design services, with the aim of highlighting the strengths and weaknesses of the alternative approaches.

2.3.5 To develop the basis for an operational manual that D&B firms could use to assist them achieve and maintain consistently high levels of excellence, especially in matters relating to the interface of design and production.

Having identified the objectives, it is necessary also to understand the meanings of some of the terms and concepts mentioned, particularly within the context with which they are being used. This subject shall be address in the following section.

2.4 The Concepts of Excellence, Quality and Value

Excellence, quality and value are commonly used in every-day communication, but often to mean different things from time to time. A clear and consistent meaning however is fundamental to the appreciation of this report. Products and services are considered to be of good or poor quality depending on how much the user or recipient of the good or service

values them. Furthermore, the product or service that continues to give satisfaction to the user is thought to be of good quality. It is however difficult to objectively quantify the "amount of value" a user receives from anything. Another source of difficulty is the fact that the word "quality" has in recent years become the subject of much research and writing. The study of "quality", "quality assurance" and "total quality management" has become fashionable and the meanings of these are sometimes misunderstood, confused or at best only vaguely appreciated. It is not within the scope of this paper to attempt to throw new light on this heavily trod ground. However, it is vital that the reader be clear about how some of these terms shall be used in this report.

2.4.1 Quality, in simple terms is meant to be meeting the requirement for which a good or service is intended (OAKLAND, 1989). This relates to the concept of fitness for purpose and as such the attributes of an item that reflect on its ability to satisfy the stated or implied needs. This means that for quality to be delivered, both parties (the provider and recipient) know and agree upon the purpose for which the item is required. This issue of "provider and recipient" is of great importance to the use of the term in the context of this report. This is so because even within one organisation, individuals should be seen as suppliers and customers in as much as information is generated by one party and passed on to another. Once the intended purpose is not achieved, it may be said that quality has not been attained. Quality however is subjective since there may be a multitude of individuals experiencing a particular product or service. Consequently, "there can be no one arbiter of quality, for it is the summation of the input of several people and the judgement of many more" (CROOME & SHERRATT, 1977).

2.4.2 Excellence in this paper is regarded as being a state of consistently achieving quality. Thus if an organisation consistently manages to provide a quality service to its customers, then it may be considered to be "managing for excellence" in its scope of business.

2.4.3 The concept of value relates to quality and adds the dimensions of both cost and performance over time. Providing a good or service to a budget that is suitable and acceptable to the customer and making sure that the good / service supplied meets the requirements of the customer over its lifespan, is giving good value to the customer (DALE & COOPER, 1992). This brings into consideration the aspect of competition in that though two different organisations may supply an identical good or service, one may be able to offer it at a lower price to the customer thus giving better value for money. Similarly, one organisation may provide a customer with a product that requires much less maintenance over the years than the product of the second organisation. This also represents better value for money and investment.

2.4.4 Quality Assurance may be thought of as a problem-prevention-based system used by organisations, which endeavours to improve product and service quality and increase productivity by placing the emphasis on product and process design and control (DALE & COOPER,1992). This is in contrast to finding and solving problems after the event, which some years ago was the norm, where inspection and elimination of unsatisfactory products was the means of ensuring a certain level of quality. The essence of quality assurance is organising things in such a way as to prevent problems occurring at source. Emphasis is placed on advanced quality planning, improving the design of product, process and services, improving control over the process and involving, motivating and training the personnel

involved in the process.

2.4.5 Related to the above is Total Quality Management (TQM) which is a process in which everyone in an organisation and associated business process is involved in cooperating to furnish products and services that meet their customers needs and expectations. The essential quality here is that the whole organisation as well as its suppliers are making a concerted effort and following a common plan to achieve this mutual aim of meeting the final customers requirements. "Total quality management is an approach to improving the effectiveness and flexibility of businesses as a whole. It is essentially a way of organizing and involving the whole organization; every department, every activity, every single person at every level" (OAKLAND, 1990).

2.5 The British Standards Institute and BS 5750

The British Standards Institute is an independent national body set up for the preparation of British standards. The Institute is incorporated by Royal Charter and is the UK member of the International Organisation for Standardisation. The Institute produces standards for industry and offers other specialist services such as library facilities, a database and technical assistance to exporters.

BS 5750 relates generally to "Quality Systems" in industry. The first part of the document deals with specification for design / development, production, installation and servicing. The clauses cover, among other things, such areas as Management responsibility, Quality systems,

Contract review, Design control, Document control, Purchasing, Product identification and traceability, Process control, Inspection and testing, Control of nonconforming product, Corrective action, Quality records, Internal audits, Training and Servicing.

The British Standards Institute assesses and registers firms that are able to demonstrate that they have in place systems that conform to the standards and procedures set by the Institute. Firms that qualify are given certification to this effect and their performance is subsequently monitored to ensure that they continue to achieve the required standards. "Quality Awards" are given to firms for special or notable performance in certain areas.

This process of certification of firms gives clients the confidence that firms will perform to certain acceptable standards and that the quality of the product or service provided is assured. Although "BS 5750 'Quality Systems' was written essentially with manufacturing industry in mind" (OLIVER, 1990), it may be interpreted for use in construction. Manuals of interpretation have been published by CIRIA (Construction Industry Research and Information Association) and the RIBA (Royal Institute of British Architects). This research paper shall attempt to address the specific area of the management of aspects relating to the design / production interface in a D&B firm. This is meant to compliment the systems and procedures existing standards may have previously set out, but do not cover certain areas peculiar to this interface within the design and build context.

The above discussion defines the problem being addressed in this report, sets out the objectives and explains some concepts and terms that shall appear quite frequently. The next task is to detail the research methodology and describe how this is utilised.

References

1. Aguayo, R. (1990) Dr.Deming - The man who taught the Japanese about Quality, Mercury; London.

2. Baverstock, J.M., Pateman, J. & Walters, W.M. (1992) "Quality Management Special Focus: Quality Down the Line; Customer Satisfaction; The Road to Quality", Chartered Builder, Volume 4, Number 4, pp11-17.

3. BS 5750 (1987) Quality Systems, Brit. Stand. Inst. London.

4. Croome, D.J. & Sherratt, A.F.C. (1977) Quality and Total Cost in Buildings and Services Design, The Construction Press; Lancaster, London and New York.

5. Dale, B. & Cooper, C. (1992) Total Quality and Human Resources - an executive guide, Blackwell; Oxford.

6. Garvin, D.A. (1988) Managing Quality - The strategic and competitive edge, Macmillan; New York.

7. Oakland, J.S. 1989) Total Quality Management, Heinemann; Oxford.

8. Oliver, G.B.M. (1990) Quality Management in Construction - Interpretations of BS 5750 (1987) - 'Quality Systems' for the Construction Industry, CIRIA, (Construction Industry Research and Information Association), London.

CHAPTER THREE : PART I

CASE STUDIES

OUTLINE

The research methodology is described in this section, including a statement on the firm selection process. A brief description of each firm is then presented. For reasons of space, the full text of the case studies detailing the firms general structure, scope of operation and work plan methods is documented in Appendix A. The analysis of data collected is also presented separately in the second part of this chapter.

3.1 Research Methodology and Approach

The primary method of research adopted for the report was CASE STUDIES & STRUCTURED INTERVIEWS. This results from the fact that the study is concerned with **organisations** and how aspects of their operation might be managed to consistently achieve certain standards.

Two types of firms were studied; D&B firms that have in-house design departments and firms that by and large rely on external, independent professional service firms for their design input.

The selection and number of firms for the study was of great significance. In general terms, the firms chosen were to be representative of the average UK D&B firm. This was important because time limitations and economics made it impossible to study a broad cross section of available firms to obtain a feel of the "average" firm in this manner. Consequently, a set of selection criteria was set out to enable the selection of a few representative firms.

In carrying out the studies, use was made of structured questionnaires to ensure that identical questions were asked in each organisation for comparative purposes. Furthermore, a model or framework of the typical work plan or schedule of activities was observed to make certain that vital elements of the study were not omitted. This framework consisted of the Inception Stage, Brief Development Stage, Design Development Stage, Tender Documentation Stage and the Construction Stage.

Primary data collected was supplemented with secondary data from relevant periodicals and

research publications, official and technical publications/data sheets and construction journals. The data collected was then analysed and synthesised to enable the formulation of proposals.

3.2 Criteria for the Selection of Firms

As discussed above, two types of firm were studied, namely;

a/ D&B firms with an in-house design capability

b/ D&B firms without an in-house design capability

The first objective of the selection process was to obtain firms that are representative of the average UK D&B organisation.

The second objective of the selection process was to choose firms that were accessible since this made data collection more feasible.

The first criterion for selection was size of firm measured by value of turnover of D&B work done by the firm. The other options for measuring size such as number of staff and possibly number of D&B contracts obtained, were not thought to be suitable since personnel numbers tend to be misleading in the light of sub-contracting. Similarly, number of contracts obtained could also be misleading since some firms could obtain a host of very small refurbishment jobs of little value and others may obtain a few multi-million jobs. The objective was to choose "medium sized" firms for the research ("medium" was defined as having an annual D&B turnover of between £20m and £100m).

The second criterion pertains to the range of types of work done by the firm. Whereas some firms have experience in a limited range of building types, others obtain a much wider range. Firms with a broader scope were considered to be of greater value for the purpose of this research since their depth of experience is more likely to reflect the range of exposure covered by both the narrow scope firms as well as the broad scope firms.

3.3 The Case Studies

For purposes of reference, the firms have been given a code number for identification during the analysis of the data. The prefix "IND" is used to refer to firms with INTERNAL DESIGNERS and the prefix "EXD" is used to refer to firms that rely on EXTERNAL DESIGNERS. For each of these types there are two firms, hence IND/1, IND/2, EXD/1 and EXD/2. The firms are introduced below. The main text of the cases is presented in Appendix A.

3.3.1 CASE STUDY 1 - (Ref No; IND/1)

Firm IND/1 is part of a large, mainly construction orientated group of companies operating across the country. The groups activities include private housing, public housing, utilities, private industrial, private commercial and refurbishment work. Design and build turnover for the financial year 1992/93 was £83m out of a overall turnover of £183m, which represents a significant 45% (source: New Builder Special Features, 11 June 1993).

