The effective management of brief development throughout the project life cycle is a key factor to achieve client satisfaction, meet user needs, cope with regulation changes, exploit business opportunities, adapt to technology improvement, add more value and manage associated risk. Limitations of the current briefing theories relating to brief development with the existing approaches to manage change orders and integrate value and risk management do not adequately address the problem of managing brief development in construction. Since any brief development either adds value or risk to the project or adds both, this book has developed an innovative protocol integrating value and risk management to manage dynamic brief development in construction. The use of this unique tool resulted in achieving client satisfaction, responding to the influences of the brief development drivers, managing change orders effectively and improving the briefing process. Moreover, powerful prototype software called the BDManager was produced to overcome the limitations of the developed protocol and facilitate its use by client organisations, decision makers, design team and construction professionals.

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Ayman Ahmed Ezzat Othman

Value & Risk Management in construction

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Value & Risk Management for Dynamic Brief Development in Construction

Value and Risk Management in Construction

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بسم الله الرحمن الرحيم

IN THE NAME OF ALLAH

MOST GRACIOUS, MOST MERCIFUL

عن أبى هريرة رضي الله عنه أن رسول الله صلى الله عليه و سلم قال:

((من سلك طريقاً يلتمس فيه علماً سهل الله له به طريقاً إلى الجنة))

رواه مسلم

On the authority of Abu Huraira (May Allah be pleased with him) that Allah's messenger (may the blessing and peace of Allah be upon him) said:

Whosoever follows a path to seek knowledge therein, Allah will make easy for him a path to paradise.

It was related by Muslim

Client satisfaction was identified as one of the most significant challenges facing today's construction industry. It was considered as a key measure for construction projects success. This perspective stemmed from the pivotal role played by clients as the core of the construction process and the driving force for improvement, hence, necessitated the importance to achieve their satisfaction and get their requirements accomplished. Clients are most likely to be satisfied when two requirements have been fulfilled. Firstly, by translating their requirements into a design that specifies technical characteristics, functional performance criteria and quality standards. Secondly, by completing the project on time, as specified and in the most cost effective manner to produce a product that matches or exceeds their expectations.

Because of its vital role in eliciting and communicating client's requirements to the design and construction teams, the briefing process represents a cornerstone for achieving client satisfaction. In addition, effective client briefing is crucial to the attainment of client objectives with respect to time, cost and quality, where inadequate briefing is considered as a key source of client dissatisfaction and the reason why buildings have been wasteful of resources or defective in use. For this reason, the briefing process has to be flexible, well organised, and responsive to the client requirements.

During the course of this research, formal observations, literature review, analysis of 36 case studies, documentary data and unstructured interviews with projects' architects undertaken by the author showed that very few buildings finished on time or at the right cost and clients often criticise the fact that the finished buildings were not what they expected. In addition, the construction industry was blamed of providing products that do not achieve clients' requirements and meet their expectations. Furthermore, it was articulated that clients' organisations used change orders to achieve their emerging requirements and adapt to the influence of the internal and external brief development drivers. This is attributed to the limitations of the current briefing theories, which confine the development of the project brief to a certain stage. This approach hinders the interaction between the client and the designer since client's ideas develop and mature as the design alternatives unfold. In addition, it impedes exploiting value opportunities and managing risk threats caused by brief development drivers.

Because of the importance to overcome the limitations of the current briefing theories and their consequences as an approach to enhance the performance of the construction process, this research presented the Dynamic Brief Development concept. This concept supports and encourages brief development throughout the project life cycle as the way to achieve client satisfaction, respond in an innovative manner to the different influences of the brief development drivers, manage change orders effectively, and improve the briefing process. The Dynamic Brief Development concept was built on four principles: First, the briefing process has to be deemed as an ongoing process extending throughout the project life cycle. Second, the project brief has to be considered as a live document continually developing and adapting in an innovative manner to the brief development drivers. Third, feeding back client organisation, design and construction teams with learned lessons and comments of the facilities management team and end users will enhance the performance of the briefing process in future projects. Finally, a system to manage brief development has to be set out as early as possible. Five milestones were identified to evaluate brief development throughout the project life cycle. These milestones are at the end of the feasibility stage, the end of the detailed proposal stage, the end of the tender action stage, the end of the construction to practical completion stage, and the last milestone at the practical completion stage.

In order to support the Dynamic Brief Development concept and ensure its successful implementation, it was necessary to construct a complete perception of the drivers that lead to brief development. The research identified 47 brief development drivers from literature review and analysis of 36 case studies. Many of the drivers identified by literature review were confirmed by case studies and new drivers were added which reflected the culture and traditions of the surveyed society. All drivers were reviewed on regular basis to omit repeated ones and merge similar drivers. This resulted in identifying 30 brief development drivers. These drivers were analysed quantitatively and qualitatively to identify the most influential ones, establish the relationship between them, and a theme to classify them as internal, external and internal and external drivers was developed. Moreover, a relationship matrix between the brief development drivers and the project team members was established in order to identify the originators of brief development, value sources and risk sources to the project from the client point of view.

Permitting brief development throughout the project life cycle without establishing the procedures that control its development leaves the project brief uncontrolled and jeopardise the achievement of clients satisfaction. This necessitated the need to develop a system that is capable to manage brief development for the benefit of the client. Since brief development either add values or risks to the project or could add both, the well-established methodologies of value management and risk management were the most appropriate tools to manage dynamic brief development. Because of the obvious benefits of their integration since better value could not be achieved unless associated risks have been managed, both methodologies were integrated to formulate the Value and Risk Management Protocol (VRMP). The developed protocol is an innovative decision making tool designed to enable clients' organisations and construction professionals adopt the proper decision to develop and manage brief development. It consisted of four steps: identifying problem, structuring objectives, scrutinising alternative solutions, and adopting development decision. Due to the time consumption experienced during the application of the protocol on a real case study and the need to manage large amount of information used, it was essential to utilise the benefit of information management and information technology to overcome these limitations. The VRMP was encapsulated in a computer-based application called the Brief Development Manager (BDManager) prototype software. The produced prototype acts as a tool to expedite the implementation of the structured steps of the VRMP in a computer based environment and facilitated collecting, verifying, organising, storing, retrieving, sharing and updating live project information database. In addition, it facilitated inquiring, viewing and printing reports of projects information. The BDManager prototype software was applied on real case studies and evaluated by its users. Evaluation results are encouraging and end users recommended the use and adoption of the produced software as an innovative IT tool for managing dynamic brief development in construction.

DEDICATION

To My Parents,

My Father and Mother-In-Law,

My Beloved Wife Asmaa, And Our Children

Anas, Youssef And Basma.

I Owe So Much, For Their Infinite Love, Care, Support, Encouragement, And Patience.

May Allah Reward Them For Their Good Deed, Amen.

The Author

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Chapter 1

Introduction

1.1 Introduction

This chapter introduces the research reported in this thesis. It describes the background and rationale to the research as well as its aim and objectives. In addition, an overview of the research methodology and the research work done are presented. Moreover, this chapter establishes the originality and achievements of the research. Finally, a guide to the thesis is presented. It includes descriptions of chapters' contents and a flow chart of the thesis structure.

1.2 Background and Rationale to the Research

Achieving client satisfaction was identified as a key factor to measure construction project success (Parfitt and Sanvido, 1993) and one of the most important challenges facing the construction industry in the 1990s (Torbica and Stroh, 2001). The increasing recognition that clients are the core of the construction process and the driving force for improvement revealed the importance of achieving their satisfaction (Bennett et al., 1988; Latham, 1994; Egan, 1998; Kamara et al., 2000). Two sets of requirements have to be fulfilled in order to achieve client satisfaction. Firstly, to get client needs translated into a design, which specifies technical characteristics, functional performance criteria and quality standards. Secondly, to get the project completed within a specified time and in the most cost effective manner (Bowen et al., 1999). Clients are most likely to be satisfied when the final product matches or exceeds their expectations (Ahmed and Kangari, 1995; Hudson, 1999).

The briefing process represents a cornerstone in achieving client satisfaction. This could be attributed to the pivotal role it plays in eliciting and communicating client requirements to the design and construction teams. In addition, an effective client briefing is crucial to the attainment of client objectives with respect to time, cost and quality, where inadequate briefing was highlighted as a key source of client dissatisfaction (Latham, 1994). Furthermore, the inefficiency of the briefing process was defined as the reason why buildings have been wasteful of resources or defective in use (Jenks, 1988). According to Kelly et al. (1992) the most critical factors in determining client satisfaction with a building project are the concept brief and the selection of the project team who will design and construct the building. Smith et al. (1998) stated that the briefing process has to be flexible, well organised, and responsive to client and stakeholder needs and objectives to provide more effective, efficient, innovative and better solutions.

What mentioned above is the ideal case, but what happens in reality is relatively different. During the course of this research, formal observations, literature review, analysis of 36 case studies, documentary data and unstructured interviews with projects' architects undertaken by the author showed that very few buildings finished on time or at the right cost and clients often criticise the fact that the finished buildings were not what they expected (Othman et al., 2004a). This view was emphasised by others such as Barrett and Stanley (1999) and Kamara et al. (1999). In addition, there is widespread dissatisfaction within the clients community with the extent to which the construction industry delivers facilities that fully meet their requirements or provides appropriate buildings for its clients (Chinyio et al., 1998; Smith et al., 1998). Furthermore, it was articulated that clients' organisations used change orders to achieve their emerging requirements and adapt to influential internal and external drivers, such as exploiting new business opportunities and installing an improved technological systems not available during the brief and design stages (Burati et al., 1992; Gardiner and Simmons, 1992; Hansen, 1994; Bates, 1996; Chapman, 1997; O'Brien, 1998; PMI, 2000).

This is attributed to the limitations of the current briefing theories, which confine the development of the project brief to a certain stage. This perspective obstructs the interaction and communication between the client and the designer since client’s ideas develop and mature as the design alternatives unfold. In addition, it inhibits the incorporation of the influential internal and external drivers that lead to brief development.

The rationale and motivation for this research stems from the need to improve the efficiency of the construction industry through improving the briefing process. Because of its pivotal role in achieving client satisfaction, the need for improvement has led to focus on the limitations of the current briefing process and propose the appropriate approaches to enhance its performance. The research obtains its significance from the importance to achieve client satisfaction, the need to utilize value opportunities and manage risk threats associated with brief development drivers, the desire to manage project change orders effectively, and improve the briefing process.

1.3 The Aim and Objectives of the Research

The aim of this research has emerged from the need to overcome the limitations of the current briefing process. The research established that these limitations could be overcome by permitting and managing the development of the project brief throughout the project life cycle. This approach will enable the construction industry achieve client satisfaction, respond to different brief development drivers, manage change orders effectively, and improve the briefing process. Since brief development either add value or risk to the project or could add both, the two well methodologies of value management and risk management were integrated within this research to formulate the protocol that will manage brief development. In addition, the benefits of information management and information technology were utilised to support and facilitate the use of the developed protocol.

The aim of this research is summarised as developing an innovative protocol integrating value and risk management to manage dynamic brief development in construction and producing a software tool to facilitate its use. In order to achieve this aim the following objectives were developed.

(1) Building a clear understanding of client satisfaction, the briefing process and managing change orders in construction.
(2) Identifying, validating, quantifying, and classifying brief development drivers.
(3) Investigating the perception of the dynamic brief development concept, the existing approaches to manage brief development and identifying their limitations.
(4) Investigating the originators of brief development, the value sources and risk sources to the project from the client's point of view.
(5) Reviewing the value and risk management methodologies, the existing approaches for their combination and identifying their limitations.
(6) Developing the Value and Risk Management Protocol (VRMP).
(7) Producing the prototype software of Brief Development Manager (BDManager).
(8) Evaluating the Brief Development Manager.

1.4 Overview of the Research Methodology

The methodology adopted throughout this research was devoted to achieve the research aim and objectives. Based on the revision and analysis of the research process, the different research approaches, and the factors used for selecting the research methodology, this research was descriptive in nature and adopted the applied research approach. Quantitative and qualitative methods were used for data collection and data analysis. The research methodology adopted consisted of four activities: (1) data collection, (2) data analysis, (3) action required, and (4) reliability and validity. These activities were considered as a concurrent process rather than sequential steps. In an endeavor to ensure that the adopted methodology and methods will achieve the research aim and objectives, the relationship between the research objectives and the research methods were established.

Data collection was done using different sources and methods to achieve certain objectives. This concept was known as triangulation, which increased the reliability and validity of data findings. The methods used for data collection were observation, literature review, survey questionnaire, interview, case study and documentary data. The sampling methodology for case study, survey questionnaire, and interview selected a representative and non-biased sample to escalate the reliability and validity of findings. Representativeness and non-bias were achieved by adequately covering all population categories and applying random probability sampling methods.

Data analysis was carried out quantitatively and qualitatively. For the quantitative analysis approach, measuring the central tendency and dispersion, relative importance index ranking technique, and the linear relationship between drivers using Bivariate analysis were used. For the qualitative approach, the process of preparing and analysing qualitative data was established.

During this research many actions were taken in order to meet the research aim and objectives. These actions vary from using other data sources to validate collected data, to selecting an appropriate analysis technique, or designing a questionnaire to quantify the brief development drivers for instance.

Reliability and validity was the last activity of the research methodology. Both concepts were built in the heart of the research methodology and had a vital role in making sure that the methods used and the research findings gained were reliable and valid. This was achieved through applying certain course of actions and defined procedures.

1.5 Overview of the Research Work Done

After the introduction of the research background and rationale, the formulation of the research aim and objectives, as well as the establishment of the research methodology, it is necessary to present an overview of the research work done. Throughout this research, the work performed was targeted to achieve the research aim and objectives in the light of the methodology adopted.

In order to overcome the limitations and deficiencies of the current briefing process, this research introduced the concept of Dynamic Brief Development (DBD). This concept supports developing the project brief throughout the project life cycle. It was built on four principles:

(1) The briefing process has to be deemed as an ongoing process extending throughout the project life cycle responding in an innovative manner to emerging client requirements, meeting user needs, coping with regulatory changes, exploiting business opportunities,

adapting to technology improvement, adding more values, and managing associated risks.

(2) The project brief has to be considered as a live document, which needs to be continually developed throughout the project life cycle.

(3) Feed back to the client organisation and the design and construction teams with comments and learned lessons from the facilities management team and end users will enhance the performance of the briefing process in future projects.

(4) A system to manage the brief development drivers is required. This system must respond to these drivers in a way that adds value and manages associated risk in an endeavor to achieve client satisfaction and manage project change orders.

In addition, The Dynamic Brief Development concept identifies five milestones to evaluate brief development throughout the project life cycle. These milestones are at: (1) the end of the feasibility stage, (2) the end of the detailed proposals stage, (3) the end of the tender action stage, (4) the end of the construction to practical completion stage, and (5) the practical completion stage (Othman et al., 2004a).

Achieving client satisfaction necessitated the importance to identify the drivers that lead to brief development. Different research methods were used to improve the reliability and validity of the collected data and increase the background knowledge. Formal observations recorded both clients' dissatisfaction with the final product as not meeting their expectation and the increasing number of change orders used throughout the project life cycle. Literature review identified a group of brief development drivers, while analysis of 36 recently completed construction projects confirmed the identified drivers and added new ones. The new drivers reflected the culture and tradition of the surveyed society. The case studies were collected from the United Arab Emirates construction industry. Brief descriptions of the research locality and environment as well as the authority, which constructed these projects, are attached in appendix (A). Literature review and case studies identified 47 brief development drivers. These drivers were reviewed and refined on a regular basis in order to omit repeated drivers and merge similar ones. The end result was a list of 30 brief development drivers. In order to complete the picture of the brief development drivers throughout the project life cycle, documentary data was investigated to collect information about the project history and the development of project brief at different stages. Moreover, unstructured interviews were undertaken with the projects' architects to investigate the way in which the project brief was developed. Because of the importance of quantifying these drivers in order to explore the most influential ones, a survey questionnaire was designed and issued. Then, a three-stage data analysis approach was used to analyse the questionnaire responses. Firstly the measure of central tendency was carried out to get some overall measure of the typical value for each variable, where measure of dispersion was used to know how homogeneous or heterogeneous the collected data is. Secondly, the well-established relative importance index was used to rank drivers according to their importance on developing the project brief. Finally, the Bivariate analysis was used to investigate the correlation between the different drivers through the creation of a correlation matrix.

Permitting brief development throughout the project life cycle without establishing the procedures and drawing the boundaries which control that development leaves the project brief uncontrolled and jeopardise the achievement of clients objectives and satisfaction. This necessitated the need to develop a system that is capable to manage brief development for the benefit of the client. Since brief development either add values or risks to the project or could add both, the well-established methodologies of value management and risk management were the most appropriate tools that could manage brief development in construction. Because of the obvious benefits of their combination, both disciplines have been integrated to form the basis of the Value and Risk Management Protocol (VRMP). Information management and information technology supported the protocol in terms of collecting, verifying, classifying, storing, retrieving, sharing and updating information. The developed protocol overcame the pitfalls and shortcomings of the existing approaches for both combining value and risk management as well as managing change orders, and it represented a real contribution to the original body of knowledge as an innovative approach to manage brief development in construction projects.

Because of the time consuming experienced during the application of the protocol on a real case study and the need to manage large amount of information used, the Value and Risk Management Protocol was encapsulated in computer based prototype software called Brief Development Manager (BDManager). The produced prototype was applied on case studies and was evaluated by its users. Analysis of evaluation was encouraging and recommended the use of the prototype software.

1.6 Research Originality and Achievements

Chambers English Dictionary (1990) defined original as not derived, copied, imitated or translated from anything else; novel; creative; independent in invention. Philips and Pugh (1994) pointed out that, in the context of Ph.D., an original contribution to knowledge is a very shaded term: “It does not mean an enormous breakthrough which has the subject rocking on its foundation”. In Kuhn’s

(1996) terms, Ph.D. is unlikely to involve a 'Paradigm shift' in the study discipline. Instead, Philip and Pugh suggested, it demonstrates that the researcher has a good grasp of how research is normally done in the study field. This means making a synthesis that has not been made before, using known materials but with a new interpretation, bringing new evidence to bear on an old issue, and adding to knowledge in a way that has not been done before. The originality and achievement of this research could be summarised as:

(1) Adding new contribution to the original body of knowledge could not be achieved unless the state of the art has been reviewed and the pitfalls of the prevalent perceptions and shortcomings of the current practices were identified. Selection of the research subject and identification of the research question were derived initially from the researcher observations and practical experience. Then, in depth literature review supported by the use of different research methods resulted in formulating the research problem, which could be identified as managing dynamic brief development in construction.

(2) Accordingly, the research aim and objectives were defined and the research methodology and methods adopted to achieve this aim and accomplish these objectives were described in detail.