3.3.2 CASE STUDY 2 - (Ref No; EXD/1)

This firm (EXD/1) is part of a large national contracting company that was founded in the mid C19th and has grown to be one of the largest private family building companies in the country. Its four main activities are Building, Design and Build, Housing and Maintenance and these occur right across the country. These activities are carried out by a number of operating companies, some of which specialise in the various fields. Design and build turnover for the 92/93 financial year was £75m out of an overall turnover of £170m, which represents 44% of total turnover.

3.3.3 CASE STUDY 3 - (Ref No; IND/2)

This firm was founded about forty years ago and has grown consistently to become on of the largest privately owned construction companies in the UK. In recent years it became part of a major European construction group that undertakes projects worldwide. The firms UK activities cover almost all types of buildings, from corporate headquarters office developments through a wide variety of public buildings, pharmaceutical and electronic research facilities, hospitals, superstores, and leisure complexes to the restoration of listed buildings. Its D&B turnover for the 1992/93 financial year stood at £95m out of an overall turnover of £180, representing approximately 53%.

3.3.4 CASE STUDY 4 - (Ref No; EXD/2)

This firm is part of a larger international organisation whose main field of operation is transportation. The firm has a programme management division, commercial and engineering services divisions, construction division, marketing and business development division, training and an accounts division. The construction division engages in three forms of contracting namely, management contracting, construction management, design manage and construct or design and build. The firm's D&B turnover for the 1992/93 financial year was £45m out of an overall turnover of £720m which represents about 6%. The types of building developed include private industrial, private commercial, utilities, public buildings and refurbishments.

CHAPTER THREE : PART II

ANALYSIS OF THE CASE STUDIES

OUTLINE

The data collected during the survey is analysed in this section. A comparative analysis of the characteristics of each firm is made to understand how firms with in-house design ability essentially differ from those that buy in design services. The analysis of the four case studies will include a SWOT Analysis of each firm, highlighting inherent strengths, weaknesses, opportunities and threats to their method of operation in the context of the relationship between the design and construction departments.

3.4 Analysis Strategy

The analysis of data for the report has a four-fold set of objectives;

(1) The first objective is DESCRIPTIVE and is aimed at the CLASSIFICATION of the various methods of operation adopted by the D&B firms studied.

(2) The second objective is the IDENTIFICATION OF PATTERNS in the data collected. The recognition of pattern and order is a fundamental step in the development of theories to explain these patterns. Three basic types of patterns may be identified, namely;

(i) those showing forms of association between elements of procedure

(ii) those showing groupings of methodology types and

(iii) those showing order or precedence relationships between variables.

(3) The third objective pertains to EXPLANATION AND PREDICTION OF POLICY. The strategy here will be to evaluate past policy of D&B firms, particularly that aspect of policy relating to the interface of design and production. This evaluation shall lead to drawing lessons from past policy and the formulation of new policy for the firms.

(4) The analysis shall also include a "SWOT" ANALYSIS of the design / production interface for each firm. This shall involve the identification of features of the interface that may be considered as Strengths, Weaknesses, Opportunities and Threats. This will assist in the formulation of policy to guide future operations.

A series of deductions and general conclusions shall be made at the end of the analysis. This synthesis of findings will ultimately lead to the development of theories that are expected to guide decisions involved in the formulation of the management system that the research is to culminate in.

3.5 Classification of Work Stage Methods

3.5.1 Inception Stage

The inception stage was seen by all the firms to be of vital importance to the outcome of projects. Two categories of methodology may be identified in the operation of the firms. The first may be termed as ADVISE AND EXPLORATION OF DEVELOPMENT OPTIONS. This was the approach in the two firms that had internal designers (IND/1 and IND/2). In both cases the firms response and contribution was architect-led, though there was sometimes the involvement of marketing personnel and construction specialists who helped analyse initial ideas when this was required by the architects.

The second method consists of ADVISE WITH COST PLAN, usually done in competition with other firms with the aim of assisting the client secure a site, or convince the client that the firm was best equipped to handle the project. The response was led by a project coordinator or an operational division of the firm. This method was seen to operate in the firms EXD/1 and EXD/2 both reliant on external designers.

The two types of firm however did face the same sort of problems at this stage. These relate to clients not knowing exactly what their requirements were and thus not having enough information to convey to the firm. Furthermore, there was also the general consensus that in the cases where clients had already developed the scheme to a considerable extent, it was difficult to make a contribution to achieve the "buildability" that D&B is able to offer.

3.5.2 Brief Development Stage

The development of briefs was frequently done by EXTERNAL CONSULTANTS in a novated situation, particularly for the firms EXD/1 and EXD/2 both without designers. Briefs received in this case were invariably specific. However, there were instances when the briefs were yet to be developed in consultation with the client.

The firms with internal design departments found themselves more involved in the development of briefs although these firms sometimes also carried out projects with novated architects and previously developed briefs. In the cases where briefs had to be developed, the firm's architects invariably led procedures and brought in other specialists as required, depending on the nature of the task in hand.

Both types of firms were therefore involved in brief development though there is a difference in the frequency in which novated architects were involved, expectedly more frequently in the firms that had no internal design departments. Since all the firms regarded early involvement in both inception and brief development as a major advantage, it may be said that the firms

that have internal designers found themselves in a slightly better position as far as the ability to have an early impact on schemes is concerned.

3.5.3 Design Development Stage

Three categories of operational methods were identified at the design stage. These may be described as;

a/ DESIGN MONITORING WITH LIMITED CONSTRUCTION DEPARTMENT INVOLVEMENT

b/ DESIGN / CONSTRUCTION DEPT. COOPERATION AT PLANNING STAGE OF DESIGN PROCESS, WITH LIMITED CONSTRUCTION DEPT. INVOLVEMENT IN DESIGN

c/ CONTROL OF BUDGET AND CONFORMANCE TO BRIEF & PROGRAMME WITH LIMITED CONSTRUCTION DEPT. INVOLVEMENT IN DESIGN

Category (b) was seen to occur in both types of firms. Firms EXD/1 and IND/2 both exhibited strong levels of cooperation between design teams and construction teams at the planning stage of the design process. The process starts with a "design development" or "project launch" meeting at which all parties likely to be involved in the process were present. There was the opportunity for feed-back of lessons learned from previous projects to be shared at these meetings. The emphasis was to get all parties on the programme working to

an agreed schedule and to contribute to the outcome of the final project by sharing individual points of view on relevant issues. The actual design process though was carried out by the architects in each case, be they in-house or external.

Category (a) was evident in Firm IND/1 which although did have internal designers, their role in the main, was monitoring the design work of external architects who worked on most schemes. This arrangement dominated partly because their internal design team was small and also because many projects had novated architects involved. The construction departments involvement in design in this firm was limited to offering occasional advise on details and building elements when the design department requested it.

The third category (c) was only evident in Firm EXD/2 which always worked with external designers. The firm's emphasis appeared to be CONTROL of the budget and schedule. The firm implemented what it described as "design support" or "design management" and it actively worked to keep the budget under control, the project on schedule, reduce elements of risk in the project through design and conform to the clients brief as far as possible once this in turn satisfied statutory regulations. Actual involvement in design itself was limited to making suggestions on what was considered to be details that were serviceable and durable.

3.5.4 Tender Documentation Stage

This stage of the process is probably where there was least difference in the operations of all firms. Basically, the design department provided information in the form of drawings which

were then measured by surveyors. Quantity surveyors were either in-house or bought-in. There also existed a mechanism whereby these specialists could contribute to the project by sharing their experience from previous jobs and make suggestions regarding alternative techniques for achieving desired results.

3.5.5 The Construction Stage

This stage of the process is characterised by a series of key features that describe how the interface between the construction and design teams is manifested in each of the firms. These are described below;-

Firm IND/1:

An agreed programme of information required is set up early. The construction process involves cooperation between the design and construction teams, primarily in the area of working out solutions to problems on site and conducting inspection of works. This inspection is occasionally done by external agents working for the client.

Firm EXD/1:

An agreed programme of information required on site is established and there is cooperation between the construction and design teams. The inspection of works is done by external agents, usually the firm of external designers working on the project.

Firm IND/2:

The programme of design information required is set out early and there is cooperation between the construction and design departments. A system of internal arbitration is adopted to settle any disagreements that may arise. Internal inspection of works is the norm and there is a high reliance on maintaining the firms reputation. There is the occasional involvement of external agents in the inspection of works.

Firm EXD/2:

The firm adopts a system of closely monitoring the production information phase to prevent delays on site. There is limited involvement of the external designers except in the event of problems on site. The firm mainly does internal inspection of works and relies greatly on maintaining its reputation.

3.6 Identification of Pattern in the Data

The analytical examination of some of the important procedures of the four cases reveals a few significant patterns and relationships. These occur in each of the identified work stages and are discussed in the following sections.

At the inception stage, it was generally observed that clients required assistance in crystallizing their ideas. They invariably did not have enough information at hand and the firms consequently had to spend considerable time and effort obtaining this information for their clients. At this stage, clients usually wanted an idea of what their projects would cost

and how the scheme would function. They also attempted to introduce an element of competition by sometimes deliberating with a number of firms simultaneously.

At the brief development stage there was generally very little involvement of the construction departments in the firms. The process was usually architect-led in both types of firms. Another feature of this pattern was the fact that firms received a wide range of briefs, from very detailed and comprehensive to very sketchy. The preference was for short concise briefs which firms could have a hand in developing, enabling the "buildability" that they saw as one of the main advantages of D&B.

The design development stage of the process was usually started with what may best be termed a "launch meeting", which amongst other things attempted to develop an agreed programme for the supply of design information. This highlights the need for an early solution to a potential problem, namely how the construction process can be protected from delays caused by interruptions of information flow at critical points in the process. The meetings also attempt to institute a system whereby lessons learned from previous projects can be effectively utilised on current jobs.

The basic pattern at the tender documentation stage was the production of design information by the design team and the measuring of this by the surveyors, who tended to offer suggestions on alternative materials and techniques for discussion with designers. The designers also spent considerable amounts of time answering queries from the surveyors and sorting out discrepancies in various aspects of the design.