(3) The research was innovative in introducing the Dynamic Brief Development concept with its objectives, underlying principles and milestones to the construction industry for the first time. The new concept developed by this research encouraged developing the project brief throughout the project life cycle in order to achieve client satisfaction and enhance the project performance. In spite of, the existing ideas which called for allowing the briefing process to be ongoing process, the subject was not covered in the literature review in a comprehensive perspective as done by this research.

(4) The research identified a complete list of 30 brief development drivers. Analysis of 36 case studies validated the drivers extracted from literature review and added new drivers. These drivers were not covered by literature review and reflected the culture and tradition of the surveyed society of the United Arab Emirates. Quantitative and qualitative analysis of these drivers were carried out to quantify their impacts on developing the project brief and investigate the correlation between each others. A holistic approach to classify the brief development drivers was developed by this research.

(5) Because of the increasing awareness of its role as a key factor to measure construction project success, the research focused on client satisfaction as one of the important areas that was not covered well in the construction literature and highlighted the importance to learn from other disciplines that are more focused on client satisfaction during its products development. The research emphasised that client satisfaction could be achieved through delivering an attractive

quality products or services that meet or exceed clients' expectations within a specified time and at the most cost effective manner. In addition, the research developed a relationship matrix between the brief development drivers and the project team members. This new matrix will enable client's organisations and construction professionals identify the brief development originators, value sources and risk sources form the client's point of view.

(6) Contrary to the existing perception of the construction industry, the research adopted a new interpretation that change orders do not always have negative impacts on project's cost, time and quality. Literature review and analysis of case studies showed that change orders may have positive impacts on construction projects in terms of responding to emerging client requirements, meeting user needs, coping with regulatory changes, exploiting business opportunities, adapting to technology improvement, adding more value, and managing associated risks. The research sustained and supported the idea that change orders are useful to the project and their positive impacts should be utilised. Extensive review of the existing approaches for managing change orders was carried out and their limitations were identified.

(7) The research supported the integration of value management and risk management as two complementary disciplines since best value could not be achieved unless associated risks have been managed. Literature review showed little progress in developing an integrated approach of value management and risk management. Critical examination of the existing approaches for their combination was undertaken and their limitations were identified.

(8) Although, the two disciplines used to formulate the value and risk management protocol are well established, value management and risk management were used for the first time to develop an innovative protocol integrating the two disciplines to manage dynamic brief development in construction. The research moved a step ahead from the theoretical discussion of their combination toward applying the integrated tool to solve real construction problems. The benefits of information management and information technology were used to support to the designed protocol. Furthermore, different techniques such as Simple Multi Attribute Rating Technique (SMART) were employed to construct the proposed protocol. This protocol avoided the pitfalls and shortcomings of the different approaches used for managing change orders and combining value and risk management and answered questions suggested by them.

(9) In order to facilitate the application of the value and risk management protocol, save the time required for its implementation, and manage the large amount of information used, the research produced an innovative, reliable and validated prototype software named the Brief Development Manager (BDManager). The Brief Development Manager is a powerful tool that helped construct a live database for the project brief developments and facilitated

archiving, classifying, sharing, storing, retrieving, and updating brief development information.

(10) The research resulted in producing a number of publications. Two journal papers were submitted for publication whereas other two papers are being developed.

The above explained how the research subject was selected and demonstrated in detail how the research was done. In addition, the research discussed current practice and used techniques and identified their limitations and presented new interpretations to enhance their performance. Furthermore, the research utilised established methodologies and techniques to formulate an innovative protocol and produce prototype software which were not done before. The developed protocol and prototype were applied on real case studies in order to present to the industry a reliable and validated tool.

1.7 Guide to the Thesis

The thesis comprises nine chapters. A brief summary of each chapter's contents is presented below followed by a flow chart of the thesis structure. The flow chart shows the development of the research process and the different activities undertaken to achieve the research aim and objectives. In addition, it shows the relationship between research activities and thesis chapters, see figure (1.1).

Chapter 1: Introduction

This chapter contained a background and rational to the research. In addition, it established the research aim and objectives and presented the methodology adopted to achieve the research aim and objectives. Furthermore, an overview of the research work done as well as the research originality and achievements were provided. Finally, a guide to the thesis was presented. It described chapters' contents and a flow chart of the thesis structure.

Chapter 2: Research Methodology

This chapter explained the research methodology adopted to achieve the research aim and objectives. Brief descriptions of the research process and research approaches were carried out. In addition, the factors used for choosing the research methodology were established and the relationship between the research objectives and research methods was stated in order to ensure that each objective was achieved using the appropriate method. Finally, detailed descriptions of the different activities of the research methodology and selected methods were presented.

Chapter 3: Dynamic Brief Development to Achieve Client Satisfaction in Construction

This chapter is devoted to support the research argument, which states that permitting, and managing brief development throughout the project life cycle is the way to overcome the limitations of the current briefing process. This chapter aimed to achieve the first and third objectives of this research. It focused on building a clear understanding of three important and interrelated issues: client satisfaction, the briefing process, and change orders in construction. It comprised an overview and importance of client satisfaction, definitions, revision of concepts used in other more customer focused disciplines. Guidelines for achieving and improving customer satisfaction were highlighted. In addition, this chapter critically reviewed the current theories relating to brief development and identified their limitations, while the dynamic brief development concept as an approach to overcome these limitations was introduced. Furthermore, client satisfaction and change orders in construction were discussed in this chapter. It comprised definitions of related terms, different types of changes, clarifications of change terms used throughout the project life cycle, and change order procedures. The impacts of change orders, the existing approaches to manage change orders in construction, and limitations of the existing approaches were identified.

Chapter 4: Value Management and Risk Management in Construction

This chapter is focused on establishing the basis and setting the rules that control and manage brief development in construction. It aimed to achieve the fifth research objective. It examined the application of value management and risk management in construction and investigated the possibility of their integration. This was achieved by carrying out extensive literature review of value management and risk management, critical investigation of the possibility and argument of their integration, as well as comparison between both disciplines. Finally, the existing approaches for integrating value and risk management were studied and their limitations were identified.

Chapter 5: Drivers for Dynamic Brief Development in Construction

This chapter aimed to support the Dynamic Brief Development concept and ensure its successful implementation through constructing a complete perception of the drivers that lead to brief development. This chapter was devoted to achieve the second and fourth objectives of this research. It focused on identifying, validating, quantifying, and classifying the brief development drivers as well as identifying the originators of brief development, value sources and risk sources to the project from the client' point of view. Firstly, literature review and case studies were used to identify and validate the brief development drivers, where documentary data and unstructured interviews were used to collect information about the project history and the project brief at different stages as well as investigate the way in which the project brief was developed. Secondly, a survey questionnaire was used to quantify the influences of the identified drivers on developing the project brief. Measure of central tendency and dispersion, relative importance index and Bivariate analysis were used to analyse the questionnaire responses. Thirdly, the research developed a holistic approach to classify the brief development drivers as internal, external, and internal and external drivers. Finally, a relationship matrix between the brief development drivers and the project team members was created in order to identify the originators of brief development, the value sources and risk sources to the project from the client's point of view.

Chapter 6: The Value and Risk Management Protocol (VRMP)

This chapter is intended to sustain the Dynamic Brief Development concept and facilitate its application through achieving the sixth research objective. It represented the Value and Risk Management Protocol (VRMP) designed by this research to manage dynamic brief development in construction. It comprised, the need for the protocol, its aims and objectives, and the key principles behind the protocol. In addition, the conceptual description of the protocol was presented and a revision of models, modelling process and tools were carried out. Furthermore, the functional representation and contents of the protocol were described and in order to show how the VRMP will be implemented, the protocol was applied on a real case study. Finally, the benefits and limitations of the protocol were identified.

Chapter 7: The Brief Development Manager (BDManager) Prototype Software

This chapter is devoted to overcome the limitations of the Value and Risk Management Protocol, facilitate its use and increase its efficiency as an innovative decision making tool for managing dynamic brief development in construction. This was achieved through presenting the produced prototype software of Brief Development Manager (BDManager), the seventh research objective. Because of the importance of information management and information technology in supporting the proposed prototype, the role of both disciplines in managing brief development was illustrated. This chapter comprised detailed description of the prototype software. It included the objectives and features of the BDManager, different types of developing prototypes, development of BDManager using Microsoft Access, system architecture for the prototype, development of database objects as well as illustrating the use of the BDManager in managing dynamic brief development.

Chapter 8: Evaluation of the Brief Development Manager Prototype Software

This chapter is focused on examining the effectiveness of the produced prototype, assessing its performance, and investigating ways for its improvement. This chapter aimed to achieve the last objective of this research, which is evaluating the Brief Development Manager. Evaluating the prototype was carried out by answering three questions: what to evaluate? how to evaluate? and when to evaluate?. In order to investigate its effectiveness and capability to deal with different brief development problems as well as providing substantial comments and feed back, the Brief Development Manager was applied on real case studies. The prototype helped the study team adopt the proper decision to manage brief development. Because of their importance, the reliability and validity of the Brief Development Manager in terms of development methods and findings were discussed and procedures used to escalate the reliability and validity of the prototype were illustrated. At the end of this chapter the user comments, feedback and recommendations for improvement were summarised.

Chapter 9: Conclusions and Recommendations

This is the last chapter of this thesis. It concluded the research work undertaken to develop an innovative protocol integrating value and risk management to manage dynamic brief development in construction and produce a software tool to facilitate its use. It comprised the conclusions and contribution to original knowledge and the research recommendations for the industry and further research.

1.8 Conclusions

The rationale and motivation for this research stems from the need to overcome the limitations of the current briefing process that confine the development of the project brief to a certain stage. This perspective hinders the achievement of client satisfaction due to the lack of interaction between the client and designer. In addition, it impedes exploiting value opportunities and managing risk threats derived by brief development drivers. The research proposed that overcoming the limitations of the current briefing process could be achieved by permitting and managing project brief development throughout the project life cycle. So, emerging client requirements could be achieved and the performance of the project could be enhanced. Since brief development either add value or risk or could add both to the project brief, the two well-established methodologies of value management and risk management were the most appropriate disciplines to form the basis of the value and risk management protocol developed by this research to manage dynamic brief development. The above discussion enabled formulating the research aim as developing an innovative protocol integrating value and risk management to manage dynamic brief development in construction and producing a software tool to facilitate its use. A set of sub objectives was generated to achieve this aim. The research methodology adopted to achieve the research aim and objectives consisted of four concurrent activities of: (1) data collection, (2) data analysis, (3) action required, and (4) reliability and validity. Quantitative and qualitative methods were used for data collection and data analysis. In addition, different actions were taken in order to achieve the research aim and objectives. Because of their importance, the reliability and validity concepts were built in the heart of the research methodology and played an important role in ensuring that the methods used and the research findings gained were reliable and valid. The work carried out during this research aimed to overcome the limitations of the current briefing process. The Dynamic Brief Development concept was presented. This concept encourages the development of the project brief throughout the project life cycle and aimed to achieve client satisfaction, facilitate an innovative response to the brief development drivers, manage project change orders effectively, and improve the briefing process. In addition, 30 brief development drivers were extracted from literature review and analysis of 36 case studies. These drivers were analysed to identify the most influential ones and a theme was developed to classify them as internal, external and internal and external drivers. Moreover, the originators of brief development, value sources and risk sources to the project from the client's point of view were identified. Furthermore, since permitting the development of the project brief necessitates the need for a system to manage and control its development. The research developed an innovative system called Value and Risk Management Protocol (VRMP). This protocol integrated value management and risk management and used different techniques to achieve its objectives. Furthermore, because of the time consumption experienced during the application of the protocol and the large amount of information used, it was necessary to utilise the benefits of information management and information technology. The developed protocol was encapsulated in a computer-based application called the Brief Development Manager prototype software. The produced prototype facilitated the implementation of the VRMP in a computer based environment and facilitated collecting, verifying, organising, storing, retrieving, sharing and updating live project information database. The prototype software was applied on real case studies and then evaluated by its users. Results of the evaluation are encouraging and end users recommended the use and adoption of the produced software. In addition to the above, this chapter stated the research originality and its achievements. Furthermore, a brief summary of thesis chapters' contents was presented. This was followed by a flowchart described the development of the research process and showed the relationship between the research activities and thesis chapters.

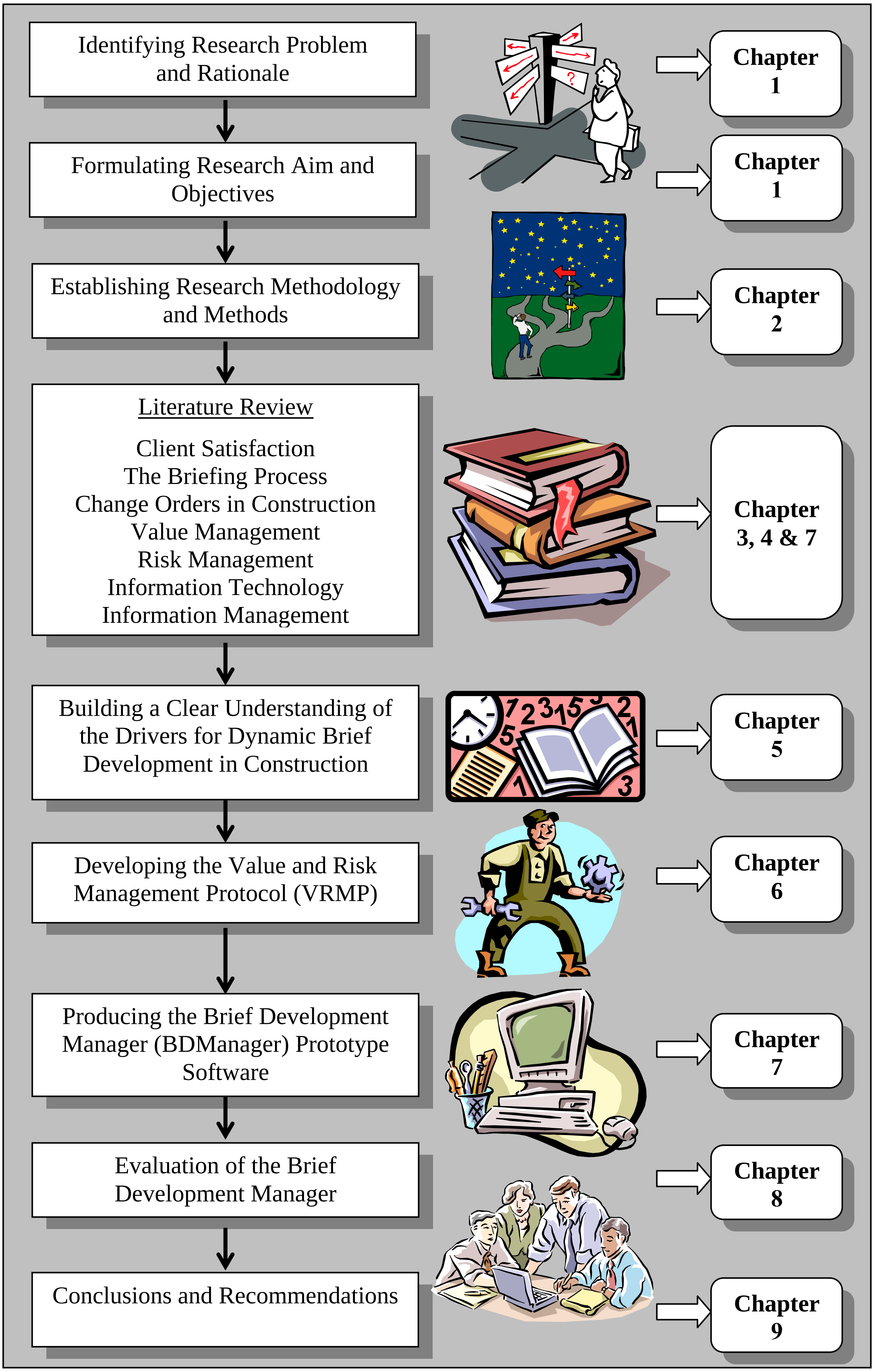


Figure 1.1 The Thesis Structure

Chapter 2

Research Methodology

2.1 Introduction

This chapter explains the research methodology adopted to achieve the research aim and objectives. Because of the importance to understand the research process and the need to select the appropriate approach for this research, brief descriptions of the research process and research approaches were made. In order to make sure that the most suitable research methodology was selected and that every objective was achieved using the appropriate method, the factors used for choosing the research methodology were established and the relationship between the research objectives and the research methods was portrayed. Finally, an elaborated description of the different activities of the research methodology and selected methods was discussed in great detail.

2.2 The Research Process

2.2.1 Definitions

The research process could be defined as a systematic investigation to establish facts or principles or to collect information on a subject using defined methods or series of actions (Collins English Dictionary, 1993).

2.2.2 Steps of the Research Process

There are different types of research and hence, different approaches to it. Although, different approaches suggest different steps, most seem to follow a similar process as follows:

(1) Choose a general topic.
(2) Focus project or area of interest within a theory.
(3) Design a study.
(4) Collect data.
(5) Analyse the data.
(6) Interpret findings and draw conclusion.
(7) Inform others in a report.

The seven steps simplify the research process and represent the necessary activities to be undertaken. Researchers rarely wait for one step to finish before they start the next one. Rather, the steps blend into each other and overlap. Often a later step stimulates reconsideration of a previous one. In addition, the research process does not end when one comes to the end of step seven. Research is an ongoing process. Each research project builds on prior research and contributes to a large body of knowledge (Neuman, 1994; Nachmias and Nachmias, 1996).

2.2.3 Research Approaches

The reason for conducting research can be classified into groups on the basis of (1) what the research is trying to accomplish and (2) how it will be used. For the first approach, research could be classified to exploration, description and explanation where on the second approach, research could be classified to basic and applied.

2.2.3.1 Exploration Approach

The exploration research approach is used when a new topic or issue is explored and more information is required to learn more about it. The less developed an area, the more likely that exploration should be the approach used. Exploration research is less structured allowing researchers to seek out new insight, ask questions, and assess phenomena in a different perspective. It could be the first stage in a sequence of studies (Adams and Schvaneveldt, 1991). A researcher may conduct an exploratory study in order to know enough to design and execute a second, more systematic, or extensive study. Exploratory research needs creativity, investigative stance, open mind, and exploring all sources of information. It addresses the "what" question and uses qualitative techniques because they are less wedded to a theory or research question, as well as more open to using many types of evidence and discovering new issues (Neuman, 1994; Robson, 2002).

2.2.3.2 Description Approach

In descriptive research a researcher begins with a well–defined subject and conducts research to describe it accurately and portray an adequate profile of persons, events, or situations. It requires intensive previous knowledge of the problem or situation to be researched or described (Robson, 2002). This is in contrast to the exploratory study in which this assumption is not made. A large amount of research, especially applied research is descriptive. The descriptive research is not interested in exploring new issues or explaining why something happens. Descriptive research focuses on the "how" and "who" questions. Qualitative and quantitative techniques are used to undertake descriptive research (Adams and Schvaneveldt, 1991; Neuman, 1994).