Regarding the construction stage, one predominant feature is the fact that architects were unable to play a truly independent role in the issue of inspection and monitoring the works on behalf of clients. Furthermore, external agents were only occasionally used and clients consequently had to rely on the honesty and integrity of the D&B firms and their desire to maintain a certain standard and reputation. There was also little involvement of Design departments during site operations except for some nominal inspection and the solution of problems on site. Architects were also involved in issuing variation orders.

3.7 Design / Production Interface Policy Evaluation and SWOT Analysis

3.7.1 The general policy for firm IND/1 was to involve the Construction department at the early stages of the process only when it seemed necessary. This means that during the brief development and design stages, the designers tended to "bounce ideas off" the construction specialists in an intermittent fashion. The Design department also had the role of client's agent and on many jobs carried out works inspections. They were thus part of the pre-contract team and the post-contract team. This simultaneous operation could only be achieved nominally.

A feature of their operation that may be considered one of their major strengths was the opportunity for close communication between the two departments. This was inherent in the firm's structure, however it appears this potential was not fully exploited. This is evident in the limited role the construction team was able to play in actually contributing to the design process.

Another weakness is the inability to cost time spent by the design department in resolving issues during the tender documentation stage and the construction stage. Although time sheets were maintained during the design stage, there was no mechanism for recording time spent in the latter stages as mentioned.

3.7.2 Firm EXD/1 appeared to structure its general policy towards achieving good team work and cooperation. It's principle aim was to inspire confidence in the client, assuring them that the firm could provide value for money. Consequently, they placed emphasis on elemental costing of the project and advising the client accordingly.

One strength the firm appeared to have in the implementation of its policy was the fact that the internal project coordinator had an estimating background and was therefore in the position to give commercial and financial advise to clients.

The firm however had a slight problem with time efficiency regarding coordination of the activities of several independent firms that were required to implement each job. However the firm has a policy of "no-job-no-pay" operating on most projects and this it thought was the best incentive for ensuring maximum cooperation and professionalism from the various parties involved. The firm saw the strength of the D&B service it offered in being able to quickly resolve problems on site. The site is where most problems occur and establishing good working relationships enabled them to resolve problems in the fastest possible manner.

3.7.3 Firm IND/2 firm adopts the policy of encouraging its clients to allow it to get involved in projects at the earliest possible stage. The reason being that they would then be in the position to make the maximum contribution. In connection with this, all effort is made to involve all the various disciplines likely to participate on a project, to work together right from the start.

The firm also has a flexible policy regarding who assumes lead roles on projects. Consequently, where a scheme has a high aesthetic design content, the architects are given the free hand to evolve an appropriate proposal. In instances where economy or function is paramount, a different approach is adopted. This is a strength for the firm since it enables them develop the right scheme for each job. The tendency to standardise a firms approach to schemes stifles creativity and negates good design.

Another significant policy of the firm is to have regular meetings at various stages of each project at which all disciplines including the design and construction teams are present. These include project launch meetings, design meetings, client meetings and post contract meetings. This allows maximum participation of all disciplines, coordination of design issues and decisions, the transmission of lessons learned from previous jobs and the ability to keep clients informed of progress.

One of the main strengths of this firm is the wide range of disciplines represented in it. This enabled the firm to provide a comprehensive and fully integrated service. Together with the flexibility mentioned earlier, the firm is able to assemble the right team for each job. At the same time however, the large design team results in high overheads and these staff levels are

not easily adjusted to suit fluctuating workloads.

3.7.4 Firm EXD/2 generally works with external designers for whose work it takes responsibility. As a result of this a special approach is adopted in connection with the firms interface with the designers. Basically, the firm offers what it terms "design support" or "design management" to the overall process. This ensures that the brief is adhered to and that the project budget is maintained. Furthermore, the firm closely monitors the progress of design work as this is carried out. The emphasis here is to ensure that the design firms resources do not for any reason fall below that which would enable them provide the information necessary for the project. Any imminent problem could thus be anticipated and planned for so as to reduce its impact.

This policy of maintaining strict financial control of the design process is achieved by costing building elements as these are designed and producing a regular "shift statement" to show how costs vary in time about an acceptable bottom line. This system is effective in cost control but could probably stifle the creation of innovative design solutions.

The subject of value engineering and achieving buildability into projects is of prime importance to the firm. This goes on as design details are produced. All disciplines, including building specialists, are involved in offering suggestions on the optimum techniques for achieving objectives. This process generates a high level of cooperation between designers and construction experts involved in projects.

3.8 CONCLUSIONS

The case studies indicate that although D&B firms preferred an early involvement in the development process, this was not always possible. A fairly large proportion of jobs came to the firms with previously developed briefs and novated architects. The D&B firms with in-house designers were more likely to achieve this early involvement and this enhanced their ability to introduce the "buildability" that both types of firms favoured.

Cooperation between design and construction departments was achieved to varying degrees in the firms and also at the different stages of the process. Construction teams generally tended to get actively involved further down the process after preliminary enquiries had become more firm. There was therefore not as much involvement from the construction specialists at what may be considered a critical stage of the design process. Furthermore, their involvement during the actual design process itself was limited.

There also appeared to be a difference in emphasis in the general approach adopted by the two types of firms. The D&B firms that relied on external designers seemed to place more emphasis on cost / budget control. They saw their strength as being able to deliver to cost and on schedule. The firms with in-house designers placed more emphasis on producing the right solution for the client and ensuring that this was built to specification. Primarily this reflects the sphere of control the different types of firms each had.

One area of possible weakness is the limited involvement of the external designers during the actual construction phase. The tendency was for involvement only when problems occurred

on site. The disadvantage here is that the design teams were unable to avail themselves of the experience on site, knowledge that would benefit them on future projects. Thus the opportunity of total involvement that D&B is in the position to offer was lost to some extent in the firms without design teams which tend to operate with different project coalitions from one project to the next.

As regards the adherence to specifications, it may be said that in both types of firms, clients had to rely a great deal on the integrity of the D&B firms. This was particularly so for the inexperienced client who did not have an independent agent on site to monitor the works. Many projects were executed without a clerk of works on site, nevertheless the firms each appeared to have an impressive string of repeat clients who were satisfied with the firms past performance and integrity.

CHAPTER FOUR

THE MANAGEMENT SYSTEM

CHAPTER OUTLINE

This chapter begins by developing the argument that a management system for the processes of the design / production interface is viable and essential for D&B construction firms. It then goes on to describe exactly what areas such a system would address and what its possible limitations might be. Procedures are then outlined and methods for their implementation and maintenance detailed. Issues such as planning, implementation, monitoring, evaluation, recording / measuring progress, and the delegation of roles and responsibilities are discussed.

4.1 Introduction - The Argument for a "Management System"

Although no two firms or projects are identical, there is invariably a fairly regular pattern of characteristics and stages for each. The existence of such patterns makes it viable to have flexible models that may be used to guide proceedings in the various processes. The issue of flexibility here is of great significance, since the model will of necessity need to be moulded to suit any variations in the situations it may be applied to.

It has been pointed out by Bowley (1966, pp 450) that the efficient design and erection of buildings in its widest sense requires expert knowledge in the following areas;

- Structures, materials and the building process
- Design and visualisation of the aesthetic implications of design and production
- The organisation of the process of design and production
- Cost estimation
- Financial risk management
- The interpretation of client requirements and the ability to offer disinterested advise

In the context of design and build, it may be said that the above aspects are by and large a function of, or closely related to, the design and production interface. It is vital therefore that this part of the organisation be carefully managed, since efficiency here will reflect on the final outcome in a significant way. The use of a 'management system' is seen by the author as a means of achieving consistency and order in the management of this all-important area of D&B firms. In general terms, the management system explains how the organisation's

management processes should operate to achieve its goals in the context of the design / production interface.

4.2 Scope and Limitations of The Management System

The Plan of Work identified and followed during the case studies is adopted in the system. It therefore covers the inception, brief, design, tender and construction stages of the process. At each stage, the corporate objectives are identified and strategies to achieve these objectives are formulated. According to Garvin (1992), managing for excellence does not essentially differ from other forms of management. It involves the formulation of strategies, setting goals and objectives, developing action plans, implementing plans and using control systems for monitoring feedback and taking corrective action. Consequently, for each of the work stages, this process of strategy formulation and action planning shall be carried out.

The system however does have certain limitations in the context of the study. First and foremost is the fact that what is produced here can only be **the basis for further work in this field**. This is primarily because of limitations of resources and time which permitted a restricted examination of the range and circumstances of D&B firms in the UK. Secondly, a point made earlier must be reiterated and this is the fact that each firm and project differs from the next. It is therefore difficult to generalise and suggest procedures for each and every situation. Nevertheless, what the system shall attempt to do is provide systematic guidelines for the general management of the design / production interface. Individual firms would then be able to adapt features of the study for their own use.

4.3 Principles of the Management System

The basic principle underlying the management system is based on the Deming Wheel for continuous improvement. This consists of the processes of "PLAN, DO, CHECK, and ACT". In general terms, all activities that are carried out need to go through a planning process in which performance objectives and standards are established. This is followed by an implementation process during which a measure of actual performance is documented. The checking stage involves comparing the actual performance with the objectives and standards set at the start of the process, and the gap between the two is determined. Once this is established, action is taken to close the gap and make the necessary improvements. In this way, the process may be continued and a state of continuous improvement is achieved. The Deming Wheel is illustrated in Figure 4.1.

This theoretical principle is translated into a plan for a quality / management system as illustrated in Figure 4.2. The starting point must always be the production of a clear written policy issued by the top management of the organisation. This is important not only to steer the course, but also to express and demonstrate involvement, support and commitment from the top.

The objectives of the programme should then be established and responsibilities allocated. This involves setting goals, appointment of Quality Managers and preparation of job descriptions. It is vital that quality should be seen to be the responsibility of all and not just the senior management of the organisation.

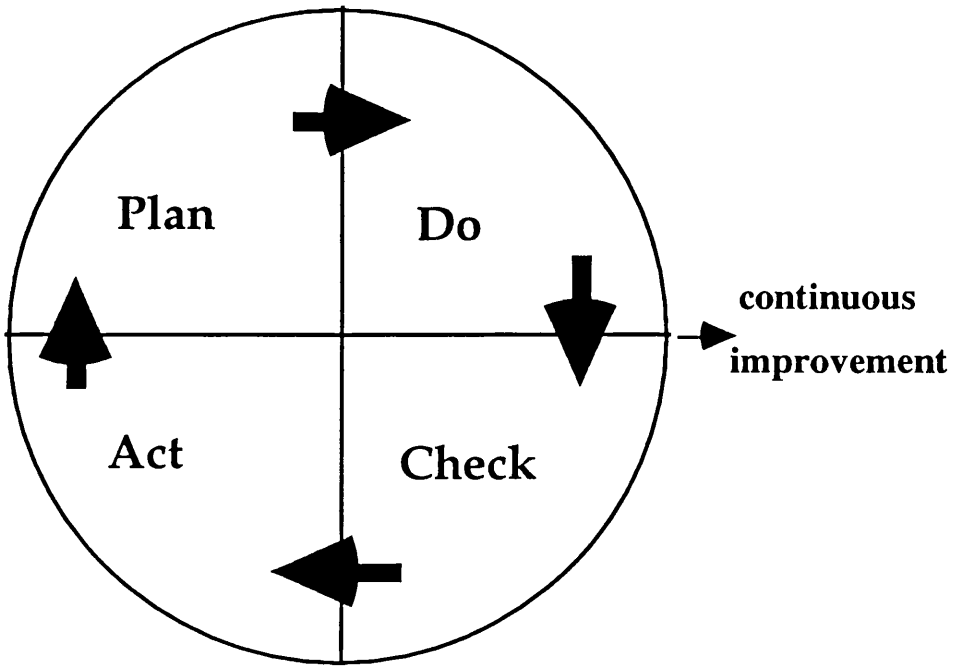


Figure 4.1 - The Deming Wheel of Continuos Improvement demonstrates the management route for Quality Management.

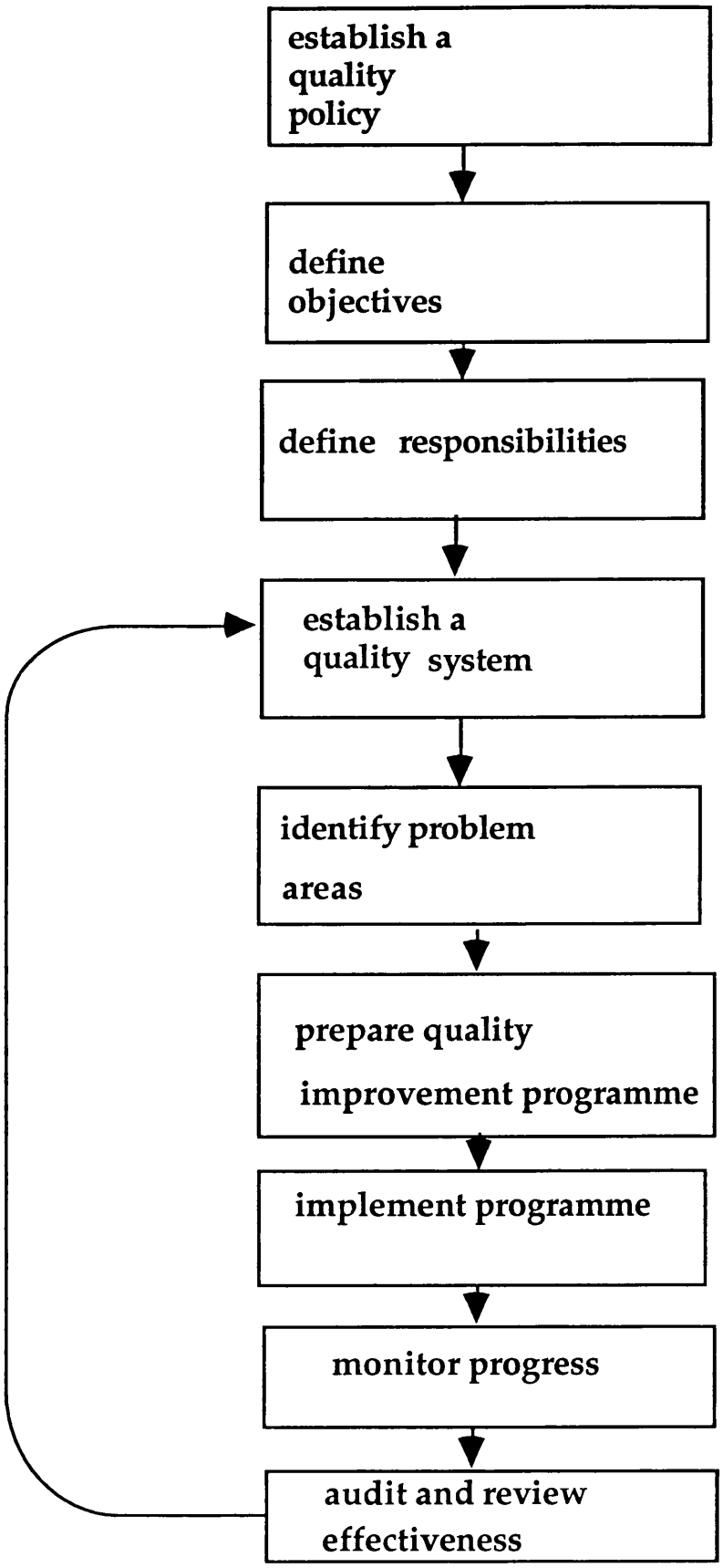


Figure 4.2 - Plan for a Quality System Source: Adapted from JS Oakland

The quality management system is then designed to ensure that the requirements of customers (internal and external) are met and that systems are put in place to monitor the progress of the system, identify problem areas, audit performance and periodically review the entire system, to ensure that continuous improvement and consistently high levels of quality are achieved.

4.4 Proposed Work Stage Procedures

The principles and quality management plan described above are applied to the Design and Build work stages in the following sections. The objectives at each stage and the general strategy to achieve these are systematically set out. This is followed by a discussion on some issues that apply to the management system as a whole.

4.4.1 The Inception Stage

The objective at this stage is to help clients crystallise their ideas. From the case studies it is fair to say that at this stage clients basically require an indication of the financial implications of the scheme and an idea of how it might function. In the light of this, the suggested strategy is that right from this early stage, the D&B firm or project coalition should be represented not only by a designer, but also by someone in a position to give advise on the cost implications of projects.

The firm's involvement at this stage is likely to be brief. The emphasis is primarily to assure

the client of the schemes feasibility and offer advise on its likely cost implications. A checklist of issues to be covered at these preliminary meetings should include;

- Capacity of the facility
- Characteristics of the proposed site and associated implications
- Finance proposals
- Structure, materials and form
- Contract form
- Conceptualisation

Once these issues have been deliberated upon, the client should be provided with a brief document or statement that clearly explains the firm's interpretation of the concept and how the scheme would be executed. This preliminary statement would also give the client an indication of preliminary costing based on the size / capacity of the facility, site conditions, materials and intended structural form. The document must be designed in such a way as to convince the client that the firm is well equipped to handle the job and will provide value for money.

4.4.2 The Brief Development Stage

The primary objective at this stage is to assist the client produce a comprehensive brief that can successfully form part of the contract. This document is invariably a technical document and clients generally require assistance in their preparation.

The key feature of the proposed strategy centres around the word 'comprehensive'. The strategy focuses on the mobilisation of all the individuals and disciplines that the project demands. The case studies indicated that the brief development stage was architect-led in most of the firms. It is suggested here that this be broadened to include other specialists that could make a positive contribution. This may include construction specialists, mechanical engineers, quantity surveyors and project managers.

Advise given to the client during this process of brief formulation should cover aspects such as;

- spatial requirements
- spatial layouts and relationships
- fixed furniture and fittings
- special equipment for rooms / spaces
- room sizes and capacities
- colour schemes and finishes
- acoustic requirements
- services and lighting
- circulation and fire escapes
- site access, landscaping, coverage and servicing
- height limitations, building lines, rights and easements
- structure, form, materials and architectural treatment/style

Although many of the above are architectural, the active involvement of other specialists should be encouraged, particularly so in the context of an integrated firm or project coalition.

The proposed multi-discipline brief development meetings may or may not be chaired by an architect. The essential quality required here is an understanding of the design process, construction, coordination and the tact and finesse that are vital in extracting requirements from a client who may not be sure what these might be. The involvement of an architect in the team is essential though since the design process proper starts here and the skills of the architect are required.

4.4.3 The Design Stage

The primary objective at the design stage is the maximisation of the involvement of the construction team or specialists. The aim is to achieve the "buildability" that their contribution is recognised to offer. The strategy proposed to achieve this is based on the following main points;

(i) The institution of multi-disciplinary Design Working Groups within the D&B firm or project coalition. This working group shall have within it an inner core group for each project with one or two representatives from both the design and construction departments. The core group shall attend regular meetings (possibly weekly) right through the duration of the design process. These meetings are intended to enable a close auditing of the progress and direction of the design as it develops. In this way, all aspects of a design including production information and details are reviewed from both a design and construction point of view.

(ii) The encouragement of the establishment of Quality Circles within the multi-discipline working groups. These are groups of four to ten people working under the same supervisor who meet for an hour each week under the leadership of the supervisor, to identify, analyse and solve their own work related problems (ROBSON, 1983). Membership of these groups is voluntary. The focus is problem solving (Fig.4.3) by the team as a whole. It is vital if they are to be effective, there must be commitment from top management for the concept and also the allocation of resources of time for training, consultation and regular meetings as well as financial support to implement suggestions and solutions that may emanate from the Quality Circles. According to work done by Robson (1983), Quality Circles have shown themselves to be an effective way of providing a framework for the development of more productive attitudes and relationships between different levels of an organisation or business. The work environment thus created facilitates efficiency at all levels of operation.

(iii) A programme of internal training that could provide the opportunity for increasing awareness across the disciplines within the firm. Such a scheme would involve exposing designers to the operational details of construction. This would in turn be complimented by a reciprocal effort in imparting relevant aspects of the processes of design to the decision makers in the construction team. This programme is not aimed at creating "universal men", but rather instituting an environment of mutual understanding and appreciation of the activities of the different departments. This, it is believed, could lead to much more effective cooperation between design and construction departments.