2.2.3.3 Explanation Approach

Explanatory research explains or answers the "why" question. It provides the reasons for something to occur and builds on exploratory and descriptive research. It reaches beyond giving focus to a topic or providing a picture of it and moves to examining the reasons for why it exists or operates in the way it does. Experimental work, qualitative and quantitative techniques are used to undertake explanatory research (Neuman, 1994; Robson, 2002).

2.2.3.4 Basic Approach

Basic research is a research that advances fundamental knowledge about the world. It focuses on refuting or supporting theories that explain how the world operates. Basic research is the source of most new scientific ideas and ways of thinking about the world. It can be exploratory, descriptive or explanatory; however exploratory research is the most common.

2.2.3.5 Applied Approach

Applied research attempts to solve specific problem or help practitioners accomplish a task. It usually focuses on specific situation or answers a particular question. Theory is usually less central in applied research. It is frequently descriptive research, and its main strength is its immediate practical use and helping people take decisions (Neuman, 1994).

2.3 Research Methodology and Methods

2.3.1 Definitions

Research methodology was defined as the philosophy, system of methods and principles used in a particular discipline. It is the branch of philosophy concerned with the science of methods. Where methods were defined as the way, techniques or arrangement of processing or doing something especially systematic or regular one for a particular field or subject. In the research context methodology may be perceived as the overall method to satisfy the aim of the investigation (Hall and Hal, 1996; Holt, 1998; Collins English Dictionary, 1993).

2.3.2 Choosing the Research Methodology

Choosing the research methodology was primarily evolved from two factors: (1) the specific research aim and objectives and how they could be achieved, (2) the research nature and characteristics (Holt, 1998).

2.3.2.1 The Research Aim and Objectives

This research aimed to:

Develop an innovative protocol integrating value and risk management to manage dynamic brief development in construction and produce a software tool to facilitate its use.

In order to achieve this aim the following objectives were developed.

(1) Building a clear understanding of client satisfaction, the briefing process and managing change orders in construction.
(2) Identifying, validating, quantifying, and classifying brief development drivers.

(3) Investigating the perception of the dynamic brief development concept, the existing approaches to manage brief development and identifying their limitations.
(4) Investigating the originators of brief development, the value sources and risk sources to the project from the client's point of view.
(5) Reviewing the value and risk management methodologies, the existing approaches for their combination and identifying their limitations.
(6) Developing the Value and Risk Management Protocol (VRMP).
(7) Producing the prototype software of Brief Development Manager (BDManager).
(8) Evaluating the Brief Development Manager.

2.3.2.2 The Research Nature and Characteristics

The research attempted to solve a practical problem and improve the existing practice of managing brief development in construction. This required collecting data from different sources using different techniques to identify the existing situation, formulate the research problem, investigate opinions and perceptions and identify the available models used to solve the problem and define their limitations. In addition, the research developed an innovative protocol integrating value management and risk management to solve the problem and then encapsulated it in a computer based prototype software as well as evaluated it to ensure its achievement of the research aim and objectives.

By comparing the research aim, objectives and characteristics with the aim, objectives and characteristics of the different research approaches described above, the research was descriptive in nature and adopted the applied approach to achieve its aim and objectives. Quantitative and qualitative techniques were used for data collection and analysis. The applied research approach adopts the following steps: (1) define the existing situation, (2) observe existing and potential for improvement, (3) develop improved model, (4) apply model, (5) observe effect of model, (6) improvement achieved, and (7) adopt improved model (Holt, 1998).

The above mentioned steps lie between three main activities namely, data collection, action required, and data analysis. The research methodology adopted to achieve the research aim and objectives consisted of these activities and added reliability and validity as an activity to be built in the other activities. These activities were deemed as a concurrent process rather than sequential steps, since analysing collected data, for instance, may entail collecting more data to validate a certain issue, see figure (2.1).

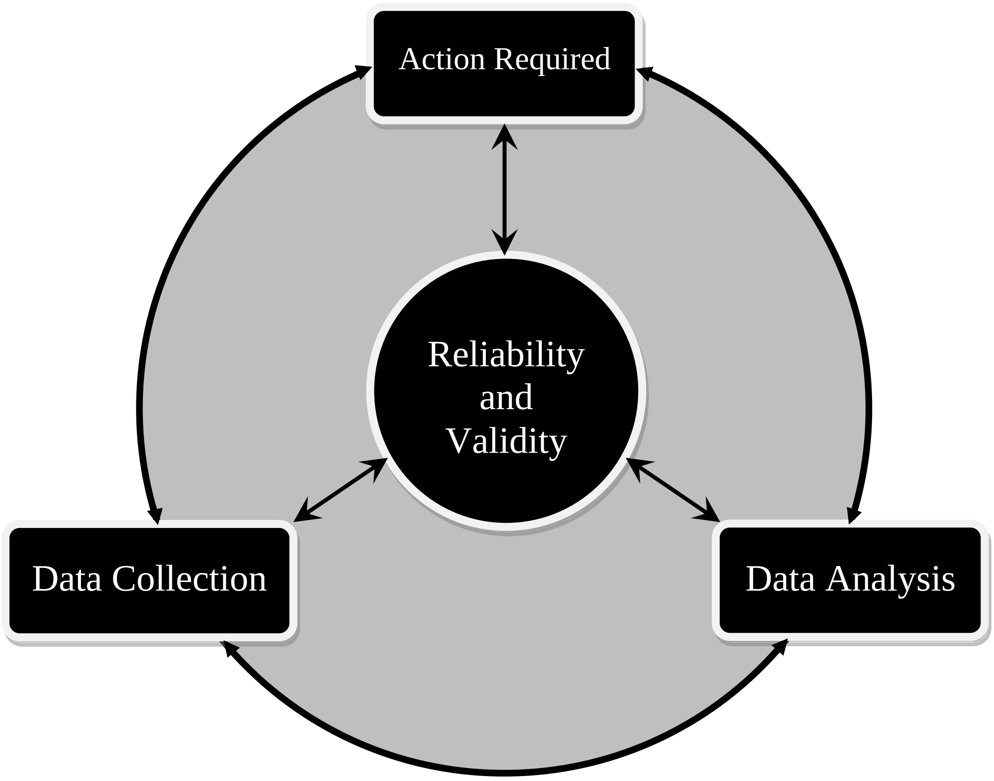


Figure 2.1 The Research Methodology

2.3.3 The Relationship between the Research Objectives and the Research Methods

It is essential to ensure that the adopted research methodology and methods achieved the research aim and objectives. This was done by making sure that every objective was assigned to the right method(s). The following table summarised the methods applied to address the specific research objectives.

Research Methods			Research Objectives							
			1	2	3	4	5	6	7	8
Data Collection Methods	Observation		*	*						
	Literature Review		*	*	*	*	*	*	*	*
	Case Study		*	*						*
	Documentary Data		*	*						
	Survey Questionnaire			*	*					*
	Interview	Unstructured Interview	*	*						
		Structured Interview			*		*			
		Group Interview				*				
Data Analysis	Quantitative	Measure of Central Tendency and Dispersion		*	*					*
		Relative Importance Index		*						
		Bivariate analysis		*						
	Qualitative		*	*	*	*	*	*	*	*

Table 2.1 The Research Methods Assigned to Achieve The Research Objectives

2.3.4 Data Collection

Data collection was a principal activity in the research process. Data was collected from different sources, using different methods to achieve certain objectives. This was known as "Triangulation" which increased the reliability and validity by verifying findings of data from one source with other sources. This strategy reduces the risk and bias associated with using specific methods (Maxwell, 1996). Selecting a method or methods to collect data was based on what kind of information was sought to achieve the research objectives, from whom, and under what circumstance (Robson, 2002).

Different quantitative and qualitative methods were used for data collection. Quantitative methods dealt with numbers and used statistical methods to explain the data, where qualitative methods dealt with words, described situations, processed and interpreted relationships. Both approaches were adopted for this research as there were no quantification without qualification and no statistical analysis without interpretation (Bauer and Gaskell, 2000). The quantitative methods used during the course of research were close-ended questions questionnaire, and structured interview. The qualitative methods used were: observation, literature review, case study, documentary data, open-ended questions questionnaire, unstructured interview, and group interview (brainstorming session) (Holt, 1998). The specific methods used for this research were:

2.3.4.1 Observation

Any improvement to an existing practice or knowledge cannot be properly considered until the existing conditions and problems were fully understood. Much of this understanding emanated from the literature search, but this in isolation was insufficient. A first and most simple complement to the literature search was observation (Holt, 1998). Edwards and Talbot (1996) mentioned that all good practitioner research started with observation.

In this research clients' dissatisfaction with the final product as not meeting their expectation was observed. In addition, the increasing number of change orders that were issued throughout the project life cycle was observed as well. Based on the different approaches for classifying observations either by degree of involvement, degree of discolour, nature of research settings, degree of control, formal and informal information gathering (Sedlack and Stanley, 1992; Baker, 1994; Robson, 2002), the researcher played a covert and participant role in the observation process using formal information gathering. These observations were made during regular construction site supervision visits and following up administrative office work and were recorded in a pre-designed form. A copy of the observation form is attached in appendix (B). In spite of the long time required for observation, this method enabled recording behaviour as it occurs without asking people about their views, feelings or attitude. In addition, it enabled the generation of firsthand data which are uncontaminated by factors standing between the investigator and the object of research (Nachmias and Nachmias, 1996; Robson, 2002).

2.3.4.2 Literature Review

Literature review was defined as the compilation and assimilation of as much information as can be discovered with respect to a given topic. It forms an important part of conducting academic research (Holt, 1998). An extensive literature review was undertaken to gather information in order to achieve the following objectives:

(1) Understanding of the research topic.

(2) Facilitating precise formulation of the research problem, aim and objectives.

(3) Assessing previous and related works in that field.

(4) Avoiding duplication of previous work.

During this research, literature review was considered as an ongoing process. Continues revision of published and unpublished works was carried out. Different sources were used for data collection to ensure that every work in that field was collected and reviewed. These sources included textbooks, professional Journals and magazines, conferences proceedings, organisations' publications, dissertations and theses, workshops and technical reports, CD-ROMs as well as the Internet. The literature review process followed could be divided to six stages:

(1) Defining the research topic.
(2) Defining research keywords.
(3) Selecting data resources.
(4) Scanning available materials.
(5) Examining relevant materials.
(6) Recording and classifying selected materials.

The research topic was identified in a broad spectrum based on the literature review, the researcher's observations and experience. Then key words such as brief, briefing process, brief development, brief development drivers, client satisfaction, change orders, managing change orders, value management, risk management, combining value and risk management were defined to focus the search process. The resources used to search for the key words were selected. These were academic journals, textbooks, professional magazines, conference proceedings, organisations' publications, dissertations and theses, workshop and technical reports, CD-ROMs as well as online database system and indices at Loughborough University, United Kingdom. Using advanced computer search database facilitated finding data relevant to the research topic. MetaLib online database system, which uses wide variety of resource, databases, opacs and e-journals, offered the facility to search for a keyword or a phrase in many databases simultaneously such as (BIDS, OCLC, Zetoc, and Compendex). Many of refereed papers were downloaded from their web sites. Electronic database systems of other institutions were contacted to collect relevant information included the United Arab Emirates University, Higher College of Technology and the Cultural Foundation, Abu Dhabi, United Arab Emirates as well as a number of Egyptian universities.

The data collected from the previous stages was scanned by reading their abstracts, keywords and contents. The relevant materials were selected for in depth reading. Information from the selected materials were recorded and classified. If the required materials were not available within the university's library, they were collected through the inter-library loan system. The process was repeated when any particular refereed paper referenced related papers. Collecting recent publications and latest editions of the relevant materials was a continuous process throughout the research period, which ensured that up to date knowledge, latest developments and relevant contributions to the study subject were captured. Materials quoted in the thesis were cited in the references and the others, which are close to the subject, were listed as a bibliography.

2.3.4.3 Survey Questionnaire

A questionnaire was defined as a set of written questions for respondents to complete themselves (Newell, 1993). It is a data gathering device that elicits from a respondent the answers or reactions to (pre-arranged) printed questions presented in a specific order (Adams and Schvaneveldt, 1991). In this research, the questionnaire survey was undertaken at two stages to achieve two distinct objectives. After the brief development drivers were extracted from literature review and case studies, the first questionnaire was issued to quantify the brief development drivers (Othman et al., 2004a). Secondly, after the prototype software of Brief Development Manager (BDManager) was produced, the second questionnaire was issued to evaluate the produced software. Copies of both questionnaires were attached in appendices (C) and (D) respectively.

❖ *Questionnaire Strategies*

In order to facilitate answering questions, achieve maximum response and improve success the following strategies were adopted:

(1) A covering letter introduced the questionnaire to the respondents, explained its objectives, assured that all information would be treated in the secrete confidence and thanked them for responding the questionnaire. Copies of the covering letters for both questionnaires were attached in appendices (E) and (F) respectively.

(2) Clear instructions were given at the outset of each question on how to complete it.

(3) The average time it would take to complete the questionnaire was determined during the pre-testing and was estimated to be 15 minutes.

(4) Each question was written in a manner that made it as simple, clear, and brief as possible. The pre-testing helped in determining effective wording of the questions.

(5) A room for additional information that could be added by respondents was provided (Denscombe, 1998; May, 1993).

(6) The researcher was present in most times when the respondents answered the questionnaire in order to clarify any question, which may arise, stimulate respondents to complete the questionnaire as well as collect the answered questionnaires when completed.

❖ *Types of Questions*

Two types of questions were used. First, the closed-ended questions, which allowed the respondent to select a single response from a list. Such list of responses covered the entire range of possible answers. This type of questions was easier and quicker to answer and responses were easier to be coded and statistically analysed. Second, the open-ended questions, which stated a question and left room for the respondent to write out an answer. Open-ended questions gave the respondents the opportunity to openly express their feels, beliefs, or provide recommendations. In addition, they allowed unanticipated findings to be discovered and permitted creativity, self-expression, and richness of details (Baker, 1994).

❖ *Preliminary Testing of A Questionnaire*

When a questionnaire draft was completed, it was essential to test it to determine its effectiveness and problems. This preliminary test was done with friends and colleagues who agreed to take the questionnaire. They were asked to answer the questions as if they were received from someone unknown and go through the questionnaire again to point out any problem they noted with questions. After going over the responses of the preliminary test and making changes, the questionnaire was ready for formal testing (Baker, 1994; Czaja and Blair, 1996).

2.3.4.4 Interview

The interview is one of the main data collection methods in research. It is a very good way of accessing people's perceptions, meanings, definitions of situations, and construction of reality. It was defined as a piece of social interaction with one person asking another a number of questions and the other person is giving answers (Punch, 1998). One of the real methodological difference between the use of questionnaire and interview is the interaction, which takes place between the researcher and the interviewee (Baker, 1994). During the course of this research, interview was carried out at three stages using three different types of interviews to achieve three distinct objectives. At the first stage, unstructured interviews were carried out with projects' architects while collecting data from case studies in order to investigate the way in which the project brief was developed. Secondly, after the brief development drivers were identified, structured interviews were conducted with design firms, constructors, and funding bodies to investigate their perceptions of the brief development concept and to identify the different techniques adopted to manage brief development. At the last stage, group interview (brainstorming session) was undertaken with clients' organisations to identify the originators of brief development, the value sources and risk source to the project from the client point of view (Othman et al., 2004a&b).

❖ *Types of Interview*

There are many types of interview. Patton (2002) distinguished between three main types of interview: the informal conversational interview, the general interview guide approach, and the standard open-ended interview. Minichiello et al. (1990), May (1993) and Robson (2002) classified interviews based on the degree of structure to: structured, semi-structured, and unstructured interview. Fielding (1996) used similar typology using the terms: standardised, semi-standardised, and non-standardised interview. From the research point of view, Punch (1998) based the classification on the research purpose to distinguish between three types of interview: structured interviews, group interviews, and unstructured interviews. The type of interview will influence the practical aspects of the interview and how the process could be managed. The interviews used in this research were:

(1) *Structured Interview*

In a structured interview, a pre determined set of questions was asked and the responses were recorded on a standardised format (Robson, 2002). There was a little room for variation in response, though close-ended questions were used. Structured interviews were used to collect a large volume of data from a wide range of respondents (Denscombe, 1998). Copy of the structured interview used in this research is attached in appendix (G).

(2) Group Interview

In the group interview, the researcher worked with several clients' organisations simultaneously, rather than just one. The role of the researcher was facilitating, moderating, monitoring and recording group interactions, which were directed by questions and topics supplied by the researcher. Group interview made an important contribution to this research and assisted in bringing to the surface aspects of a situation, which were not exposed before. Group interview was an attractive data gathering option when research was trying to probe people view, perceptions, motives and behaviour (Hall and Hall, 1996).

(3) Unstructured Interview

In the unstructured interview, the researcher used a guide, which listed the topics to be covered. The researcher started the ball rolling by introducing a theme or topic and then letting the interviewees develop their ideas and pursue their train of thoughts (Denscombe, 1998). Interviewees were encouraged to develop their contribution in the direction they wish and the interviewer joined in with his own view. The unstructured interview was a powerful research tool, widely used and capable of producing rich and valuable data (Punch, 1998).

2.3.4.5 Case Study

The case was defined as a unit of data to be studied. It could be an individual, a family, a work team, a resource, a project or an institution. Each case has within it a set of interrelationships, which both bind it together and shape it, but also interact with the external world (Edwards and Talbot, 1996). Case study is a very valuable source of data, it aims to understand the case in depth, and in its natural settings, recognising its complexity and its contents. In addition, case study can provide evidence that illustrates more general findings. This research used 36 recently completed construction projects as case studies to validate the brief development drivers which were extracted from literature review and collect any brief development drivers which were not identified or covered by literature review (Othman et al., 2004a). Case study method focus on one of few instances which enables the researcher to deal with the details of complex situation and allows the use of a variety of research methods to capture the complex reality under scrutiny, and hence, fosters the use of variety of data sources which, in turn, facilitates the validation of findings through triangulation (Denscombe, 1998).

2.3.4.6 Documentary Data

Documents are a rich source of data. This type of data collection method is generally neglected by researchers, due to using other more predominant methods such as surveys, interviews, and observations for instance (Robson, 2002). Documentary sources of data were used in various ways in research. Some studies may depend entirely on documentary data. In other research, for example case studies, documentary data may be collected in conjunction with interviews and observations (Punch, 1998). The decision to gather and analyse documents or archival documents should be linked to the research objectives developed to achieve the research aim (Marshall and Rossman, 1995). The sources of documentary data collection used in this research were (1) technical project files which included original and amended brief, drawings, specifications and Bill of Quantities, catalogues of approved materials and equipment, (2) administrative files which included correspondence between related parties, minutes of meetings, internal memos and variation studies for instance (Othman et al., 2004b).

2.3.5 Sampling Methodology

The main objective of the sampling plan was to select a representative and non-biased sample to escalate the reliability and validity of findings. Representativeness and non-bias were achieved by adequately covering all population categories and applying random probability sampling methods, so every unit has an equal chance of being included in the sample (Hannagan, 1986; De Vaus, 1990).

2.3.5.1 The Case Study Sampling

The objective of case study sampling was to select a representative and non-biased sample of construction projects from which to validate the brief development drivers extracted from literature review and identify new drivers, which were not covered by literature review. The survey was undertaken in Abu Dhabi, the capital of United Arab Emirates (UAE) and information about distribution of the districts surveyed was collected from the Department of Social Services and Commercial Buildings (DSSCB), UAE. The city was divided into 87 districts (DSSCB, 2000). Random number tables were used to select 45 districts, which represented 51.72% of the total. 10 districts were excluded because of the difficulty in obtaining information about the projects in general and the brief development in particular due to national security matters. Buildings in each district were counted up and each building was given a unique number to form a table of 900 buildings. A systematic sample of 36 buildings (1:25) was used to select the case study sample. This sampling methodology effectively covered the surveyed city, so the identified brief development drivers were extracted from different projects constructed in different districts, with different regulations, types, clients' organisations, cost, time and quality, all of which enhanced the reliability and validity of the drivers of brief development.

2.3.5.2 Selecting the Survey Questionnaire Sample

Sampling was done in two stages using two different probability sampling methods. At the first stage, random stratified sampling was used to classify the population into 7 different stratums. They were clients' organisations, end-users, design firms, constructors, suppliers, government authorities and funding bodies. The stratified random sampling was adopted to ensure that the resulting sample would be distributed in the same way as the population in terms of the stratifying criteria (Bernard, 2000; Bryman, 2001). Units of the stratified random sample were chosen from sampling frames, which were a list of clients' organisations (DSSCB, 2000), the yellow pages directory (ETC, 2001) and the Abu Dhabi Chamber of Commerce and Industry directory (ADCCI, 2000). At the second stage, random systematic sampling with sampling factor of 1:20 was applied to all stratums, which resulted in the numbers shown in table (2.2).

Stratum	**No. Of Units**	**Stratum Type**	**Sampling Factor**	**Stratified Sample**
Client	1390	Individual	1:20	69.5
End-user	261298	Individual	1:20	13064.9
Design firm	175	Organisation	1:20	8.75
Constructor	315	Organisation	1:20	15.75
Suppliers	147	Organisation	1:20	7.35
Government Authority	7	Organisation	1:20	0.35
Funding Body	45	Organisation	1:20	2.25

Table 2.2 Initial Stratified Sample Size

Table (2.2) shows varied numbers of stratified samples (i.e. 13064.9 end-users and 0.35 government authorities). For this reason and in order to select a reasonable sample size of large population categories that commensurate with time, cost and accuracy, a sampling factor of 1: 2000 was used for selecting the end-users sample to produce 131 units. Because of the different role that every government authority plays in the construction process and in order to represent categories with low population, a sampling factor of 1:1 was used to select government authorities, which means that all seven government authorities were chosen (Barnett, 1991). After the different stratums were identified and the stratified sample was selected, the names of individuals and organisations to be surveyed were collected. Then the selected organisations were contacted in order to know the average number of employees in the engineering and construction departments. This resulted in the numbers shown in table (2.3).

Category	**Design Firms**	**Constructor**	**Suppliers**	**Government Authority**	**Funding Body**
Total No. of Organisations	175	315	147	7	45
Average No. Of Employees	6	6	3	20	9
Total No. of Employees	1050	1890	441	140	405
Organisations Stratified Sample	9	16	7	7	2
Actual Stratified Sample Size	54	96	21	140	18

Table 2.3 The Average Numbers of Employees in Construction and Engineering Departments against Sample Size

To summarise, the total population was (1390+261298+1050+1890+441+140+405) = 266614 units and the actual stratified sample size was (70+131+54+96+21+140+18) = 530 units. The sample size suits the population taking into account a 95% confidence interval and 4.25 sampling error (De Vaus, 1990; CRS, 2003). In addition, the sample size was more than what was recommended by Sekaran (1992), but this is recommended in cases where there are a variety of population categories and there is a need for high degree of accuracy (Hannagan, 1986; De Vaus, 1990). The adopted sampling methodology enabled the researcher to represent the surveyed population with all its stratums. This resulted in a reliable, valid and accurate quantification of the brief development drivers.

2.3.5.3 Selecting the Interviewees Sample

The analysis of the questionnaire responses showed that the parties that most influence the brief development were clients' organisations, design firms, constructors and funding bodies. As part of the research methodology, it was planned for the clients' organisations to participate in a brainstorming session, while the other three parties were interviewed. Random stratified and systematic sampling methods were used to select 88 (9*6 + 16*2 + 2*1 = 88) persons to be interviewed. They were chosen from 9 design firms, 16 construction companies and 2 funding bodies. They were managers of design firms, heads of architectural, civil, structural, electrical and mechanical sections, managers of construction companies, senior project managers, and heads of engineering sections in funding bodies. The sampling methodology used to select the interviewees sample with their different stratums helped portray a clear picture of their perception of the brief development concept and identify the different techniques adopted to manage brief development.

2.3.6 Likert Scale

Scaling is a method of obtaining information by the use of a scale rather than a long list of individual questions. On most subjects, which were surveyed or sampled, it would be possible to make a long list of relevant questions, particularly when asking about attitudes and opinions. Scaling methods are an alternative to asking questions, by utilising simultaneously a number of observations on each respondent (Hannagan, 1986). The Likert scale of 1 to 5 was employed to measure the respondents' attitudes about the questionnaire questions. The scale varies from never to always, and from very low influence to very high influence. Although there are many forms of scaling, the Likert scale was adopted because it is commonly used (Bernard, 2000), simple to construct, permits the use of latent attitudes and it is likely to produce a highly reliable scale (Baker, 1997).

2.3.7 Data Analysis

Data analysis is concerned with analysing and interpreting the collected data. During the course of this research, two types of data were collected, namely quantitative data, which dealt with numbers, and qualitative data, which dealt with words. Since each of them had its own characters and different analysis techniques, the following sections describe briefly the process of data analysis. It is worth mentioning here that the results of data analysis were distributed throughout the thesis chapters to serve the objectives of each chapter.

2.3.7.1 Analysing Quantitative Data

The use of quantitative data in research has its attractions because it carries with it an aura of scientific respectability. In addition, it conveys a sense of solid and objective research due to the use of numbers and the ability to present findings in the form of graphs and tables.

❖ *Types of Quantitative Data*

It was essential to understand the different types of quantitative data, so the suitable statistical techniques could be used.

(1) Nominal Data

Nominal data came from counting things and placing them into a category. They were the lowest level of quantitative data, in the scene that they allow little statistical manipulation with other types. For example, there was a count of organisations based on particular category, such as the function played by the organisation surveyed: client organisations, end-users, design firms, constructor, suppliers, government authorities, funding body, or others.

(2) Ordinal Data

Like nominal data, ordinal data based on counts of things assigned to specific categories, but in this case, the categories stand in some clear, ordered and ranked relationship. This meant that data in each category was compared with data in the other categories as being higher or lower than those in the other categories. For example the use of Likert scale to quantify the influence of a particular driver on developing project brief (1 = very low influence, 2 = low influence, 3 = average influence, 4 = high influence, and 5 = very high influence).

(3) Interval Data

Interval data is like ordinal data, but the categories are ranked on a scale. This means that the distance between the categories is a known factor and can be pulled into the analysis. For example, data collected for the years 1960, 1970, 1980, 1990 and 2000 not only differ in terms of being earlier or later than one another, they are also earlier or later by a known time span interval (Denscombe, 1998).

❖ *Coding, Grouping and Presenting Data*

The raw data, which came in the form of numbers, is convenient for quantitative analysis. However, on many occasions the data came in the form of words or pictures, which needs to be coded. In other words, transformed into the only format suitable for quantitative analysis: numbers. This involves a process of coding the data. Coding entails the attribution of a number to a piece of data, or group of data, with the express aim of allowing such data to be analysed in quantitative term. When the raw data is coded, it is essential to organise them in a way, which is more easily understood. A further stage in organising the data is to make a tally of the frequencies which gives a clearer picture of which data were the most common and is far better in terms of being able to read the data. The process of transforming a mass of raw data into tables and charts was vital as part of making sense of the information. Computer software provides a major help on this process. Statistical packages allow coding, grouping, presenting and undertaking statistical analysis. In addition, word processing packages generally contain a table making and a chart making facility.

❖ *Exploring Data*

A three-stage data analysis approach was adopted. The first stage was simply to measure the central tendency and dispersion of the questionnaire and interview responses. Measure of central tendency was used to get some overall assessment of the typical value for each variable. This was done by calculating the most widely used measures, the mean, the median and the mode. Each measure of central tendency carried important information about the value of each variable. Measure of dispersion was used to know how homogenous or heterogeneous the collected data was. This was carried out by calculating its most useful measures, the variance and the standard deviation (Bernard, 2000). Secondly, since not all brief development drivers had the same influence on brief development, the well-established relative importance index ranking technique was used to determine the relative importance of the brief development drivers (Olomolaiye et. al, 1987; Shash, 1993; Kometa and Olomolaiye, 1997). In order to investigate the correlation between the brief development drivers, the third stage established the linear relationship between the drivers using the

Bivariate analysis. The data were analysed with the aid of Microsoft Excel spreadsheet and the Statistical Package for Social Sciences (SPSS) computer software (Kirkpatrick and Feeney, 2001).

2.3.7.2 Analysing Qualitative Data

Qualitative research is an umbrella term that covers a variety of styles of research, drawing on a variety of disciplines. Qualitative research has its distinctive character, because it is concerned with meanings and the way people understanding things as well as it is concerned with patterns of behaviour.

❖ *Preparing Qualitative Data for Analysis*

Qualitative data can come in a variety of formats: fieldwork notes, interview transcripts, and texts, for example. Whatever the format, the data was organised before proceeding to analysis. Firstly, all materials were obtained in a similar format in order to facilitate storing and sifting through materials. Secondly, the raw data was collected in a way that allows the researcher's notes and comments to be added alongside. Finally, each piece of raw data material was identified with a unique serial number and coded for reference purpose. The importance of this was twofold. First, it enabled the researcher to return easily to points in the data, which were of particular interest. Second, it facilitated sifting through mounds of papers or record cards. Since qualitative data tends to be irreplaceable, a back- up copy of all originals was kept.

❖ *Procedures for Analysing Qualitative Data*

The procedures for analysing qualitative data consisted of the following steps.

(1) Coding and Categorising Qualitative Data

Coding qualitative data is known as 'unitising' data. The aim of this process was to discover, name and categorise phenomenon, and develop categories in terms of their properties and dimensions (Strauss and Corbin, 1990). Coding data began with breaking the data down into units for analysis. The units were a specific used or appeared word, ideas or events. Then, these units were classified in defined categorised.

(2) Reflections on the Early Coding and Categories

In depth revision of the fieldwork notes, transcripts and texts allowed adding comments and reflections in the margins alongside the raw data. As the analysis progressed, new sights emerged and new interpretations given were recorded on the back up copy of the data.

(3) Identification of Themes and Relationships

Miles and Huberman (1994) stated that a vital part of the reflections undertaken by the researcher would be the attempt to identify patterns and processes, commonalties, and differences. When the fieldwork notes, transcripts, or texts, were visited it was essential that themes or interactions that recur between the units and categories were looked out.

(4) Return to the Field to Check out Emerging Explanations

As the various explanation and themes were emerged from the early consideration of the data, it was essential to return back to the field with these explanation and themes to check their validity against reality.

(5) Develop A Set of Generalisation

Through the process of reflection on materials and checking these out in the field, the researcher should aim to refine a set of generalisations that explain the theme and relationship identified in the data.

(6) Use the New Generalisation to improve any Relevant Existing Theories The researcher should compare the new generalised statement with existing theories or explanation and develop these with the findings from fieldwork (Denscombe, 1998).

2.3.8 Action Required

Action was defined as (1) doing something, performance; activity, (2) the working of one thing on another so as to produce a change (Merriam-Webster Dictionary, 2000). Figure (2.1) showed that the action required activity was used clockwise and anti-clockwise to achieve the research aim and objectives. The action required was adopted after the data is collected either by using other data sources to validate the collected data, carrying out further investigation to thoroughly understand the data or by selecting the appropriate analysis technique. For example, when the brief development drivers were extracted from literature review, it was an essential action to use case studies to validate these drivers. In addition, a theme was developed to classify the brief development drivers and the survey questionnaire was used to quantify the drivers in order to identify the most influential ones. The suitable analysis technique of measure of central tendency and dispersion, relative importance index and Bivariate analysis were used to analyse these drivers.

On the other hand, the action required could be adopted after the data was analysed. This represented the steps required to solve the problem in an innovative manner such as designing the suggested protocol to manage brief development in construction and encapsulating it in a user-friendly prototype software to facilitate its use. Furthermore, the action required after the prototype software was produced was to evaluate its performance through testing on real case studies. Evaluation questionnaire was used to collect information for enhancing the performance of the software.

2.3.9 Reliability and Validity

The methods used to achieve the research objectives were not considered as successful tools that produce critical information, which could be count on, unless they were reliable and valid (Litwin, 1995). Because of the importance of the concepts of reliability and validity, they were built in the heart of the research methodology used during the course of this research to ensure that the methods used and conclusions produced were reliable and valid.

2.3.9.1 Reliability

Reliability was defined as the extent to which a test would give consistent results if applied by a different researcher more than once to the same people under standard conditions (Hall and Hall, 1996). This could be transformed into the question: if someone else did the research would he or she has got the same results and arrived at the same conclusion?

2.3.9.2 Validity

Hammersley (1992) defined validity as another word for truth. It refers to the correctness or credibility of a description, conclusion, explanation, interpretation or other sort of account. Hall and Hall (1996) mentioned that validity means the extent to which a test, questionnaire or other method is really measuring what it is intended to measure.

2.3.9.3 Reliability and Validity of the Research Methods

In order to escalate the reliability and validity of the methods used to achieve the research aim and objectives, the following certain course of actions and procedures were adopted.

(1) An explicit explanation of the research aim, objectives, methodology and methods used were provided.

(2) The reasoning behind key decisions made (e.g. sampling) was explained (Denscombe, 1998).

(3) The reliability and validity of observation was achieved by systematising the process of collecting and recording data, detailing the relevant context of observation (Kirk and

Miller, 1986) and distinction between analysis based on the researcher's perception and analysis derived from the studied objects was undertaken (Silverman, 2001).

(4) The reliability and validity of survey questionnaire and interview was escalated by:

- Ensuring that the designed questionnaire and interview fully represent the underlying concept of the subject being studied. This was called content validity (Baker, 1994).
- Consulting a number of specialists to assess the extent to which the questions relate to the subject being investigated (Nachmias and Nachmias, 1996).
- Using as much as possible of fixed choice answers.
- Pre-testing of the questionnaire and interview.
- Using representative and non-biased sample.
- Making sure that each respondent understood the questions in the same way as other respondents and their answers were coded correctly (Silverman, 2001).
- Encouraging respondents to answer the questions honestly and competently (Adams and Schvaneveldt, 1991).

(5) Strengthening the reliability and validity of case studies and documentary data was achieved by:

- Documenting the steps followed for data collection in a standardised and categorised way in order to allow any researcher read the case study through its various steps and use the same categories adopted. This will enable other researchers repeat the research effort and reach to the same conclusion (Baker, 1994).
- Using different sources of data such as documentary data to validate that the collected information and the results make sense and agreed by all concerned parties (Burns, 2000)
- Focusing on facts and events rather than highly subjective interpretations (Yin, 1989; MacPherson et al., 1993; Maxwell, 1996).

2.3.9.4 Reliability and Validity of the Research Findings

Burns (2000) and Denscombe (1998) stated that there are many ways in which checks on the reliability and validity of the findings of a research could be undertaken; in this research the following guidelines were adopted.

- The conclusion justified the complexity of the phenomenon being studied and oversimplification was avoided.

- The researcher him / her self should not cause biased or one-sided reporting.
- The research methods were selected on explicit and reasonable grounds and the aim of the research were achieved.
- Other ideas related to the research subject was reviewed and the existing practical solutions were discussed and their pitfalls were identified.
- The research findings were triangulated with other sources as a way of strengthening their validity.
- The research findings were fed back to informants in order to get their opinion on the explanation being proposed.
- The extent of the research findings and conclusions fit with the existing knowledge was established and the group of people that the findings be generalised was defined.

2.4 Conclusions

The methodology adopted for this research was devoted to develop an innovative protocol integrating value and risk management to manage dynamic brief development in construction and produce a software tool to facilitate its use. A number of well-defined objectives were developed to enable the achievement of the research aim. A brief description of the research process and the different research approaches were introduced to establish a conception of the appropriate approach for this research. Choosing the research methodology was primarily evolved from two factors: (1) the specific research aim and objectives and how they could be achieved and (2) the research nature and characteristics. This research was descriptive in nature, adopted the applied approach, and used quantitative and qualitative methods for data collection and data analysis. The research methodology adopted consisted of four activities: (1) data collection, (2) data analysis, (3) action required, and (4) reliability and validity. These activities were deemed as a concurrent process rather than sequential steps. Because of the importance to make sure that the adopted research methodology and methods would achieve the research aim and objectives, the relationship between the research objectives and the research methods were established.

During the course of this research, data was collected from different sources, using different methods to achieve certain objectives. This concept was known as triangulation, which increased the reliability and validity of data findings. The methods used for data collection were observation, literature review, survey questionnaire, interview, case study and documentary data. The sampling methodology for case study, survey questionnaire, and interview were described. Two approaches were adopted for data analysis, the quantitative approach and the qualitative approach. For the quantitative approach, the different types of data, the process of coding, grouping and presenting data was explained. Certain tests were used to explore quantitative data. They were measuring the central tendency and dispersion, relative importance index ranking technique, and the linear relationship between drivers using Bivariate analysis. For the qualitative approach, the process of preparing and analysing qualitative data was discussed. The third activity of the research methodology was the action required. Many actions were taken during this research in order to meet the research aim and objectives. These were either using other data sources to validate the collected data, carrying out further investigation to thoroughly understand the data or by selecting the appropriate analysis technique for instance. Reliability and validity was the last activity of the research methodology. Because of their importance, both concepts were built in the heart of the research methodology and had a vital role in making sure that the methods used and the research findings gained were reliable and valid. This was achieved through applying certain course of actions and defined procedures. Many of the research methods explained in this chapter were used to review client satisfaction in construction, the briefing process and managing change orders in construction projects, which is discussed in chapter 3.