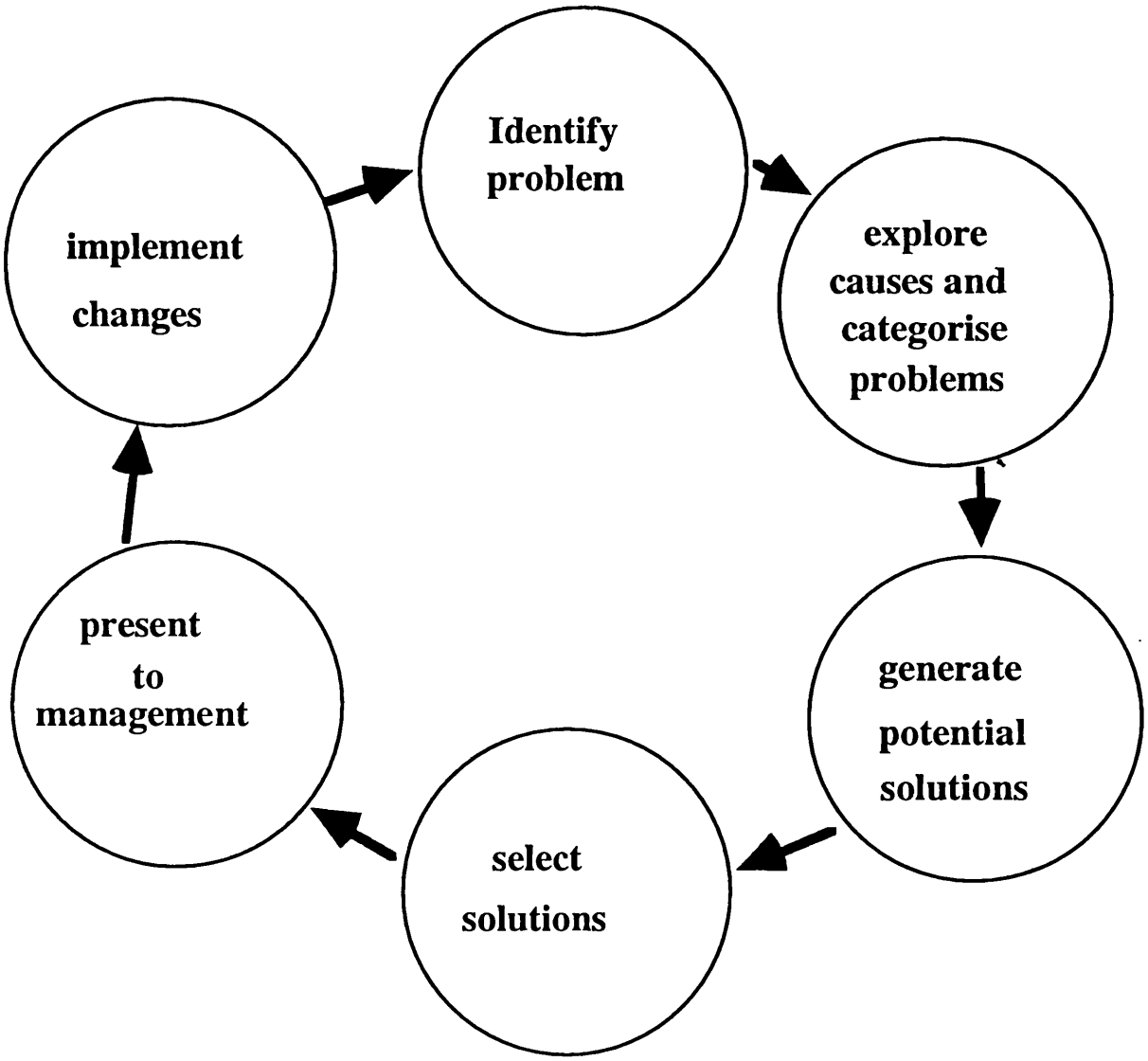


Figure 4.3 - The Quality Cycle , reflects the focus and methods of Quality Circles

Design and build firms would have to monitor the progress of the above schemes to evaluate their contribution and performance and adapt their operation to suit the particular nature of the firm concerned.

The case studies revealed that most D&B firms had "launch meetings" at the start of most jobs, to get the project teams working together. This practice is considered by the author to be highly commendable. It is believed that the practice should be further developed to include "brain-storming sessions" which could be the platform for the emergence of novel ideas that may have a significant impact on the project at hand.

Another issue of major importance relates to the manner in which feed-back from previous jobs may best be made available at the design stage. This issue shall be touched on at a later stage when the construction stage is being discussed since it is here that the DATABASE required will be built up. However, at the design stage, the Design Working Group mentioned earlier should have access to all relevant information that the firm would have built up over the years.

4.4.4 The Tender Documentation Stage

At the tender documentation stage, the management system has a threefold set of objectives as summarised below;

1. To facilitate the effective transfer of design information from the designers to the Quantity surveyors for measurement.

2. The introduction of operational procedures that would reduce the occurrence of undesirable omissions and contradictions in the information supplied.

3. To encourage frequent and constructive dialogue between surveyors and designers with the aim of selecting and specifying the most appropriate details and finishes for the project.

The strategy for achieving these objectives centres around increased COOPERATION and INTEGRATION. This could be manifest firstly by the inclusion in the Design Working Group mentioned earlier, of a Quantity Surveyor. This involvement need not be on an ongoing basis but only on an intermittent basis, particularly at the regular weekly meetings. In this way, the Q.S. would be in the position to advise at all stages of the design process, on the most appropriate materials and details, from an economic and commercial point of view.

Secondly, it should also be possible to temporarily transfer a suitable member of the design team to work with the quantity surveyors at certain critical stages of their measuring procedures. This would facilitate the resolution of discrepancies and any other queries that might arise. The person selected for this important liaison role would need to be sufficiently capable of taking decisions and where need be, quickly convening design team meetings to resolve issues. The modalities of operation of such an office will differ from firm to firm, but in general terms this position need exist only for specific periods to be determined by the quantity surveyor's programme.

In order for the process to be efficiently managed, it is recommended that either this liaison

person from the design department or a member of the quantity surveyor's team be appointed as a "Quality Manager" to evaluate the information flow and the processes described above. This is critical to ensure that corrective action is taken immediately if problems should develop. Depending on the nature of the problem, this could entail increasing the number of QS representatives on the Design Working Group or frequency of meetings, introducing new procedures to resolve disagreements, or changing the design team representation in the QS department.

4.4.5 The Construction Stage

The objective at this stage is basically to increase the involvement of the Design team. This is seen to be instrumental in making interpretation of drawings on site more effective, enabling the anticipation of problems as construction progresses and facilitating prompt response to the solution of design problems. Furthermore, it is seen as a means of continuing the 'education' of the designers on site, where conditions exist for certain lessons to be learned. The process of documenting these lessons is probably best done by a designer who is in close contact with the construction specialists and the process. In addition to the aforementioned, the design teams involvement will enable the traditional role of works inspection to be carried out.

The principal strategy for achieving these objectives involves the appointment of a Site Architect / Quality Manager. This role may well be performed by one person, though two people could work together as a team. A system of recording site proceedings will be

implemented as part of the overall strategy. The emphasis here is to be design / detail implementation in the construction process. This could take the form of sketching "as-built" details which at a later stage could be compared to the original details.

The Site Architect should also monitor the flow of production information to site and anticipate the need for new details on site. As part of the design team, the site architect will be in the position to start the design process on site, contact the right person in the design team to continue the work and in this manner get the solution ready in the shortest possible time.

Another aspect of the quality system is the introduction of regular, on-site 'project team meetings'. These would involve representatives from both the design and construction departments. The purpose of the meetings is to review proceedings, resolve outstanding problems, share experiences and review the documentation process being carried out by the site architect / quality manager. The meetings will assist in the dissemination of information and lessons learned, to the team as a whole for future use, and also enable the fine-tuning of the quality data recorded, since this will be presented in the presence of both design and construction representatives who may comment on various aspects of the documentation.

It must be pointed out that the above measures are more easily introduced into an integrated D&B firm. In the case of firms that rely on external designers, the D&B firm should present the quality system and work for cooperation with the independent designers. It should be stressed that both the design firm and the client stand to benefit from the procedures described. The design firm will gain from the lessons learned on site, have more satisfaction

from the knowledge that their design is being implemented correctly and also save on time that is often lost when design problems are not resolved efficiently on site. The client will benefit from the higher levels of quality the process will produce.

4.5 Programme Audits and System Reviews

It is essential that the management system is monitored constantly to ensure that the predetermined objectives are achieved. This requires systematic auditing of procedures. Quality Circles have a vital role to play here as they are in the position to observe and assess the effectiveness of the procedures. Firms should develop and utilise checklists, schedules and forms for the purpose of recording all activities and the performance of aspects of the management system. The 'gap' between these records and the initial objectives will then lead to overall reviews of the system. In this manner, the management system can be adjusted and redesigned to better meet the initial objectives. This process must be complimented with a review of the requirements of both internal and external customers and suppliers to ensure that their requirements are monitored for change. Any change in these should also be reflected in the system and how it may adapt procedures to continue to meet the new requirements.

4.6 SUMMARY

The management system is based upon setting objectives, planning activities, implementing them, checking performance and taking corrective action. Cooperation and integration of the

various professional disciplines is enhanced. Quality managers are appointed and the development of Quality Circles encouraged. All other job descriptions and responsibilities are clearly defined. The System is continuously monitored and overall reviews carried out regularly to ensure internal and external customer needs are consistently met.

References

1. Bowley, M. (1966) The British Building Industry, The University Press, Cambridge.

2. Garvin, D.A. (1992) Operations Strategy - Text and Cases, Prentice Hall, New Jersey.

3. Green, R. (1986) The Architects Guide to Running a Job, Butterworth Architecture, London.

4. Hansen, R. & Sjoholt, O. (1989) Quality Management - A challenge for the Building Industry, Norwegian Building Research Institute, Oslo.

5. Harper, D.R. (1978) Building - The Process and The Product, The Construction Press, Lancaster, London, New York.

6. Oakland, J.S. (1993) Total Quality Management - The route to improving performance, Butterworth-Heinemann Ltd, Oxford.

7. Quality Assurance - Quality systems in building design firms ISO 9001 1987, EN 29001 1987, BS 5750: Part 1:1987, RIBA Indemnity Research Ltd., London (1989).