Chapter 3

Dynamic Brief Development in Construction to Achieve Client Satisfaction

3.1 Introduction

This research proposed that overcoming the limitations and deficiencies of the current briefing process could be achieved by permitting and managing the development of the project brief throughout the project life cycle. This approach will enable achieving client satisfaction, responding to the influence of the brief development drivers, managing change orders effectively, and improving the briefing process. This chapter focused on building a clear understanding of three important and interrelated issues: client satisfaction, the briefing process, and change orders in construction. Firstly, an overview and importance of client satisfaction were investigated. Definitions of client satisfaction and its related terms were presented. In addition, because of the importance of learning from other disciplines that are more focused on customer satisfaction, some of the concepts used in total quality management studies were explained. Furthermore, guidelines for achieving and improving customer satisfaction were highlighted. Secondly, because of the vital role it plays in eliciting and communicating client requirements to the design and construction teams, a critical review of the current theories relating to brief development was undertaken. Limitations of the briefing process to achieve client satisfaction were identified and the Dynamic Brief Development concept was introduced as an approach to overcome these limitations. The last issue investigated in this chapter was change orders in construction. Definitions of changes, change orders, and construction change directives were presented. In addition, different types of changes and clarifications of change terms used throughout the project life cycle were clarified. Furthermore, change order procedures, impacts of change orders, the existing approaches to manage change orders in construction, and the limitations of the existing approaches were identified.

3.2 Client Satisfaction

3.2.1 Overview and Importance of Clients Satisfaction

Traditionally, customer satisfaction has been studied within market research. In the past, no much effort was made to close the loops, i.e. to find out which specific factors are important to customer satisfaction and then take action for product improvements. One important reason for this was the view that considered gaining a new customer is more important than retaining old ones. It is, however, much more expensive and difficult to gain a new customer than to keep one who is satisfied and delighted with the company product (Bergman and Klefsjo, 1994). Historically, customers were excluded from the product development process. The organisations, which adopted that approach, encountered the risk of getting their clients dissatisfied. In a competitive marketplace that is global in scope, such an approach could be disastrous (Goetsch and Davis, 2000).

Today, the increasing recognition that clients are the most important asset of any organisation and that they must be treated as the organisation's top priority as they are the ones who pay the bills and the survival of any organisation depends on them (Ahmed and Kangari, 1995; Goetsch and Davis, 2000), has actuated many industries to focus on their customers and involve them in the product development process. Different techniques and concepts were developed and used to ensure that the developed product fully satisfies customers' requirements. Examples of these are: total quality management (TQM), robust design, reliability analysis, failure mode and effect analysis (FMEA), function analysis, Tagushi methods and quality function deployment (QFD) (Kamara, 1999). Understanding the customer's needs and expectations is essential to winning new businesses and keeping existing ones. An organisation must give its customers a quality product or service that meets or exceeds their needs at a reasonable price, which includes on-time delivery and outstanding service (Besterfield et al., 1999).

3.2.2 Definitions

In order to define client satisfaction precisely, a number of related terms have to be defined. Client was defined as (1) a person who consults or employs the services of a professional man as a lawyer or a doctor; or (2) a customer of any business or store, where customer was defined as a person who buys, especially who buys regularly from the same store (Merriam-Webster Dictionary, 2000). Since construction clients consult and employ construction professionals to design and construct their buildings, and buy the final product in terms of paying the cost of design and construction, construction clients could be considered the customers of the construction industry. According to the close definitions of client and customer, the research used both terms synonymously. This view is supported by literature focusing on the business side of construction (Marsh, 1999; Roy and Cochrane, 1999; Torbica and Stroh, 2001). This explanation is useful to facilitate the adoption of learned lessons from other disciplines.

Satisfaction was defined in many ways. Pearsall and Trumble (1996) defined satisfaction as a thing that satisfies desire or gratifies a feeling. The Penguin Dictionary of Psychology defined satisfaction as an emotional state produced by achieving some goals (Reber, 1995). Others, Czepiel (1985 cited Ahmed and Kangari, 1995) defined satisfaction as the result of some comparison process in which expectations are compared with what is actually received. (Merriam-Webster Dictionary, 2000) defined "to satisfy" as (1) to supply what was wanted or expected; (2) to meet a requirement; or (3) to fulfil a condition.

Expectation was defined as something expected or hoped for (Pearsall and Trumble, 1996). Expectations were viewed as predictions made by consumers about what is likely to happen during the impending transaction or exchange. In addition, expectations were viewed as desires or wants of customers, i.e. what they feel that a service provider should offer rather than would offer (Auchterlounie and Hinks, 2001).

Quality was defined as conformance to an owner's or customer's product requirements (Kubal, 1994). There are two kinds of quality: must be quality and attractive quality. Some products and services sell well even though they are the subject of a considerable number of complaints because they are highly attractive to customers, while others that receive few complaints do not sell at all because that lack appeal to potential customers. To achieve true customer satisfaction, industries must not only achieve must-be quality by eliminating defects and improving upstream processes but must also provide its products and services with excellent attractive quality (Kondo, 2002).

As a result of the above, the research defined client satisfaction as supplying the client with an attractive quality product or service that meets or exceeds his or her expectations within a specified time and at the most cost effective manner.

3.2.3 Learning from Total Quality Management

Customer satisfaction is one of the dynamic topics covered by Total Quality Management (TQM) research which aims at continual increase in customer satisfaction through the production of high quality products that meet their expectations at continually lower real cost (Bounds et al., 1994). Because of the importance to learn from other disciplines and adopt suitable concepts and techniques that enhance the performance of the construction industry in general and achieve the research aim and objectives in particular, the following concepts were used in TQM to achieve and improve customer satisfaction.

3.2.3.1 External and Internal Customers

Every organisation has two kinds of customers, external and internal. External customers are the customers who exist outside the organisation and buy its product or service. They are the financial support of any organisation. Every employee in the organisation must know how his or her job enhances the total satisfaction of the external customer. Performance must be continually improved to retain existing customers and gain new ones. Internal Customers are important like external customers. Every function, whether it is engineering, processing or production, has an internal customer who receives a product or service and, in exchange, provides a product or service. Every person in a process is considered a customer of the preceding operation. Each worker's goal is to make sure that the quality meets the expectations of the next person. When that happens throughout the organisation, internal customers will be satisfied and this will assure the achievement of external customer satisfaction (Besterfield et al., 1999; Bergman and Klefsjo, 1994; Kondo, 2002).

3.2.3.2 Customer Satisfaction and Customer Loyalty

Customer satisfaction is a key issue for every company wishing to increase customer loyalty and thereby create a better business performance. Organisations work hard to build customer loyalty. The theory is that a loyal customer is a customer forever. Companies spend so much in marketing to attract customers and keep them for the long term to recoup their investment. The European Foundation for Quality Management (EFQM) introduced the European Customer Satisfaction Index (ECSI), which links customer satisfaction to its determinants, and in turn, to its consequences, namely customer loyalty. The determinants of customer satisfaction are: perceived company image, customer expectation, perceived quality and perceived value for money, see figure (3.1).

- Image is a latent variable not explicitly introduced in the majority of the customer satisfaction studies. It relates to the brand name and what kind of general associations the customers get from the product, brand or company.
- Customer expectations relate to the prior anticipations of the product or company in the eyes of the individual customer. Such expectations are the result of active company or product promotion as well as hearsay and prior experience with the product or service provider. Customer expectations have a direct effect on customer satisfaction.
- Perceived quality was conceptually divided into two elements: "hard ware", which consists of the quality of the product / service attributes, and "human ware", which represents the associated customer interactive elements in services, i.e. the personal behaviour and atmosphere of the service environment.
- Perceived value concerns the 'value for money' aspects as they are experienced by the customer.

Customer satisfaction has positive effect on customer loyalty. In order to keep their customers loyal, organisations should go beyond satisfying customers to creating value for them in every supplier-customer interaction (Goetsch and Davis, 2000; Gronholdt et al., 2000; Martensen et al., 2000; Auchterlounie and Hinks, 2001; Hallissey, 2000).

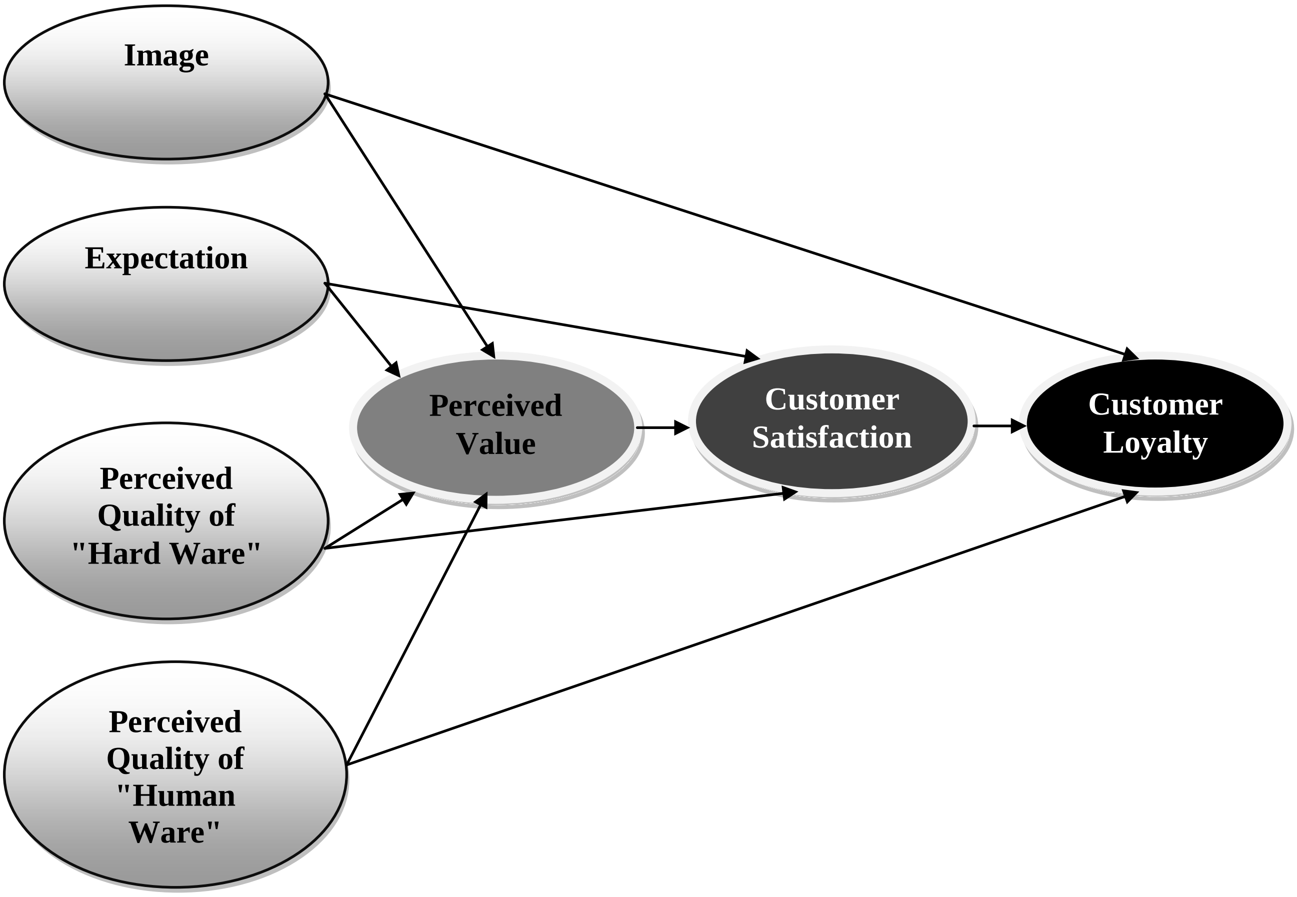


Figure 3.1 The Basic European Foundation for Quality Management Model

3.2.3.3 Customer Satisfaction and Customer Retention

Customer satisfaction is a fundamental cornerstone to achieve customer retention. An organisation develops a customer focus to be better able to satisfy its customers. Consequently, forward-looking organisations use customer satisfaction data to measure success. Since measuring customer satisfaction alone is not enough. Another important measure of success is customer retention. Albeit, the two concepts are complementary to each other, they are not necessarily synonyms. A customer satisfied is not always a customer retained. Customers may be delighted with a product but still end up buying the generic equivalent. This is not to say that customer satisfaction is not important but it is a means to an end. Customer should be satisfied enough to be retained. To retain customers over the long term, organisations must turn them into partners, proactively seek their inputs rather than waiting for and reacting to feedback provided after a problem is occurred, and enhance the after sale services (Besterfield et al., 1999; Roy and Cochrane, 1999; Goetsch and Davis, 2000; Torbica and Stroh, 2001).

3.2.4 Client Satisfaction in the Construction Industry

Until recently, organisations in the construction industry focused primarily on their internal functions and placed relatively little emphasis on their customers and other organisations within their supply chain network (Botchway et al., 2000). In addition, the evaluation of performance in construction generally focuses on a limited number of performance elements of completing the project within schedule and budget. It is possible to have dissatisfied, or at least not satisfied, customer even though explicit time, cost and performance criteria have been met (Sanvido, 1988; Maloney, 1990).

Today, the construction industry has become aware of the importance of client satisfaction as a key factor to measure construction project success (Parfitt and Sanvido, 1993). Although, using customer satisfaction as a performance criterion in the construction industry is at an early evolutionary stage (Torbica and Stroh, 2001), one of the most significant changes in today's business is the shift from treating financial figures as the foundation for performance measurement to treating them as one measure among a broader set of measures (Eccles, 1991). Recently, a number of companies have begun to create new performance measurement systems that supplement and extend the more traditional financial measures of company performance. These firms have begun to use so-called non-financial measures, such as quality and customer satisfaction (Eccles and Pyburn, 1992).

The recognition that clients are the core and the driving force of the construction industry has led to repeated calls for the construction process to be more client-oriented (Bennett et al., 1988; Howie, 1996). The Latham report named *"Constructing the team"* emphasised the need to satisfy the demands of clients, who are increasingly becoming more sophisticated, through an overall improvement to the efficiency of the construction process (Latham, 1994). In addition, the Construction Industry Task Force report *"Rethinking Construction"* (Egan, 1998), commonly referred to as the Egan report, highlighted a customer focus approach to business as one of the five key drivers for improving the construction industry. Others include committed leadership, integrated processes and teams, quality driven agenda and commitment to people. Moreover, CIRIA (1999 cited Botchway et al., 2000) in their report *"UK Construction: Future trend and issues"* also emphasised the need for a customer focused approach to maintain higher level of profitability and growth.

3.2.4.1 Achieving and Improving Customer Satisfaction in Construction

Two sets of requirements have to be fulfilled in order to achieve client satisfaction. Firstly, to get client needs translated into a design, which specifies technical characteristics, functional performance criteria and quality standards. Secondly, to get the project completed within a specified time and in the most cost effective manner (Bowen et al., 1999). Clients are most likely to be satisfied when the final product matches or exceeds their expectations (Ahmed and Kangari, 1995; Hudson, 1999). In order to get benefit from the Total Quality Management concepts mentioned above, the construction industry should strive to improve client satisfaction. Improving customer satisfaction was identified as one of the most important challenges facing business in the 1990s. In spite of the increasing competition, slower growth rate, and prices pressure facing industries and companies worldwide, greater attention continues to be placed on customer satisfaction (Johnson and Fornell, 1991). Because of the dynamic nature of clients' organisations and the different influences that affect the construction industry, continual improvement and flexibility in responding to client requirements, user needs, regulations changes, business opportunities, technology improvement, is the only way to keep customers satisfied, loyal, and retained (Goetsch and Davis, 2000; Roy and Cochrane, 1999; Othman et al., 2004a).

In addition, construction organisations continually need to examine their quality system to ensure its response to ever-changing customer requirement and expectation. This would involve investment in customer relationship with the view of continually and systematically mapping out individual customer preferences and creating new opportunities based on the knowledge gathered. Moreover, a competitive selling price is a must in the modern workplace, but it should not be achieved by sacrificing quality or service (Goetsch and Davis, 2000).

One of the most important keys to improve client satisfaction is the after service offered once the building is completed. The rise in educated customers and the establishment of facilities management as a professional discipline means that clients are expecting a lot more from the contractor after practical completion. One of the customer key needs is good maintenance support. This form of customer support could be used as competitive tool and as a profitable corporate tool as well (Marsh, 1999).

3.2.5 Client Satisfaction and the Briefing Process

As mentioned above client satisfaction could be achieved by translating the client requirements into a design and by completing the project on time, as specified and in the most cost-effective manner to produce a qualified product that meets or exceeds the client expectations. Within this research, initially, formal observation carried out during regular construction site supervision visits and following up of administrative office work recorded both clients' dissatisfaction with their buildings and the increasing number of change orders issued. These observation records were validated and emphasised by using various data collection methods such as extensive literature review, analysis of 36 case studies, documentary data and unstructured interviews with projects' architects. In addition, these data collection methods showed that very few buildings finished on time or at the right cost and clients often criticise the fact that the finished buildings were not what they expected (Barrett and Stanley, 1999; Kamara et al., 1999; Othman et al., 2004a). There is widespread dissatisfaction within the clients community with the extent to which the construction industry delivers facilities that fully meet their requirements or provides appropriate buildings for its clients (Chinyio et al., 1998; Smith et al., 1998). In addition, it was articulated that clients' organisations used change orders to achieve their emerging requirements and adapt to influential internal and external drivers, such as exploiting new business opportunities and installing an improved technological systems not available during the brief and design stages (Burati et al., 1992; Gardiner and Simmons, 1992; Hansen, 1994; Bates, 1996; Chapman, 1997; O'Brien, 1998; PMI, 2000).

The briefing process plays a vital role in the elicitation and communication of client requirements to the design team and specialist consultants. An effective client briefing is crucial to the attainment of client objectives with respect to time, cost and quality. Inadequate briefing was highlighted as a key source of client dissatisfaction (Latham, 1994). In addition, it was defined as the reason why buildings have been wasteful of resources or defective in use (Jenks, 1988). Kelly et al. (1992) mentioned that there are generally accepted view that the most critical factors in determining client satisfaction with a building project are the concept brief and the selection of the project team who will design and construct the building. Furthermore, the briefing process became a highly complex task due to the increasingly complicated nature of clients' organisations, the increasingly complicated nature of building projects, and the ever changing unpredictable socio-political environment where the client and the project exist. Smith et al. (1998) stated that the briefing process has to be flexible, well organised, and sensitive to client and stakeholder needs and objectives to provide more effective, efficient, innovative and better solutions.

The previous argument emphasised the role of the briefing process in achieving client satisfaction and the need for a flexible briefing process that interacts with the different influences that lead to brief development. The following section will review the different approaches to the briefing process. In addition, the Dynamic Brief Development concept as an approach to overcome the limitation of the current briefing process to achieve client satisfaction will be presented.

3.3 Current Theories Relating to Brief Development

Briefing in construction has become the focus of considerable attention in the post-Latham era both within the research community and amongst industry professionals (Hassanen and Bouchlaghem, 1999). The current approaches were investigated in general and particular attention was paid to study brief development throughout the project life cycle.

3.3.1 Definitions

The brief was defined as a formal document, which is the medium for expressing or communicating the objectives and needs of the client (Goodacre et al., 1982; Bennett et al., 1988; Hellard, 1993; CIB, 1997a). The brief contains information for project implementation and should include: (1) the background, purpose, content and desired outcomes of the project; (2) the functions of the intended facility and the relationship between them; (3) cost and time target, (4) instructions on procurement and organisation of the project; (5) site and environmental conditions, safety, interested third parties and other factors which, are likely to influence the design and construction of the facility (Kamara, 1999). The verb "to develop" was defined as to unfold gradually, or in detail; to change from one state into another by modification, omission, or addition to a project document, design, process, or method previously approved or accepted. Development was defined as an unfolding, growth, or progress (Merriam-Webster Dictionary, 2000; Gardiner and Simmons, 1992). Therefore, for the purposes of this research, brief development was defined as a detailed, gradual unfolding, growth, progress or change either by modification, omission, or addition to the brief document contents that will affect the final product and hence affect the achievement of the client objectives, needs and satisfaction. In addition, brief development drivers were defined as the drivers that lead to unfolding, growth, progress or change of the project brief (Othman et al., 2004a).

There appears to be a split in the approach to brief development. One approach considers the brief as an entity in itself, which should be frozen after a critical period. Decisions tend to be taken as early as possible, and briefing becomes a stage or stages in the design and construction process. The other approach considers the brief as a live and dynamic document that develops iteratively from an initial global brief in a series of stages. Briefing is deemed an ongoing activity that evolves during the design process (Barrett et al., 1996; Kamara, 1999). This approach is emphasised by Barrett and Stanley (1999) who defines the briefing process as the process running throughout the construction project by which means the client's requirements are progressively captured and translated into effect. These schools of thoughts are illustrated by the following examples:

3.3.2 The Different Briefing Approaches

3.3.2.1 The RIBA Plan of Work

The RIBA Plan of Work states that the brief is normally developed in three phases. In the first phase, the client establishes the need for the project objectives, perhaps by way of a business case. In the second phase, which is the most effective if carried out after completion of feasibility studies and/or option appraisals, the strategic brief is developed from the initial statement to provide sufficient information for the consultants to commence the design process. In the third phase the project brief is developed from the strategic brief in parallel with the design process during work at stages C and D, namely outline proposals and detailed proposal stages respectively. The project brief is frozen at the end of the detailed proposal stage (RIBA, 2000). The RIBA plan of work emphasises the need to produce an explicit and detailed brief at an early stage and then to work to it as closely as possible (Barrett et al., 1996).

3.3.2.2 The Process Protocol

The process protocol is the result of collaboration between a number of like-minded organisations from various disciplines within the UK construction industry together with the research expertise of the University of Salford and Loughborough University in UK. The process protocol is a common set of definitions, documentation and procedures that provide the basis for the wide range of organisations involved in a construction project to work together seamlessly. It emphasises the need to improve co-ordination between different parties through the adoption of manufacturing industry perspective. The protocol presents a map for the construction process where the project brief is finalised at the production information stage and places a soft gate between the production information stage and the construction stage. All solutions and various options and requirements are fixed for construction (Kagioglou et al., 1998).

3.3.2.3 The Netherlands Approach

In the Netherlands, the brief is seen as a process not an event. It is a process that not only starts early, but also continues to inform all the technical work throughout the project. The brief is explicitly managed to evolve through various stages in parallel with the technical information till specification stage and could be extended through the construction stage. Continued interaction with the client is essential to this process, the underlying principle is to make as few decisions as possible at each stage. This means identifying the critical decisions and leaving flexibility on other issues for later consideration as more information becomes available (Barrett and Stanley, 1999).

3.3.2.4 Learning from Experience: Applying systematic Feedback to Improve the Briefing Process in Construction (Acronym: LEAF)

LEAF is the title of two years research led by the University of Sheffield, UK with the collaboration of many partners. The theme of the project is the improvement of the client briefing and evaluation process by systematising the gathering and application of feedback to improve the industry productivity and user satisfaction. It states that the failure to learn from the accumulated wealth of experience from completed construction projects is both costly and unproductive (Phiri and Haddon, 2000).

3.3.3 Limitation of the Current Briefing Theories

The limitations of the current briefing theories are evident in confining the development of the project brief to a certain stage, lack of communication between the client and the designer, and shortage of interaction with the different influences that affects the project brief. These limitations led to clients' dissatisfaction as their emerging requirements and potential brief development for the benefit of the project were not achieved. In addition, these limitations forced client organisation to use change orders irrespective of their impacts on time and cost to meet their needs in order to enhance the performance of their projects. In an endeavor to overcome the limitations of the briefing process and achieve client satisfaction, this research presented the Dynamic Brief Development concept.

3.4 The Dynamic Brief Development Concept

3.4.1 The Need and Aims of Dynamic Brief Development Concept

The importance of the Dynamic Brief Development concept arises from two significant flaws in current practice, which are discussed below.

(1) **Deficiencies of the Current Briefing Process in Achieving Client Satisfaction**

The RIBA plan of work limits the brief development to the detailed proposal stage. Barrett et al. (1996) stated that there are a number of problems with this approach. Clients' ideas develop as the possibilities of a design unfold and a beneficial creative dialogue with the design team can occur. An insistence on adhering to a detailed early brief will inhibit such a dialogue occurring. Many client organisations are in a state of dynamic change. That is often why they need a new building in the first place. However, the rate of change may be such that their requirements change during the course of the project. A static brief will prevent these changes from being accommodated. Bouchlaghem et al. (2000a) and Rezgui et al. (2001) stated that clients preferred to consider the briefing process as extended until almost the final stage of construction to ensure that the final product meets their requirements and fulfils their objectives. On the other hand, consultants tend to consider the briefing as a limited process with a well-defined start and end to be able to claim fees for any extra work. In addition to this, neither the process protocol nor the Netherlands approach extend the briefing process to cover the after practical completion stage, where the lessons learned could be fed back to enable client organisations and construction professionals enhance the briefing process for new projects as promoted by LEAF.

(2) Managing Project Change Orders and Adapting to the Influential Internal and External Drivers

Very few projects are implemented without any change to the original scope of work (Hansen, 1994). Change orders are an indicator of someone's failure to fulfil his or her functions in the construction process. It is argued that no one benefits from change orders during the construction period. They are generally disruptive of the orderly progress of the work and are usually an economic burden on both the client and the contractor (O'Leary, 1992). Change orders are seen as a major cause of project delay and a source of many disputes in today's construction industry (Zaimi, 1997; Mezher and Tawil, 1998; Al-Khalil and Al-Ghafly, 1999; Hanna et al., 1999).

On the other hand, (O'Brien, 1998; PMI, 2000) mentioned that client organisations used change orders to achieve their emerging requirements and adapt to influential internal and external drivers, such as exploiting new business opportunities and installing an improved technological systems not available during the brief and design stages. Smith and Wyatt (1998) stated that external forces may drive changes and clients respond to these forces by demanding a design that is more effective and more efficient. Chapman (1997) emphasised that effective client organisations are those who adapt and change in response to their environment and markets. In addition, successful design practices are those who manage changes successfully. As a result, the more influential the internal and external drivers, the greater the use of change orders in particular during the construction and after practical completion stages. There is a need to decide on how to react to these drivers for the benefit of the project. This decision process should include the consideration of potential value and associated risk.

The inability of the current briefing process in achieving client satisfaction and adapting to influential internal and external drivers for the benefit of the project as well as the need to manage project change orders effectively, dictate the need for the Dynamic Brief Development concept. This concept will (1) enable client organisations achieve their expectations, (2) facilitate an innovative response to the drivers that may develop the project brief by unfolding, growing, progressing or changing its content for the benefit of the project, (3) manage project change orders, utilise their benefits, minimise their impact on project cost, time and quality, and (4) improving the briefing process through learned lessons and feedback.

3.4.2 Principles behind the Dynamic Brief Development Concept

The following underlying principles of the Dynamic Briefing Development concept have been identified within this research. They were emerged from the need to overcome the limitations of the current briefing process. These principles represent the basis that will facilitate the achievement of the concept aims.

(1) The briefing process has to be deemed as an ongoing process extending throughout the project life cycle responding in an innovative manner to emerging client requirements, meeting user needs, coping with regulatory changes, exploiting business opportunities, adapting to technology improvement, adding more value, and managing associated risks. This flexible approach will contribute to the achievement of client expectations, adapt to the influential internal and external drivers for the benefit of the project and hence avoid the consequences of change orders as a result of not considering these drivers.

(2) The project brief has to be considered as a live document, which needs to be continually developed throughout the project life cycle, see figure (3.2).

(3) Feed back to the client organisation and the design and construction teams of the lessons learned and comments from the facilities management team and end users will enhance the performance of the briefing process in future projects.

(4) A system to manage the brief development drivers is required. This system must respond to these drivers in a way that adds value and manages associated risk in an endeavour to achieve client satisfaction and manage project change orders.

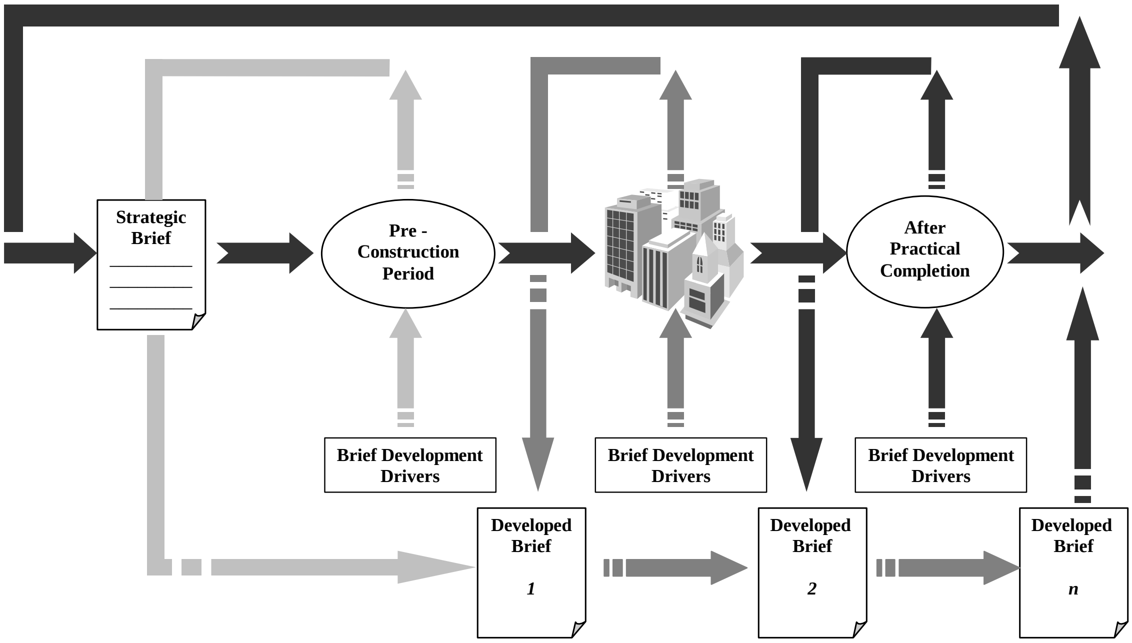


Figure 3.2 Developing the Brief throughout the Project Lifecycle

This figure shows that the project brief is subject to be affected by brief development drivers throughout the project life cycle. For example, the client decided during the construction process to install a new technological system to enhance the performance of his project. Installing this system entails modifying the project design to adapt to the system requirements. This brief development driver affects the brief contents and produces a new version of the project brief that reflects these changes. This process takes place throughout the project life cycle to produce different developed versions of the project brief that achieve emerging requirements, meet user need, cope with regulatory changes, exploit business opportunities, adapt to technology improvement, add more value, and managing associated risks.

3.4.3 Time Frame / Process Stages

According to the RIBA Plan of Work, the work stages into which the process of designing building projects and administrating building contracts is divided into three main stages, namely feasibility, pre-construction period and construction period (RIBA, 2000). The Dynamic Brief Development concept identifies five milestones to evaluate the brief development throughout the project life cycle, see figure (3.3). The rationale behind selecting these milestones is attributed to the following:

Milestone (1) comes at the end of one of the most important stages, the feasibility stage, where the client requirements are identified, studies that enable the client decide whether to proceed and select the probable procurement method are prepared and the strategic brief is identified. Evaluating the project brief at this milestone represents the basis to compare subsequent developed versions.

Milestone (2) evaluates the brief development at the end of the detailed proposals stage where the information becomes more concrete and the pace of change is reduced, as the detailed proposals are prepared. This milestone should reflect the influence of internal and external drivers on design since clients' ideas develop and mature as the design alternatives unfold.

Milestone (3) comes at the end of the tender action stage, which represents the end of the pre-construction period and the beginning of the construction period, and potential contractors and / or specialists for the construction of the project are identified and evaluated. In addition, tenders are obtained, appraised and recommendations are submitted to client. Evaluating brief development takes a particular importance because the cost of change or modification after this stage is expensive.

Milestone (4) this milestone evaluates the brief development at the end of the construction to practical completion stage. Implications of the drivers that affected the project brief during construction in terms of cost, time and quality should be reflected in the developed brief. Analysis of case studies showed that the construction stage represents the stage that witnesses most development of the project brief. This can be attributed to the industry’s fragmented nature, long investment term, risk exposure, time consumption, and myriad other internal and external influences.

Milestone (5) comes at the practical completion stage where, the final inspections and settlement of the final account occur. Evaluating brief development at this milestone provides the client organisation, design team and construction professionals with learned lessons and feedback from the end users and facilities management team which play an important role in improving the briefing process for future projects (Othman et al., 2004a).

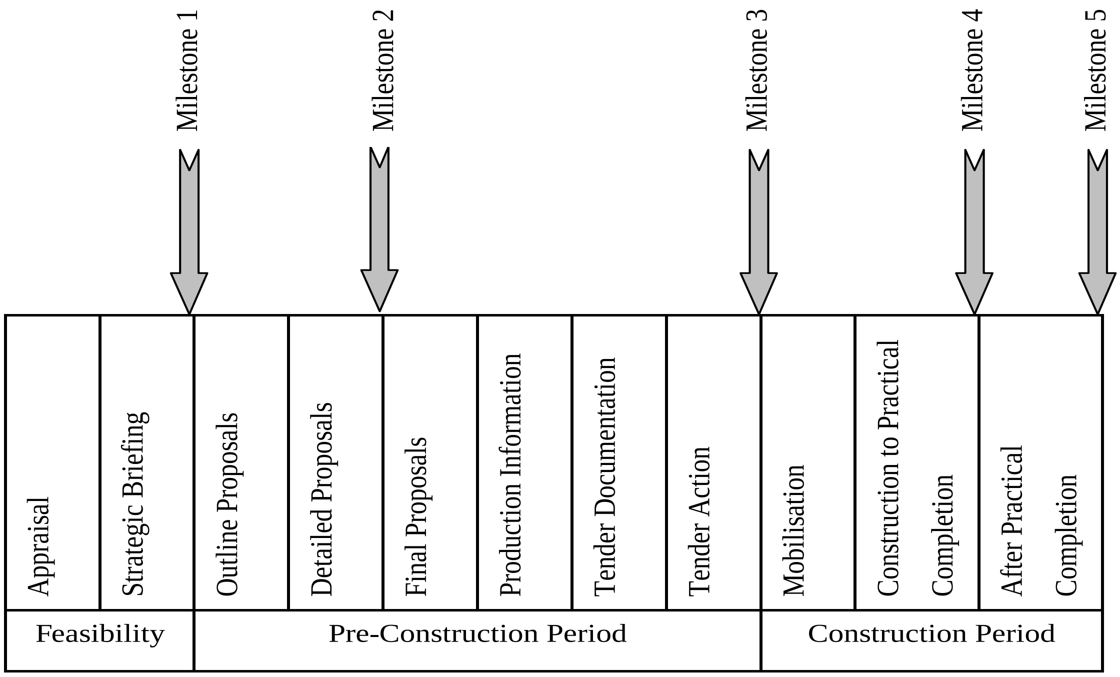


Figure 3.3 Brief Development Evaluation Milestones against Revised RIBA Plan of Work

3.5 Change Orders in Construction

Most construction contracts give the client the right to make changes within the general scope of the contract without invalidating or breaching the contract. In making a change, the client is responsible for the impact upon the contractor's time and cost of performance. The desire or need to make changes to the original contract can result from a variety of situations and reasons. After the contract has been awarded, the client may decide that something different than what specified in the final design is needed. The limitations of the current briefing process to achieve clients' satisfaction due to fixing brief development at certain stage forced client organisation to use change orders to modify and change what has been decided at earlier stages. The most common changes are to the physical characteristics or technological capabilities of the facility. Situations encountered in the field may also require change orders. The majority of field initiated modifications result from differences between site conditions shown on the plans and those actually encountered during construction, corrections of design errors, necessary co-ordination of the contractor's work with other prime contractors or the client, variations between estimated quantity and actual quantities, client-caused delay, and weather related delays (Bramble and Callahan, 1992; Othman et al., 2004a). The following section will define change, change order and construction change directive. In addition, it will review, briefly, the different types of change, change orders procedures, impacts of change orders, the existing approach to manage change and change orders in construction, and the limitations of the existing approaches.

3.5.1 Definitions

Change was defined as any change made to the original scope of work (Thomas and Napolitan, 1995). Gardiner and Simmons (1992) defined change as any alternation by modification, omission, or addition, to a project, design, process or method previously approved or accepted. Change order is synonymous to variation order. The American Institute of Architects (AIA) defined a change order as a written instrument prepared by the architect and signed by the owner, contractor, and architect stating their agreement on a change in the work and the amount on adjustment, if any, in the contract sum and time if any" (Clough and Sears, 1994). Levy (2000) added that this written order is issued after the contract was executed. O'Leary (1992) stated that in those occasional circumstance where the owner and the architect have signed the change order but the contractor will not, the contractor is required to proceed with the work, reserving the resolution of the disagreed portions to a later time. A change order not agreed to and not signed by the contractor is called constriction change directive. The disputed portion of a construction change directive, if not resolved by negotiation, will be decided by the architect. If the architect's decision is not acceptable to the parties it is subject to the arbitration.

3.5.2 Types of Changes

Project changes were classified under various types. Ibbs et al. (2001) classified project changes based on the need to change. That is as elective changes against required change and they can occur at any time of a project.

(1) Elective Change

They are the changes, which the client can choose whether or not to implement. They may be several options that produce the desired result. The decision to implement elective change will arise from cost / benefit analysis. In other words selecting the change that will provide best value and lowest risk. Examples include change to client requirements, functional scope changes and detailed brief changes.

(2) Required Changes

They are the changes that the client must accept. There are no alternatives, although there may be implementation or timing option. Examples include alternation or design assumption, change of manufacturing specification or site conditions; clarification of regulatory and statutory requirements compared to project assumptions, and force majeure.