8. Quality Management in Construction _ Interpretations of BS 5750 (1987) - 'Quality Systems' for the Construction Industry, CIRIA Special Publication 74, London (1989).

9. Robson, M. (1983) Quality Circles - A practical guide, Gower Publishing Company Ltd, England.

10. Stebbing, L. (1989) Quality Assurance - The route to efficiency and competitiveness, Ellis Horwood Ltd, Chichester.

CHAPTER FIVE

DESIGN AND BUILD - THE WAY FORWARD

CHAPTER OUTLINE

The practical implications of the management systems described in the preceding chapter are discussed here. The chapter looks forward and attempts to objectively assess what impact these procedures might have on the average D&B construction firm and how these firms may plan for the inevitable change. It also considers what likely changes the British construction industry may go through and how some of the suggested procedures might be adapted to accommodate these changes and still be effective in the years ahead. The chapter ends by drawing conclusions from the study and summarising what contribution the research may have made to the subject of design and build contracting in the British construction industry.

5.1 Planning for change

If D&B firms are to be successful in implementing the new management systems described in the preceding chapter, certain preparations will have to be made. The firms must realise that ultimately, a new culture should begin to emerge within the organisations for the changes to become really a part of their "way of doing things". It is important to stress that each organisation has its own peculiar culture and the process of change will differ from firm to firm. However certain basic ingredients must be present for the right "recipe" to emerge. According to Johnson and Scholes, the recipe is "the set of beliefs and assumptions held relatively commonly throughout the organisation, taken for granted in that organisation, but discernible to the outside observer in the stories of organisational history and explanation of events. The recipe makes sense of the situation managers find themselves in and provides a basis for formulating strategy".

One ingredient, the importance of which cannot be overemphasised, is commitment from the top management or the strategic apex of an organisation. They must be fully convinced of the need for the management systems and must also be seen by the organisation at large, to be actively involved in implementing the systems.

Another significant factor is motivation of employees. According to work done by Professor Hertzberg, the factors that motivate people in their jobs are achievement, recognition for achievement, meaningful interesting work, increased responsibility and growth and advancement at work. Furthermore, these motivators are assisted by job enrichment, feedback, self-checking and direct communication. The other group of factors that keep

people satisfied at work, known as 'hygiene' factors such as general working conditions, salaries, supervision and how people are treated at work, should also receive careful consideration in each organisation. The factors that motivate MUST be in place and well designed for the employees to give their best.

5.2 Possible Future Developments

As pointed out at the beginning of this report, D&B as a system of building procurement appears set to continue increasing its market share in the UK. This will only happen though if the system continues to fulfil the needs of clients and the constructions industry in general. In general terms, clients require their projects to be properly designed, built to budget and completed on schedule. The D&B sector in turn requires its production costs to be met and also to earn a reasonable mark-up to keep it in business through investment, training, expansion of scope and general development. Apart from this it is important that the sector does not carry more risk than is reasonable. Current design and build practices result in the D&B contractor carrying an enormous level of risk with each job contracted for. This can only lead to an eventual decline of the sector.

In the light of the high risks they carry, it is vital that effective management systems be deployed to ensure that their processes are consistently executed in such a manner to produce the desired results. This should reduce the time taken to develop briefs, produce optimum designs and realistic tenders, facilitate well-managed construction activities and project teams that are properly motivated and working together in the most efficient manner.

Although building to cost and within schedule shall always be important to the D&B firm, the future is likely to depend more and more on their ability to operate efficiently and provide a quality product and service to their clients.

5.3 CONCLUSIONS

To a large extent, it may be said that D&B firms at present are not achieving their full potential. There appears to be scope for increased levels of cooperation between the various professionals and organisations involved in the process. This would lead to achieving many of the acknowledged advantages the system is thought to offer such as increased "buildability" and early involvement of construction specialists.

The study has shown that firms with in-house designers were in a better position to achieve this early involvement in the process and the ultimate buildability this offered. Although firms that relied on external designers were able in some instances to influence the design of projects, the frequency with which this happened was rather limited and the firms often dealt with projects that were quite well advanced prior to their involvement. Consequently, these firms tend to place more emphasis on budgetary control and cost-monitoring of designs as these are produced. This is a significant difference in the method of operation of these two types of D&B firms.

The firms studied also did not appear to have a structured system for the documentation of lessons learned during the construction process. Consequently, it was difficult for designers

to avail themselves of this wealth of knowledge and experience, which by and large was carried about by individuals.

Another feature of the D&B process was the fact that clients appeared to rely on the contractors integrity to adhere to specifications. Although their integrity is not doubted, it seems preferable for all parties concerned that clients should be encouraged to have an independent agent on site during the construction process. This would leave no room for there to be any suspicion that the client's interests were not being served by the contractor.

This research report has among other things highlighted the significance of the DESIGN / PRODUCTION interface to the D&B contractor. It has shown where weaknesses occur in current practices and has made some practical suggestions to how these areas may be managed more effectively. In doing this, it has provided a basis upon which individual D&B firms may proceed to develop QUALITY MANUALS suitable for their particular circumstances that would assist in the management of this all-important area of their operations. These 'custom-made' manuals would complement existing manuals and guidelines such as those offered in BS 5750 and equivalent documents.

The study has also demonstrated areas for possible future research that would benefit the D&B sector in particular and the construction industry in general, namely the development of a DATABASE for these construction firms, of lessons and experience gained from previous projects for use in the future.

References

1. Ball,M.(1988), Rebuilding Construction - Economic change and the British construction industry, Routledge, London.

2. Johnson, G. & Scholes, K. (1989), Exploring Corporate Strategy - Text and Cases, Prentice Hall, London.

3. Oakland, J.S. (1993), Total Quality Management - The route to improving performance, Butterworth-Heinemann Ltd, Oxford.

APPENDIX A - THE CASE STUDIES (FULL DOCUMENTATION OF TEXT)

3.3.1 CASE STUDY 1 - (Ref No; IND/1)

Firm IND/1 is part of a large, mainly construction orientated group of companies operating across the country in Scotland, the North, East Anglia, the South, South-East and the Greater London area. The groups activities include private housing, public housing, utilities, private industrial, private commercial and refurbishment work. Design and build turnover for the financial year 1992/93 was £83m out of a overall turnover of £183m, which represents a significant 45% (source: New Builder Special Features, 11 June 1993).

The Group has a fairly wide range of Divisions covering areas such as Homes, Special Contracts, Construction, Hydro Works, Small Works, Plant Hire, Concrete Repairs, and International Works. The internal Design Department consists of a small nucleus of architectural and engineering professionals whose duty it is to service all the above the Divisions. The department is small, consisting of an architect and five technicians. The two engineers are mainly site-based. As a result of its size, external professionals are often used although this depends primarily on how the job is obtained.

At the inception / brief development and design stage of D&B projects, there is a variety of ways in which the Design department gets involved and interacts with the construction department. In the majority of cases, clients engage external consultants to assist them evolve the scheme and possibly obtain planning approval prior to the contract going out to tender.

In other instances, the Design department is involved in advising the client during the inception and brief development stage. The Construction departments are NOT involved at this early stage, although ideas may be "bounced off" them since their contribution could have a significant impact on the eventual route taken. The Design department's involvement in most aspects of projects enables it to effectively utilise lessons learned from previous schemes.

During the tender documentation development stage the Design department is involved to a large extent in providing answers to numerous queries from the surveyors. The resolution of contradictions in the tender documents is the responsibility of the Design department. The important issue here is to ensure that the scheme complies in all aspects to planning / building regulation requirements and also meets the clients brief / requirements.

The work of the Design department continues right through the actual construction stage as well. Apart from the initial provision of working drawings and making applications for building regulations the designers also perform the traditional role of works inspection. The principal architect wears two hats and is part of both the pre-contract team and the post-contract team

Supply of design information to site is managed by an internal planning department which works out a programme of information required based upon the job in hand and the staffing levels of the design department. This schedule is worked out in consultation with the design department. Delays on site due to late information supply is significantly reduced.

A few clients rely on external agents such as clerk of works or management agents to ensure that projects are executed in accordance to the stipulated specifications. Other clients rely on the contractor to administer and execute the contract in accordance with the employers documents. The principal architect notifies the contract manager if unsatisfied with anything. He has the option to go straight to the Managing Director if still dissatisfied. He is responsible to the Board and not to any individual director. Variations are usually handled by Architects Instructions. The close relationship between the designers and constructors is not thought in this firm to significantly reduce the number of AI's issued.

The Design department spends a lot of time resolving problems on behalf of the construction department. This is even the case when the problems are not directly related to design aspects of projects. Time spent in this way is often unrecorded and consequently difficult to cost. The designers regard this as a disadvantage resulting from their close relationship with the construction department.

3.3.2 CASE STUDY 2 - (Ref No; EXD/1)

This firm (EXD/1) is part of a large national contracting company that was founded in the mid C19th and has grown to be one of the largest private family building companies in the country. Its four main activities are Building, Design and Build, Housing and Maintenance and these occur right across the country in the North, the Midlands, East Anglia, the South and South East and the London area. These activities are carried out by a number of operating companies, some of which specialise in the various fields. Design and build

turnover for the 92/93 financial year was £75m out of an overall turnover of £170m, which represents 44% of total turnover.

The firm is essentially a contracting firm and has no internal designers as such. However it does tend to get involved in the inception stage of projects since clients approach the firm for advise and preliminary budget costs for their schemes. As regards the actual brief development, the contractor tends to have very little involvement since the client at this stage is likely to be working with design consultants. Once the brief is developed, the enquiry the firm receives goes to the project coordination department which then sends the information out to the various parts of the organisation to obtain their response.

In order to achieve effective liaison with the external design firm, a series of design meetings are scheduled quite early in the programme, the idea being to enable the firm share their experience with the designers to produce details and construction strategies that enable the project to be done in a more cost efficient manner. The firm is able to impart lessons from previous projects to the designers during these design development meetings. To some extent the firm is unable to make much of an impact particularly when designs have been quite far advanced before the firm's involvement.

In the formulation of tender documents, the firm gets the consultant designers to produce design statements of what their various inputs will be. These eventually become part of the contract document. Bills of quantities may be taken off by independent surveyors or done internally. Despite the fact that the firm has to deal with several independent organisations, communication is not thought to be a problem. The reason given for this is that they deal

with experienced professionals who want to achieve good results since they often operate on a "no job, no pay" basis. Traditional adversarial relations are also not evident because of the professionalism of the people involved and the fact that D&B is essentially about cooperation.

The construction stage usually starts with a flurry of activity during which schedules of information are worked out and building regulations obtained. To reduce delays related to late submission of drawings, a schedule of information required is agreed with the architects. The firm however, in its experience, has had difficulty enforcing this since architects seem to be slow and often appear to under-resource their work. It is the firms opinion that this situation would not change even if the architects were within the organisation.

As regards checking that specifications are adhered to on site, the firms experience is that a lot depends on the client making sure that the brief is very comprehensive. Clerks of works were not commonly used by clients on projects.

Variation orders initiated by the client are presented by the client's agent and AI's are developed. These are costed and priced in accordance with the contract just as in the standard JCT form. If variations are the result of a party for whom the firm is responsible, the client does not to cover the costs.

3.3.3 CASE STUDY 3 - (Ref No; IND/2)

This firm was founded about forty years ago and has grown consistently to become on of the largest privately owned construction companies in the UK. In recent years it became part of a major European construction group that undertakes projects worldwide. The firms UK activities cover almost all types of buildings, from corporate headquarters office developments through a wide variety of public buildings, pharmaceutical and electronic research facilities, hospitals, superstores, and leisure complexes to the restoration of listed buildings. Its D&B turnover for the 1992/93 financial year stood at £95m out of an overall turnover of £180, representing approximately 53%.

The firm is organised into three teams, each with architects and engineers. The workload is distributed on a team basis although this used to be discipline based. There are about 115 people on the staff, and this includes a large number of designers, a few surveyors, commission engineers and a board director is responsible for the design group. The firm prides itself on being almost self-sufficient in providing a full service to it's clients.

The firm is involved at the inception stage of projects, but the level of involvement depends a lot on the client. Some come to the firm very early needing ideas for the development of a site. A concept is quickly developed for such enquiries and this would involve a "footprint" for the building and unit area costing. Other clients come with a written brief and a package of drawings which the firm develops into working drawings. This arrangement restricts the introduction of buildability and can thus be disadvantageous. Preliminary enquiries generally do not involve the construction department, but only the architects, quantity surveyors and

possibly the marketing department.

Briefs received from clients may either be comprehensive or sketchy. The firm is confident that it has the personnel to assist clients develop their briefs effectively. This process normally involves architects, environmental services specialists and other specialists as required. If the initial enquiry becomes a certain one, the firm endeavours to get all people likely to be involved in the project together at a "launch meeting". Early planning of approach is done at these meetings and the essential ingredient is "communication".

These launch meetings are chaired by a Design Manager whose job it is to "pull all the reigns together" in order to get things done at the right time. These meetings in essence mark the beginning of the design stage of the process. The construction team has a vital part to play planning and assessing how the project is to be executed, in terms of speed and economy of construction. If the building is a prestigious architectural statement, the designers are given a free hand to produce just that. The client is provided with a method statement and a programme to explain exactly how the firm intends to proceed. Regular design team meetings are held fortnightly and these are interspersed with client meetings to present progress reports.

The Design team contributes to the construction process by offering advise on the best way to achieve certain results. Information-required schedules are agreed early in the process to prevent delays on site. Variations are dealt with by AI's. Disagreements between the designers and constructors are resolved by internal arbitration and this is a great advantage. The cost and time implications of any variations are discussed with and explained to the client whose consent is sought. Where changes are the result of parties under the firms

responsibility, these are referred to as "non recoverable charges", and may result in either losses or savings.

Monitoring of specifications is done by the firm using the specifications and contract documents, though some clients do use clerk of works. The firm points to the fact that they have gained a reputation for quality building and also for repeat clients and "this doesn't come from producing shoddy work".

After each project, post-contract meetings are held and attended by all disciplines and teams, the aim being to analyse the firm's performance. Lessons learned are transmitted at this stage to ensure that mistakes are not repeated. Technical notes and standards are recorded and made available to future project teams and new staff.

3.3.4 CASE STUDY 4 - (Ref No; EXD/2)

This firm is part of a larger international organisation whose main field of operation is transportation. The firm has a programme management division, commercial and engineering services divisions, construction division, marketing and business development division, training and an accounts division. The construction division engages in three forms of contracting namely, management contracting, construction management, design manage and construct or design and build. The firm's D&B turnover for the 1992/93 financial year was £45m out of an overall turnover of £720m which represents about 6%. The types of building developed include private industrial, private commercial, utilities, public buildings and

refurbishments. These were done in Scotland, the North, Midlands, the West, South, South East and the London area.

Inception stage involvement by the construction division takes the form of advising clients on how to develop sites that the client may have acquired. This is very often done on a competitive basis as clients may be in consultation with other construction firms simultaneously.

The firm receives both detailed, comprehensive briefs and completely undeveloped briefs from clients. The former type usually are the result of the involvement of a novated firm of architects, already engaged by large corporate owner-occupiers. The undeveloped briefs may be from clients who may not have acquired a site, and the firm assists them crystallize their ideas and formulate a brief. The firm has special procedures to cover this process and this involves the use of pro-formas and such systems. Discussions would cover costings, spatial layouts and the development of a model to fit a variety of sites.

The firms involvement during the design stage of most projects is essentially threefold; maximising the value of the scheme through value engineering, the management of any risk that might result during the execution of the design and finally controlling the design process to ensure it stays within budget and is delivered on time.

Managing the design or providing "design support" as the firm likes to call it, involves preparing periodic "shift statements" which is basically producing costing for elements of the design as these are produced. The objective here is to monitor the inevitable up and down

movement of costs so as to maintain the bottom-line position all the time. It is essential that before specialist packages go out for bidding, they are within budget. Furthermore, design support involves making sure that the design satisfies the clients brief and that any alterations suggested by the client are incorporated.

Although issues such as the aesthetics of the building are left in the hands of the architects, the firm does make suggestions if it appears that details being proposed are likely to have maintenance or service problems in use. Once a satisfactory brief is developed at the start of the process, the firm faces few problems during the design stage. However, special care must be taken to coordinate the three design disciplines involved; architects, services specialists and structural engineers. If design issues are not solved simultaneously, a lot of time and other resources are wasted.

The tender documentation stage is characterised by the provision of information by the external design team and the preparation of quantified bills by the firm's quantity surveyors. There are times when this service is "out-sourced" and carried out by independent Q/S firms.

At the construction stage the firm tends NOT to involve the designers very much, except where there might be problems of fit, coordination, or performance. The design management procedures implemented at the early stages minimises delays due to late supply of design information. However commercial pressures often force design firms to run down their resources and as such it is important to closely monitor the process of design detail development. Communication and close contact with the design firm makes it more difficult for problems to be camouflaged.

As regards adherence to specifications, the firm depends on the professional indemnities it provides and its general reputation. It is the firms opinion that even though the temptation to cut corners may arise, it is best to discuss possible adjustments on ways to maintain the specifications in the face of unexpected changes in the markets that otherwise might have led to attempts to economise. Design and build as a system is very high risk in terms of adverse effects of inflationary market pressure and there is likely to be the temptation to lower specifications. The firm adopts the attitude that the client "must keep the specifications tight and not allow for the use of similar or approved substitutes". Furthermore it is advisable for the client to have their own independent project manager or specialist on site.

Variations to the project that are client driven are followed by an "impact assessment analysis" that details the changes, estimates their cost, effect on the programme and any impact they may have on quality. Nothing is done until this analysis is carried out and signed. If changes are the result of actions of the firm or designers, the client does not cover the cost. Negligence by a design consultant would result in them having to cover costs of any variations.

One area there is thought to be room for improvement is the feedback of lessons learned from previous jobs. The establishment of a data base of experience gained has proved difficult. Features that are innovative and proven tend to get circulated around the industry as a whole. Others go in and out of fashion over the years. There definitely seems to be the need for a system for documenting the important lessons and effectively passing these on for use where appropriate in the future.

APPENDIX B - SURVEY QUESTIONNAIRE

STAGE I ;INCEPTION/CONCEPT FORMULATION

INVESTIGATION OBJECTIVE; To establish the level of involvement of D&B firms in the inception stage of projects.

OUTLINE QUESTIONNAIRE

1. To what extent do clients normally involve D&B firms at the inception stage of projects?

2. Which departments of the firm are usually represented at this stage?

a/ construction team representative

b/ design team representative

c/ both of the above

d/ director of the firm

3. What form does the firms involvement take?

a/ consultation and advice

b/ brain-storming

c/ think-tank

d/ other (please specify)

4. What type of problems, if any, are encountered at this stage?

STAGE II; BRIEF DEVELOPMENT

INVESTIGATION OBJECTIVE; To establish;

(i) if D&B firms receive comprehensive briefs

(ii) whether clients normally obtain assistance from experts to prepare briefs, and

(iii) how D&B firms respond to the briefs that they receive

OUTLINE QUESTIONNAIRE

1. How comprehensive are the briefs clients provide D&B firms?

a/ general description only

b/ general description and spatial requirements

c/ detailed description, spatial requirements, performance specification, etc

2. Do clients appear to receive technical advise in brief development? If so, where from?

3. Do clients ever request help from D&B firms in brief development or is this exclusively the preserve of the client's own consultants?

4. If there is any involvement of D&B firms, what form does this take and which departments are deployed to assist?

5. How do D&B firms respond to briefs and which departments are most active in the various levels or stages of response?

STAGE III; DESIGN DEVELOPMENT

INVESTIGATION OBJECTIVE; To establish the level of involvement and contribution of the construction department in the design process.

OUTLINE QUESTIONNAIRE

1. Which parties are involved in the design development process?

a/ architects

b/ architects and construction specialists

c/ others

2. What level of contribution is made by the construction team?

a/ actual design work

b/ details and working drawings development

c/ consultation and advise when problems occur

3. At what stage of the design development does the construction team make its contribution?

a/ sketch design

b/ scheme design

c/ details and working drawings

d/ all the above

4. How is the design input of specialist subcontractors catered for in terms of integration into the overall design process?