Lazarus & Clifton (2001) classified project changes under two categories firstly, according to the source of change to:

Legislative changes	:	such as acceptable discharge rates into external drainage reduced.
Design changes	:	such as change to cladding system.
Client changes	:	provision required for further expansion of facility.
Contractor changes	:	introduce pre-casting in lieu of in situ construction.
Site conditions changes	:	existing foundation identified on site.

Secondly, according to the time of change to:

(1) Design Development Changes

They refer to the changes that take place during the design stage. Change during design development must relate to a starting point, the baseline for the project, which, initially is described in terms of client objectives, the basic functional brief, design cost and time. This baseline will be revised during the project to reflect agreed proposals at the end of each project stage.

(2) Post-Fixity Changes

They refer to the changes which were issued at the point in the project when the design development of a particular area / component / package is signed off as accepted or completed. Beyond this point no further changes to the area / component / project proposal or information are, or should be, made.

3.5.3 Clarification of Terms

It is important to distinguish between the different terms given to project changes throughout the project life cycle. Changes during the feasibility and pre construction period are called design development. Changes that take place during the construction period are called change orders, where changes that occur after the practical completion and during the use of the building are called facility modification (O'Brien, 1998; PMI, 2000; Mustapha and Bintaher, 2000). Since any change happens during any of these stages is a change in the strategic brief of the project as the base point to measure any development of the project brief, the term brief development presented in this research is a catchall term that embraces any changes or modification occurred to the brief throughout the project life cycle. To facilitate the use of terms and because the brief development term includes all other changes, during the course of this research, the term brief development will be used interchangeably with design development, change order and facility modification.

3.5.4 Change Order Procedures

When a modification in the work is contemplated by the architect or the owner contingent upon an acceptable price and time quotation, a request is sent to the contractor describing the proposed change. The request needs to be signed only by the architect, as it is simply a request for information and not an order to change the work of the contract anyway. If the quotation tendered by the contractor is acceptable to the client, a change order may be written and circulated for signature. If the contractor is not agreeable to any aspect of the proposed changes, construction change directive should be used. If the construction change directive is later found to be acceptable to the contractor, an appropriate change order should be issued. If the construction change directive continues to be unacceptable to the contractor a claim to be decided by the architect (O'Leary, 1992).

In the Institute of Civil Engineers (ICE) conditions of contract the engineer can instruct the contractor to vary the works if he thinks it is necessary or desirable. Depending on the terms of the contract, variations may include instructions to add or omit work or change the contract programme. The engineer should then instruct the contractor by means of a formal Variation Order (VO). He should advise the client on variations found necessary or desirable and inform the client of their effect on the programme and the cost of the project (ICE, 1996a). Probably the most disruption part of agreement between design consultants and their clients concerns changes to the client brief. To minimise the possibility of disputes, the consultant should insist on all changes being requested in writing. If the proposed changes will cause alternation to other things which have previously been agreed, the consultant should inform the client of this in writing and insist on acceptance of the new arrangement before proceeding. Even if there is no knock-on effect from the requested change, the consultant should confirm in writing receipt and acceptance of the request to avoid any further confusion. Any additional work result from changes to the client brief should certainly be charged for, either on additional fixed fee basis or at an agreed hourly rate (Jebb, 1992).

3.5.5 The Impacts of Changes Orders on Projects

Project changes can turn to be beneficial or disruptive. In addition, they have direct and indirect impact on project's cost and time as follows.

- The major cost due to change is by the cost of rework or revision of work. Rework is the unnecessary effect of re-doing a process or activity that was incorrectly implemented first time (Love et al., 1999). It has been found to be 10-15% of contract value (Burati et al., 1992; Love et al., 2000).

- Changes made at the concept stage cost little but can have a major impact (Valence, 1999). In contrast, changes to design during construction can be excessive, because of the direct costs of repeating work and scrapping material, and the indirect cost of disrupting economic working (ICE, 1996b). Cox et al. (1999) found that the direct cost of post contract design changes amount to 5.1%-7.6% of the total project cost.
- 31% of the total planned design time was spent on design variations and most of these variations were client-initiated changes (Manavazhi and Xunzhi, 2001). Change orders are a major cause of delay, claims and disputes in construction projects (Ibbs et al., 2001).

In addition, there are indirect consequences of change as follows:

- Change orders results in loss of productivity. There is a strong correlation between the amount of changes on a project and loss of productivity. The greater the amount of change on a project, the greater the negative effect on labour productivity (Moselhi et al., 1991; Hanna et al., 1998).
- Ibbs and Allen (1995) mentioned that changes issued later in the project tend to have a more negative impact than changes issued when the project is < 50% complete.
- Other indirect impacts of project changes are lost in stopping and restarting work, change in cash flow, loss of earnings, loss of rhythm, revision of projects reports and documents (Bower, 2000).
- Moreover, indirect effects of change can take the form of changed communication, changed project information, rescheduling work methods, increased co-ordination, increased waste in abortive work, increased uncertainty and lower moral (Cox et al., 1999; Bower, 2000; Lazarus and Clifton, 2001).

In spite of the negative impacts of change orders mentioned above, formal observation, literature review, case studies and unstructured interviews with project architects showed that change orders could be beneficial in terms of enabling client organisation achieve their emerging requirements, meeting user need, coping with regulatory changes, exploiting business opportunities, adapting to technology improvement, adding more value, and managing associated risks. Analysis of the survey questionnaire undertaken by the author to quantify the brief development drivers showed that brief development was rated 4.22 on a scale of 5, on increasing project's cost, time and risk. This is because of the extra cost and time required for reworking construction documents and implementation of the required work coupled with the reflections of development in one discipline on other disciplines as well as the consequences of the unexpected events, which represent risks that lead to project failure and client dissatisfaction. On the other hand, brief development could improve the project quality and add more values through upgrading project facilities, eliminating proven poor quality materials and equipment as well as responding to market demand for instance.

Moreover, analysis of the management interview undertaken by the author showed that 92.2% of the interviewees pointed out that brief development helps achieve the clients' and end-users' satisfaction and enhances the project performance as well. On the other hand it increases the project documents rework, increases organisation supervision duties, disturb the organisation overall work schedule and could be considered as a source of disputes. 94.15 % of the interviewees mentioned that brief development could add more values and eliminate associated risks but at the same time could increase organisation overhead, reduce employees / labour productivity and rectify brief errors and missing data. Finally, 47% of the interviewees agreed that developing the brief could reduce organisation profitability. Analysis of the results showed that brief development has positive and negative impacts on projects and the interviewed organisations. Positive impacts should be exploited and negative ones should be managed for the benefit of both the project and the construction organisation. This necessitated the importance to set out a brief development management system capable to respond to brief development in a way that adds more value and manages associated risk in an endeavor to achieve client satisfaction and manage project change orders effectively (Othman et al., 2004b).

3.5.6 The Existing Approaches to Manage Change Orders in Construction

Limited research work has been focused on areas that contribute to the management of change in design and construction (Hegazy et al., 2001). Mokhtar et al. (1998) mentioned that the issue of managing design has not received much attention in the literature. Handy (1983 cited Gardiner and Simmons, 1992) stated that management research in the construction industry has tended to focus on topics such as industry performance, site productivity, contractual procedure, organisation design, computer in construction, and more recently the application of expert systems, and quality systems. The role of conflict and change in construction has received scant attention, with the exception of the very specific field of contract litigation. Motawa et al., (2003) stated that two approaches were developed to manage change and change orders. They are the process models approach and the IT system approach.

3.5.6.1 The Process Models Approach

Different models for managing change orders process have been developed.

- The Construction Industry Institute, CII (1994) established a concept for project change management where change is considered as a modification to an agreement between project participants. The CII reports defined the elements of a project that are subject to change and that will affect the change management process as: project scope, project organisation, work execution methods, control methods, and contracts and risk allocation. The interaction of these elements becomes significantly more complex as the project proceeds.
- Hansen (1994) stated that change order management should start early in a project. Since the planning stage is the most economical stage in the project life cycle to influence the cost, duration, and quality of the project, it is also the time to start managing future change orders. A detailed project plan includes: project objectives, project scope of work, time plan, risk plan, cost plan, management plan, and controls plan should be prepared by professionals from engineering, cost and scheduling, procurement and logistics, maintenance, operation and construction groups. These plans should identify how the change orders will be managed in terms of the change required, its justification and impacts, the parties responsible for reviewing, pricing, approving and recording change orders. In addition, the time allowed for processing change orders and the ways in which the constructors will be informed should be defined for instance.
- Chapman (1997) stated that effective client organisations are those, which adapt and change in response to their environment and markets. Similarly, successful design practices are those who mange changes successfully. It must be accepted at the outset of a project that change is going to occur, and a change-control system must be set-up to manage it. But it is often difficult, as frequently changes are difficult to estimate and negotiate. Change by its nature is disruptive, can demoralise and is frequently requested at a very tight time scale, calling on the goodwill of the project team. Client changes predominantly as a result of alternations in the business environment or in the client's own organisation, an ill-defined brief or the client's inexperience. A change control system composed of 14 steps was suggested to be used to manage project changes.
- Stocks and Singh (1999) concluded that the US Navy' s Functional Analysis Concept Design (FACD) is a 10 days process by which clients and designers can partner to define clearly the functions through the FAST diagram and value analysis job plan. It is reported that change orders are reduced from 18.75 % for non-FACD contracts to 2.19 % for FACD contracts.

- Wallace (2000) stressed that the prime focus for the project manager should not be to deliver the agreed scope on time and on budget, but to optimise the benefit that is generated by the project. If that means allowing the scope to change then that scope change is a good thing, not a bad thing. It is wrong to resist all scope changes. Where a scope change generates improved benefit, it should be proposed to the project's decision-making body. An efficient scope and change control should be defined. There needs to be a balance between flexibility and control. If the process is too onerous, either valuable changes will be lost or participants will ignore the rules. If the process is too easy, then many changes may be applied with insufficient thought given to their merits and consequences. Four basis of the decision to change are suggested, they are: is the change unavoidable? does the change increase the overall benefit to the organisation? is the project team able to make such a change? and is the change best done now, or would it be more beneficial to defer it until the current work is completed?
- Lazarus and Clifton (2001) referred in a best practice guide published by CIRIA that in managing change in construction a positive approach should be taken by developing a framework for dealing with consequences of change at the start of the project. The guide presented best practice recommendations for the effective management during design development, and post-fixity changes. Effective briefing was introduced as a tool to reduce required change, value management as a tool to manage elective change and risk management as a tool to forecast change.
- Ibbs et al. (2001) introduced a comprehensive project change management system that is founded on five principles: (1) promote a balanced change culture, (2) recognise change, (3) evaluate change, (4) implement change, and (5) continuously improve from lessons learned. Each of these principles works together to minimise deleterious changes and promotes beneficial ones.
- Motawa et al. (2003) proposed two approaches for managing change: reactive and proactive. In the reactive approach, the objective is to improve efficiency in handling changes after they have already occurred whereas in the proactive approach, the aim is to identify and forecast potential changes and develop solutions before the change occurs.
- Othman et al. (2004b) stated that analysis of interviews, undertaken by the author to investigate the construction organisation management's perception of the brief development concepts and the different techniques adopted for managing brief development, showed that different steps were followed to manage brief development as follows.

(1) All interviewees pointed out that if the brief development was requested by government authorities and funding bodies due to regulation changes or the design violates building codes and requirements these developments have to be done in order to get the design approved.

(2) If the brief development was requested by the clients' organisations or end users, they are in front of two cases:

- 25 out of 47 interviewees referred that they do the requested development in order to win their clients and achieve his/her satisfaction, even if development will not improve the project performance. In addition, they pointed out that the client would pay proper compensation for major documentation rework.
- The remaining interviewees referred that when the brief document needed to be developed either by omission, or addition to its contents the designer arranges for a meeting with the concerned parties to study the possibility to apply the required development and study its effect on other disciplines. Based on the practical experience and the feasibility study, the cost of development will be determined. Clients' organisations in order to cover the cost of brief development, they either arrange for additional fund or they may modify the project design or reduce the project specifications.

(3) 28 out of 47 interviewees pointed out that brief development in many cases was done by the construction professionals due to the provision of new information, unforeseen conditions, lack of materials production, rectification of design errors, or generation of new ideas without getting prior consent of the client organisation. This will result in client dissatisfaction and more development in the future.

All interviewees mentioned that no particular attention has been paid to the value of brief development and to what extent it could enhance the project performance. The reason is that the designer will be compensated for re-work and the contractor will claim for extension of time on the pretence of development, in particular if he was already delayed. No clear steps or procedures were established in advance that could help clients' organisations and construction professionals decide to or not to accept the requested development for the benefit of the project.

3.5.6.2 The IT System Approach

Managing changes and change orders in construction has been the focus of different IT systems.

- Ahmed et al. (1992) have developed an integrated environment for computer-aided engineering, which is a blackboard representation that integrates a global database, several knowledge modules, and a control mechanism. It contained a version management system that kept track of project changes.
- Peltonen et al. (1993) proposed an Engineering Document Management System (EDMS) that incorporated document approval and release procedures.
- Spooner and Hardwick (1993) developed a system with rules for coordinating concurrent changes and for identifying and resolving conflicting modifications.
- Ganeshan et al. (1994) developed a system to capture the history of the design decision making process, initiate backtracking, and determine the decisions that might be affected when changes are made in the spatial design environment.
- Kirshnamurthy and Law (1995) presented an integrated change management model that support multidisciplinary collaborative design environment.
- Mokhtar et al. (1998) mentioned that it is essential to ensure that the production of technical construction documents is free of incompatibility errors. An information model was developed to solve this problem. The core idea of the model is to build a single repository of active building components that are assigned the task of propagating design changes. The model is also capable of tracking past design changes and planning / scheduling future ones.
- Karim and Adeli (1999) presented a generic model, which is an object-oriented (OO) information model for construction scheduling, cost optimisation, and changes order management. The model could be used to approve any change order request.
- Soh and Wang (2000) proposed a constraint methodology based on a parametric technique to co-ordinate design consistency between different geometric models to facilitate managing design changes.
- Hegazy et al. (2001) introduced an information model to facilitate design co-ordination and management of design changes. Important dependencies between building components were represented by this model to help identify the ripple effect of changes made by all disciplines.
- Othman et al. (2004b) showed that analysis of interviews pointed out that the interviewees do not use value management or risk management in managing brief development. The use of information management and information technology was in the area of organising and updating project files. CAD programmes and word processing software were used in

producing and modifying construction documents. The techniques, which were used to manage brief development, depend on calculating the cost of omission or addition and their implications on other disciplines and to what extent could the client bear the cost of development. In many cases the project design will be changed or the specification will be reduced in order to cover the cost of development.

3.5.7 Limitations of the Existing Approaches to Manage Change Orders

The above process models have mainly focused on describing the change process and the best practice for it throughout the project life cycle. While these recommendations are beneficial, they are not sufficient alone to manage the complex process of change.

All of these approaches dealt with the change order after it happened. Few approaches adopted the view that change orders may have positive impacts and could enhance the project performance. In addition, none of these models adopted the integrated approach of value management and risk management that was presented in this research to manage change orders in construction. Furthermore, none of these approaches adopted the management of change orders after the practical completion stage and modifications, which occur during the post occupancy stage. Analysis of the IT system approaches developed for managing project changes showed that they were integrated systems to represent design information, recording design rationale, facilitating design co-ordination and changes, as well as notifying users of file changes. These systems were developed mainly to deal with reactive changes, particularly design changes and did not adopt the proactive approach or cover later brief changes in construction and during the use of the building. Interview analysis showed that the techniques adopted to mange brief development are not deep enough to consider the value of development, the associated risk and to what extent could brief development enhance the project performance. In addition, the capabilities of information management and information technology have not been fully exploited.

3.6 Conclusions

The increasing recognition that clients are the core of the construction process and the driving force for improvement highlighted the importance to achieve their satisfaction. Client satisfaction is identified as a key challenge facing the construction industry and the only way to retain the industry's customers and keep them loyal. Analysis of formal observations, literature review, case studies, documentary data, and unstructured interview showed that very few buildings finished on time or at the right price and clients often criticise the fact that the finished buildings were not what they expected. In addition, the increasing number of change orders used by client organisations to achieve their emerging requirements and enhance the performance of their projects was observed as well. These deficiencies are attributed to the limitations of the current briefing process, which confine the development of the project brief to a certain stage. This approach hinders the interaction between the client and the designer since clients' ideas develop and mature as the design alternatives unfold. In addition, it inhibits the utilisation of value opportunities and management of risk threats derived by internal and external brief development drivers.

The failure of the current briefing ideas to achieve client satisfaction, coupled with the need to respond to the influence of the brief development drivers, and the desire to manage project change orders effectively, as well as the importance to improve the briefing process, dictates the need to adopt the concept of Dynamic Brief Development (DBD), developed within this research, with its four underlying principles. First, the briefing process has to be deemed as an ongoing process extending throughout the project life cycle. Second, the project brief has to be considered as a live document continually developing and adapting in an innovative manner to the influential internal and external drivers for the benefit of the project. Third, feeding back to the client organisation and the design and construction teams with learned lessons and comments of the facilities management team and end users will enhance the performance of the briefing process in future projects. Finally, a system to manage the drivers of brief development has to be set out as early as possible. Five milestones were identified to evaluate the brief development throughout the project life cycle. These milestones are at the end of the feasibility stage, the end of the detailed proposal stage, the end of the tender action stage, the end of the construction to practical completion stage, and the last milestone at the practical completion stage.

Since the limitations of the briefing process forced client organisation to use change orders to achieve their satisfaction, it was essential to investigate the practice of change orders in construction. Project changes, change orders, and construction change directives were defined. Project changes were classified under many categories. According to the need to change they were classified to elective change and required change. In addition, they were classified on the basis of source of change to legislative changes, design changes, client changes, contractor changes, and site conditions changes. Furthermore, according to the time of change, project changes were classified to design development changes and post fixity changes. Since changes throughout the project life cycle have many names due to the stage where they occur, during the course of research, the term brief development was used interchangeably with design development, change order, and facility modification. Change order procedures, direct and indirect impacts of change orders were reviewed. Because of the need to manage change orders in construction for the benefit of the projects, it was imperative to investigate the existing approaches to manage change orders and identify their limitations. Albeit, the little work done to manage changes in construction, the developed approaches were reviewed and classified to the process model approach and the IT approach. The process models have mainly focused on describing the change process and the best practice for it throughout the project life cycle. While these recommendations are beneficial, they are not sufficient alone to manage the complex process of change. All of these approaches dealt with the change order after it happened. Few approaches adopted the approach that change orders may have positive impacts and could enhance the project performance. None of these models adopted the integrated approach of value management and risk management to manage change orders in construction. In addition, none of these approaches adopted the management of change orders after the practical completion stage and modifications, which occur during the post occupancy stage.