5. What is the mode and level of frequency of communication with the client during the design process?

6. How is feedback of lessons learned from previous projects (often by the construction team) made use of by the design team during the design process?

7. What problems are usually encountered at the design development stage?

STAGE IV; TENDER DOCUMENTATION

INVESTIGATION OBJECTIVES; To establish how the design and construction teams contribute towards the preparation of tenders and tender documentation.

OUTLINE QUESTIONNAIRE

1. What contribution if any does the design team make towards the taking-off procedures?

2.Are the measurers regarded as part of the construction team or as a separate entity?

3. What feed-back loops exist during the measurement process to ensure that designers take account of the views of measurers (or QS)?

4. Do building specialists liaise with designers to achieve details that are buildable within project time stipulated in the tender documents?

STAGE V; CONSTRUCTION

INVESTIGATION OBJECTIVE; To establish (i) how efficiently design information is supplied to construction team, (ii) the involvement of the design team in the resolution of problems on site, (iii) how the construction process is monitored to ensure that it conforms to the brief and specification.

OUTLINE QUESTIONNAIRE

1. To what extent is the design team involved in the construction process on site?

2. How are details and general design information supplied to site to ensure minimum delay?

3. What procedures are adopted to ensure that specifications are adhered to? Is it possible for this to be done objectively by internal staff or are external observers usually requested by clients?

4. How are variation orders handled when these are requested by;

a/ the client

b/ the designers

c/ others

APPENDIX C - DESIGN AND BUILD LISTING -

Extracts from the 'New Builder', 11 June 1993, illustrating the range of D&B firms operating in the UK and demonstrating the fact that "design and build contractors are holding their own through the recession" (New Builder, 11 June 1993).

Company	£m D&B Turnover	£m Turnover (Overall)	A&E
AMEC	172.6	690.0	41A, 360E
AMEY BLDG	15.0	36.0	-
ANGLO H.CON.	10.1	11	2A, 2E
ARNOLD&NATHAN	7.0	12.0	2E
AUSTIN CO.	12.0	12.0	10A, 25E
AUSTIN HALL	1.2	3.0	-
BALFOUR B'TY	380	1881	-
BALLAST NE'DM	33.0	79.1	-
BARRATT CONS'N	12.0	22.0	-
BELL & WEBSTER	3.5	8.5	-
HENRY BOOT D&B	34.3	129.0	-
BOVIS CONS'N	50.0	-	-
BOWNER & KIRKLAND	40.0	150.0	-

BRAZIER & SON	4.0	14.0	-
BRITTANIA CONS'N	4.62	19.12	1A
CLUGSTON CONS'N	7.0	68.0	-
CONDER PROJECTS	48.0	50.0	-
COSTAIN	50.0	701.0	-
COUNTRYSIDE PROP.	30.0	90.0	17A, 6E
W.COWLIN & SON	8.0	25.0	-
CROUDACE	50.0	63.0	4A, 6E
DEAN & DYBALL	6.6	43.0	-
DEW GROUP	8.5	45.0	3A, 7A
DURTNELL & SONS	2.2	14.0	-
EVE GROUP	9.0	36.2	6E
FAIRHURST & PTNS	2.1	13.1	205E
GMI CONS'N	16.0	32.5	6A
GLEESON GROUP	80.0	-	4A, 2E
HALL & TAWSE	65.0	190.0	-
HAMILTON, A.B.	0.7	4.5	-
HAYMILLS	7.5	75.0	-
HIGGINSS & SONS	15.0	36.0	-
HIGGS & HILLS	71.0	-	3A, 20E
HUTTON CONS'N	5.5	11.7	-
HYNES CONS'N	0.9	10.5	-
JACKSON CONS'N	4.0	8.0	-
JARVIS & SONS	12.0	49.0	-

JT DESIGN BLD	20.3	20.3	21A, 3E
JENNER CONT'RS	2.1	6.5	-
KIER GROUP	122.0	523.0	1A, 29E
KYLE STEWART	90.0	-	42A, 53E
JOHN LAING	170.0	728.0	23A, 169E
LLEWELLYN GRP	25.0	68.0	8A, 1E
A.C. LLOYD	9.5	10.7	1E
J.LONGLEY & CO	15.0	47.0	10A, 15E
LOVELL CONS'N	41.0	130.0	2A, 2E
R. MANSELL	18.0	102.0	-
MAY GURNEY	9.0	60.0	6A, 4E
A.McALPINE BLDG	55.0	210.0	3A, 12E
R.McALPINE	60.0	230.0	3A, 52E
McCARTHY & STONE	8.1	-	10A
McHUGH & BURR	0.8	0.9	1E
McLAUGHLIN & HR'VY	20.0	80.0	-
D.McLEAN	14.5	25.0	-
MORRISON CONS'N	35.0	200.0	3A, 4E
J.MOWLEM & CO	124.0	1245.0	-
T&E NEVILLE	5.0	13.0	1A, 3E
NORWEST HOLST	55.0	120.0	2A, 23E
NUTTALL	3.9	136.0	10E
G. OSBORNE	10.0	82.0	-
PEARCE CONS'N	55.0	98.0	13A

POCHIN D&B	11.9	32.8	-
REDROW CONS'N	10.0	17.0	-
ROBINSON & WHITE	12.0	19.0	-
SHEPHERD D&B	100.0	225.0	-
SIMONS CONS'N	41.5	104.0	7A
SINDALL CONS'N	3.0	21.0	1E
J.SISK & SON	23.0	163.0	-
SOL CONS'N	12.0	25.0	-
SQUIRREL D & C	0.8	0.8	1A, 1E
SUNLEY TURRIF	35.0	110.0	6A, 5E
TARMAC CONS'N	250.0	1000.0	199A, 444E
TAY HOMES	0.1	15.0	5A
TAYLOR WOODROW	130.0	817.0	15A, 200E
TEAM SERVICES plc	30.0	57.0	5A, 19E
THOMAS CONS'N	5.2	32.0	-
TILBURY DOUGLAS	40.0	235.0	3E
TRAFALGAR HOUSE	184.0	786.0	10A, 85E
TRY D & C	5.0	5.0	-
W.J.S. CONT'RS	2.5	8.5	-
WARINGS CONT'RS	19.0	26.0	3A, 4E
WATES CONS'N	21.0	170.0	-
WEBSTER & PATULLO	2.0	3.0	2A
WESTBURY PTNS	14.1	14.0	6A, 2E
WICKENS CONS'N	9.9	23.6	-

WIGGETT CONS'N	7.5	10.0	-
WILCON CONS'N	15.3	36.2	-
WILLMOTT DIXON	70.0	-	-
WILSON CONS'N	2.5	10.0	-
WIMPEY CONS'N	70.0	375.0	10A, 22E
WREKIN CONS'N	7.0	39.0	3A, 4E
E.WRIGHT CONS'N	11.5	17.5	1A

Notes:

1. The 'New Buider' listing from which the above data is extracted includes a disclaimer which states; "This is not a comprehensive listing of design and build companies. Only those companies that responded to the 'New Builder's' questionnaire are included, and some may have been omitted for space reasons".

2. 'A' and 'E' in the above listing refers to the number of in-house Architects and Engineers a firm employs.

BIBLIOGRAPHY

1. Aguayo, R. (1990) Dr.Deming - The man who taught the Japanese about Quality, Mercury; London.

2. Ball, M. (1988) Rebuilding Construction - Economic change and the British construction industry, Routledge: London.

3. Baverstock, J.M., Pateman, J. & Walters, W.M. (1992) "Quality Management Special Focus: Quality Down the Line; Customer Satisfaction; The Road to Quality", Chartered Builder, Volume 4, Number 4, pp11-17.

4. Bowley, M. (1966) The British Building Industry - Four studies in response and resistance to change, Cambridge University Press.

5. BS 5750 (1987) Quality Systems, British Standards Institution, London.

6. Chartered Institute of Building (1988) Design and Build, CIOB Supplement Number Two, Unwin Brothers Ltd: Surrey.

7. Croome, D.J. & Sherratt, A.F.C. (1977) Quality and Total Cost in Buildings and Services Design, The Construction Press; Lancaster, London and New York.

8. Dale, B. & Cooper, C. (1992) Total Quality and Human Resources - an executive guide, Blackwell; Oxford.

9. Garvin, D.A. (1988) Managing Quality - The strategic and competitive edge, Macmillan; New York.

10. Garvin, D.A. (1992) Operations Strategy - Text and Cases, Prentice Hall, New Jersey.

11. Green, R. (1986) The Architects Guide to Running a Job, Butterworth Architecture, London.

12. Hansen, R. & Sjoholt, O. (1989) Quality Management - A challenge for the Building Industry, Norwegian Building Research Institute, Oslo.

13. Harper, D.R. (1978) Building - The Process and The Product, The Construction Press, Lancaster, London, New York.

14. Janssens, D.L.E. (1991) Design-Build Explained, Macmillan: London.

15. Johnson, G. & Scholes, K. (1989), Exploring Corporate Strategy - Text and Cases, Prentice Hall, London.

16. Masterman, J.W.E. (1992) An Introduction to Building Procurement Systems, E. & F. Spon: London.

17. Nunn, D. (1992) The 1992 Design and Build Survey, Contract Journal.

18. Oakland, J.S. (1993) Total Quality Management - The route to improving performance, Butterworth-Heinemann Ltd, Oxford.

19. Oliver, G.B.M. (1990) Quality Management in Construction - Interpretations of BS 5750 (1987) - 'Quality Systems' for the Construction Industry, CIRIA, (Construction Industry Research and Information Association), London.

20. Quality Assurance - Quality systems in building design firms ISO 9001 1987, EN 29001 1987, BS 5750: Part 1:1987, RIBA Indemnity Research Ltd., London (1989).

21. Quality Management in Construction _ Interpretations of BS 5750 (1987) - 'Quality Systems' for the Construction Industry, CIRIA Special Publication 74, London (1989).

22. Robson, M. (1983) Quality Circles - A practical guide, Gower Publishing Company Ltd, England.

23. Rowlinson, S. (1987) Design build - its development and present status, CIOB Occasional Paper No. 36.

24. Stebbing, L. (1989) Quality Assurance - The route to efficiency and competitiveness, Ellis Horwood Ltd, Chichester.