The IT system approaches developed for managing project changes are integrated systems to represent design information, recording design rationale, facilitating design co-ordination and changes and notifying users of file changes. These systems were developed mainly to deal with reactive changes, particularly design changes and did not cover later construction stages. Interview analysis showed that the techniques adopted to mange brief development are not deep enough to consider the value of development, the associated risk and to what extent could brief development enhance the project performance. In addition, the capabilities of information management and information technology have not been fully exploited. The next chapter will investigate value management and risk management and the possibility for their integration to form the basis of the system suggested by the Dynamic Brief Development concept to manage brief development in construction.

Chapter 4

Value Management and Risk Management in Construction

4.1 Introduction

The previous chapter introduced the Dynamic Brief Development concept as an approach to overcome the limitations of the current briefing process. This concept supports developing the project brief throughout the project life cycle in order to achieve client satisfaction, respond to the influence of the internal and external brief development drivers, manage change orders effectively, and improve the briefing process. Permitting brief development without establishing the basis that control and manage brief development leaves the project brief uncontrolled and jeopardise the achievement of client satisfaction. Since brief development either add value or risk to the project or could add both, the two well established methodologies of value management and risk management represent the most appropriate techniques to manage dynamic brief development in construction. In order to form the basis and set the rules that control and manage brief development, this chapter is devoted to examine the application of value management and risk management in construction and investigate the possibility and argument for their integration. These aims were achieved through the accomplishment of two objectives.

Firstly, an extensive literature review of value management and risk management was carried out. It included an overview of both techniques, different types of values and risks, the value process and the value management procedures as well as the risk management process. In addition, the opportunities of value management, benefits of implementing value management and risk management, and their role in managing brief development were identified. The second objective investigated the possibility of integrating value management and risk management, the comparison between value management and risk management, and the argument for their integration. The existing approaches for integrating value and risk management were studied and their limitations were identified.

4.2 Overview of Value Management (VM) in Construction

Value management is the European name given to a service concerned with providing the product or service demanded by a customer at the required quality and at the optimum cost. The philosophy is based on the work of Lawrence Miles who, in 1940s was a purchase engineer with the General Electric Company. Miles, found that using substitute solutions and alternative materials succeeded in providing equal or better performance at a lower cost. Based on these observations he proposed a system called Value Analysis which was defined as an organised approach to the identification and elimination of unnecessary cost that provides neither use, nor life, nor quality, nor appearance, nor customer features. Since that time, value management witnessed obvious development steps in the construction industry worldwide. This took the form of setting out the rules and drawing the boundaries of the discipline in terms of stating its objectives and defining the relevant terminology. In addition, development of value management included the adoption and implementation by government authorities, modifying contracts to include value engineering service clause, spreading and using the discipline worldwide, initiating professional societies, benchmarking, academic research and publications for instance (Kelly and Male, 1992; Kelly and Male, 1993; Green 1992 & 1994; Locke and Randall, 1994; Meng, 1994; Thiry, 1997; Male et al. 1998 a&b; Tsuchiya, 1998; FHWA, 1999; Pasquire and Maruo, 2001).

4.2.1 Value

Value was defined as a measure expressed in currency, effort, exchange or on a comparative scale, which reflects the desire to obtain or retain an item, service or idea (Kelly and Male, 1993). Thiry (1997) stated that value is a very subjective concept; it has different meanings for different people. A consumer will regard it as the "best buy", a manufacturer will consider it as "the lowest cost", and the designer will view it as the "highest functionality". The Institute of Civil Engineers (ICE) referred that value can be considered as the ration of function achieved to its life cycle cost.
Value = Function / Cost (LCC) (ICE, 1996a).

Dell'Isola (1997) stated that three basic elements that provide a measure of value to the user: function, quality, and cost. These elements can be interpreted by adding quality to the numerator of the above equation to form the following relationship:

Value = (Function + Quality) / Cost (LCC)

Where:

Function = The specific purpose or work that a design / item must perform.

Quality = The Client's or user's needs, desires, and expectations.

Cost = The total life cycle cost of the product.

Maximising the relationship of these three elements is necessary to satisfying the customer. From this relationship it is easy to see that value could be enhanced by improving either function or quality or both or reducing cost. A decision that improve quality but increases cost to a point where the product is no longer marketable is as unacceptable as one reduces cost at the expense of required quality or performance. In addition, if added cost does not improve quality or enhance the ability to perform the necessary functions, then value is decreased. A balance between value elements is required to achieve best value for money. From this relationship the following definition for value has been evolved. Value is the most cost-effective way to accomplish a function that will meet the user's needs, desires, and expectations (ECOMAN, 2001).

4.2.2 Types of Value

Thiry (1997) and PROMIS (2003) stated that there are five different types of value.

Use Value (Need)	The amount of current resources expanded to realise a finished product that performs as it was intended.
Esteem Value (Want)	The amount of current resources a user is willing to expand for functions attributable to pleasing rather than performing.
Exchange Value (Worth)	The amount of current resources for which a product can be traded for something else.
Cost Value	The amount of current resources expanded to achieve a function measured in monetary terms.
Function Value	The relationship of function worth to function cost.

These different types of values will vary in importance according to the client's objectives and thus more effort should be expanded on those considered the most important to the client.

4.2.3 The Value Process

Value process relates to the overall sequence of actions that lead to the achievement of value. Variation in the use of value derivatives depends upon timing, geographical location, industry sector, and organisation and when, in the project life cycle, the processes are used. The following section will explain the value terms used in Value management studies.

4.2.3.1 Value Planning and Value Reviewing

Value Planning (VP) and Value Reviewing (VR) are employed by the ICE as part of value management. Value Planning (VP) is applied during the concept phase of a project and used during the development of the brief to ensure that value is planned into the whole project from its inception. This is achieved by addressing the function and ranking the client's requirements in order of performance for guidance of the design. Value Reviewing (VR) is applied at planned stages to check and record the effectiveness of the value process and its management. It analyses and compares a completed, or nearly completed, design or project against pre-determined expectations.

4.2.3.2 Value Management and Value Engineering

While the terms of VM and VE still overlap in their interpretations, they can be divided into different categories based on their definitions and objectives. For example, VM is focused on "maximising value" and "client's requirements" whereas an object of VE is "the lowest life-cycle cost without sacrificing quality, performance and safety". Value Management was defined as a systematic, multi-disciplinary effort directed toward analysing the functions of projects for the purpose of achieving the best value at the lowest overall life cycle project cost (Norton and McElligott, 1995).

Others, Male et al. (1998a), defined Value Management as a proactive, creative, problem solving or problem seeking service which maximises the functional value of a project by managing its development from conception to use through structured, team-oriented exercises which make explicit and appraise subsequent decisions, by reference to the value requirements of the client. The Construction Industry Board, CIB (1997b) defined Value management as a structured approach to establishing what value means to a client in meeting a perceived need by, clearly defining and agreeing the project objectives and establishing how they could be achieved".

Value Engineering was defined as a strategic, innovative approach to obtain optimum value for every dollar spent. Value Engineering reduces overall project and life cycle costs without sacrificing quality, aesthetic, or operation and maintenance capabilities (WSDOT, 1999). Furthermore, the ICE (1996a), Dell'Isola (1997) and Omigbodun (2001) defined it as the process of relating the function, the quality and the cost of the project in the determination of optimum solutions for the project. Value Engineering investigates, analyses, compares, and selects amongst the various options to produce the required function and meets or exceeds the customer expectations. Value Engineering produces a range of 'How' design options for the whole project or for defined parts of it, which are tested against the client's value objectives and criteria to remove unnecessary cost without sacrificing functions, reliability, quality and safety. Furthermore, the Society of Japanese Value Engineering (SJVE, 1999) defined Value engineering as a professionally applied, functional-oriented, systematic team approach used to analyse and improve value in a product, facility design, system or service. It is a powerful methodology for solving problems and / or reducing cost while improving performance and / or quality requirements.

4.3 The Value Management Procedures

The systematic procedures applied during a VM study, whether a VP or VE study, encompass the three phases pre-study, workshop or study, and post-study activities.

4.3.1 Pre-Study Phase

The main objective of the pre-study phase is to ensure that all parties are well co-ordinated, that the study properly targeted and that there is sufficient pertinent information available for the actual study. The activities that occur during this phase include:

- Orientation meeting
- Finalising the team structure
- Selecting the team members
- Deciding on study duration
- Determining study location and conditions
- Gathering information
- Site visit
- Cost estimate verification
- Preparation of models and efficiency data

4.3.2 Study or Workshop Phase

During this phase the Multi-disciplinary team is mobilised to conduct the VM study following the procedure set down in the five-step job plan subsequently described. The team structure is tailored to suit the particular project type, but generally includes a Value Management Team Co-ordinator (VMTC) (qualified value specialist or equivalent), relevant design engineer, operation experts, quantity surveyor/cost engineer and client and user representatives. Where constructability and sequencing issues are of concern a construction manger may also participate. The optimal size is generally recognised to be between six to twelve members, overlay large teams should be avoided. The duration of the study depends on the nature and size of the project and the stages at which the study is conducted. Study are generally of three to six days duration, and may be divided into parts and extend to a number of weeks if the project is large and /or complex. The five-step job plan comprises the following:

(1) Information Phase.

(2) Creativity Phase.

(3) Evaluation Phase.

(4) Development Phase.

(5) Presentation Phase.

4.3.2.1 Information Phase

The objective of this phase is to establish a good understanding of the project, its design and operation, the functions of the project itself, and its constituent elements, and to determine areas with the greatest potential for saving and needed improvements. To that end, the workshop generally starts with an overview of the activities, which will occur within during the VM process by the value specialist. This will be followed by design presentation from the design team. These activities are followed by the function analysis part of the information phase. Function analysis is intended to assure that every VM team member fully understands all of the project's functional requirements, not just his or her own area of speciality: first by examining the total project and then each of its component elements, to identify their basic and secondary functions.

4.3.2.2 Creativity Phase

This phase includes any of various creativity/motivational techniques to generate alternative ideas to achieve the same basic functions at lower costs or to achieve necessary improvements. The most often used method is the brainstorming technique, which consists of VM team generating and recording a large number of ideas without evaluation, (idea evaluation is performed in the evaluation phase). The entire VM team participates in this session, so that ideas covering all disciplines are generated, even by participants in areas other than their discipline. The aim is to obtain quantity and association of ideas, to eliminate blocks that thwart creativity thinking, and to a free flow of ideas.

4.3.2.3 Evaluation Phase

Various evaluation methods may be used during this phase to analyse and highlight the best ideas generated during the creativity phase. Since there are usually time constraints on the number of ideas that can properly be developed, it is important that only the best ideas are selected. These ideas are evaluated, both on economic and non-economic criteria such as aesthetics, environmental impact etc.

4.3.2.4 Development Phase

The ideas for alternatives selected during the evaluation phase are now developed into fully detailed proposals, which generally comprise:

- Description of both the original and the proposed design.
- A narrative on the advantages and disadvantages of each proposal.
- Initial and life cycle cost consequences of the proposals.
- Detailed technical calculations, sketches, etc., which are necessary to fully describe the VM proposal.

- Proposals must be detailed and avoid ambiguity otherwise they may be rejected with little consideration by decision-makers. The process of developing detailed proposals also forces team members to consider all the ramifications of their ideas. If, during this consideration, it becomes apparent that any advantages are outweighed by disadvantages, the proposal is dropped.

4.3.2.5 Presentation Phase

Generally on the last day of the study a presentation of the refined and developed proposals will be made to decision makers and other interested parties. The proposals generated by the VM team will be summarised and the life cycle cost saving presented. The VM team members will present the rationale behind each of the recommendations presented. Draft copies of summaries of the proposals may be handed over so that decision makers can immediately commence evaluation of the recommendation.

4.3.3 Post-study phase

Within five to ten working days a preliminary VM report may be submitted which will contain all the detailed proposals and summaries, narratives on the process and so on. Concurrently with the report preparation, and for a period after its issues, decision-makers will consider the recommendations from the VM team. Following an appropriate period for review, an implementation meeting should be held to determine whether proposals are to be accepted or rejected, and to establish subsequent actions (Norton and McElligott, 1995).

4.4 Opportunities for Value Management

In construction there was consensus on the six opportunities where the value management could be employed to achieve maximum effectiveness of any project during its life cycle. These are:

(1) The pre-brief workshop, where the focus if on the business project.

(2) The brief workshop.

(C) The Charette: (which is an audit of the brief often undertaken before the concept design is completed. It is usually undertaken in the place of the workshops 1, 2, and 3).

(3) The concept design workshop.

(4) The detail design workshop.

(5) The operational study undertaken at the construction stage.

While there is evidence to suggest the use of value management beyond the construction stage, they were not mentioned to any large extent in fieldwork discussion, as is the case also with facilities management. This may indicate that few studies were undertaken during these phases (Male et al., 1998b; Kelley and Male, 2002).

4.5 Benefits of Implementing Value Management

Value Management is attracting considerable interests in the construction industry and by carrying out value management in a structured manner throughout the project life cycle, it is possible to obtain the following benefits as concluded by Locke and Randall (1994); Watson and Asher (1999); Connaughton and Green (1996); Dell'Isola (1997); AMEC (1999); Kelly and Male (1999); PROMIS (2003); Neasbey et al. (1999); Leung et al. (2002).

(1) Better Understanding of the Client Needs and Requirements

- Clear identification of the client requirements.
- Differences between client's needs and wants are identified and prioritised.
- Reviewing and challenging client's business cases.
- Improving client brief through refining requirements, analysing functions and feeding back for future projects.
- Identifying client's value system
- Identifying, assessing, and managing associated risks.

(2) Removing Unnecessary Cost

- Optimum value for money in satisfying a range of customer's requirements.
- Prevention of unnecessary expenditure.
- Understanding balance between cost and function.
- Using substitute materials.
- Reviewing design at key points.
- Improving Life Cost Cycling.
- Avoiding over specification.
- Conserving Energy.

(3) Reducing Time

- Simplifying project design and construction method
- Increasing certainty of completion
- Using standard elements.

(4) Improving Communication and Team Working

- Conscious decision-making.
- Enhancing client involvement with project development.
- Escalating employees' enthusiasm and enhancing skills through team participation.
- Ensuring clearer understanding of the project brief by all parties involved.
- Improving communication between stakeholders.
- Wider ownership of project outcomes and commitment to implementation.

(5) Created, Challenged and Innovative Ideas

- Better confidence in developed solutions
- Accelerated incorporation of new materials and construction techniques
- Considers all options, alternatives and innovative ideas
- Continual improvement of standards and policies
- Challenging traditional working processes and procedures.

4.6 Value Management and Managing Brief Development

The use of value management is steadily increasing as clients seek better outcomes from their investment in buildings and structures. Some clients are now including the requirements for VM workshop in building contracts, as a way of ensuring optimal solutions. VM is a fundamental tool that can be used by bringing together the widest possible range of project stakeholders in the VM workshops, where different views and perspectives can be openly debated, and many of the problems that typically arise in building projects can be avoided (Neasbey et. al, 1999).

For many years, managers throughout the construction industry have faced the challenge of survival and growth in a dynamic and competitive business environment. For example, customers are expecting higher level of service or new products and services. Similarly, managers are expected to improve performance on a continuous basis to ensure survival and profitable development. The relationship between these drivers need to be fully understood in order to give the client best value for money. However, in seeking to achieve enhanced value for money, a structured approach to examination, development and completion of each project needs to be adopted. This structured approach could be value management, which with its powerful philosophy and approach can help achieve best performance and client satisfaction (Watson and Asher, 1999). By enhancing value characteristics, value engineering increases client satisfaction and adds value to their investment (Dew and Siddiqi, 2003). Value could be enhanced by adequately identifying client requirements, minimising capital costs, maximising operational period, reliability and ease of maintenance as well as achieving highest possible safety standards (Watson and Asher, 1999).

As mentioned in chapter 3, two sets of requirements have to be fulfilled in order to achieve client satisfaction. Firstly, to get client needs translated into a design, which specifies technical characteristics, functional performance criteria and quality standards. Secondly, to get the project completed within a specified time and in the most cost effective manner (Bowen et al., 1999). Clients are most likely to be satisfied when the final product matches or exceeds their expectations (Ahmed and Kangari, 1995; Hudson, 1999). Value management is an appropriate tool that could be used to manage brief development. This is attributed to the following factors:

(1) Value management is total client driven technique, which is oriented towards understanding the client objectives, establishing the client value system and achieving his/her satisfaction at the most cost effective manner throughout the project life cycle. In addition, the function analysis, which is considered the heart of value management, is developed from the customer's point of view (ECOMAN, 2001).

(2) Value management plays a vital role in the process of establishing the client's business case to ensure that the project addresses real needs, adds value and presents better ways of providing the same performance at lower cost. Value management should be deemed as automatic part of every project and not an option (RICS, 1995).

(3) The diversity of team members who will carry out value management workshop and managing brief development study represent a cornerstone for successful results. Representing all project stakeholders ensures that their views, objectives and requirements are well perceived and adequately reflected in the brief development decision. In addition, their participation in the decision making process emphasises their commitment to implement the selected decision.

(4) Value Management is based on systematic steps, which have a definitive start and end. This systematic approach ensures that the problem in hand is thoroughly studied, innovative alternatives are generated and evaluated, best alternatives are selected and implemented. Furthermore, following up and monitoring of the implementation process will enrich managing brief development and improving the briefing process in future project through learned lessons and feedback. Systematic steps avoid the pitfalls of unstructured methods.

(5) Changing client values and requirements as well as the influence of the different brief development drivers throughout the project life cycle necessitate the importance to adapt to these changes for the benefit of the client. Value management has different opportunities to be

applied in order to achieve best value for money. These opportunities are at: (a) Conception formulation, (b) Design tentative, (c) Working Drawings, (d) Construction, and (e) Operation stages (Tenah 1985). This harmonises with the five milestones to evaluate the brief development throughout the project life cycle. These milestones are at: (a) the end of the feasibility stage, (b) the end of the detailed proposals stage, (c) the end of the tender action stage, (d) the end of the construction to practical completion stage, (e) the end of the after practical completion stage (Othman et al. 2004a).

(6) Using value management for the adequate identification of client requirements at early stages of the project and the flexibility in responding to emerging client requirements, user need, regulatory changes, business opportunities, technology improvement, expected value, and associated risks will reduce later change orders and manage them for the benefit of the project. In addition, participants experience with similar cases will help in directing the attention of the study team to any comments and learned lessons of previous project change orders.

(7) Applying value engineering during the construction stage to review all potential change orders tending to increase contract costs is recommended and considered a fruitful area for internal application of VM. In addition, large potential saving could be gained when value engineering is applied at the operation phase. Value engineering studies during this phase offer an opportunity to make changes not made earlier due to lack of time or other constraints (Tenah, 1985).

The above showed the close relationship between value management and the dynamic brief development and how applying value management throughout the project life cycle will achieve client satisfaction, enable client organisation and construction professionals respond to the different influences that affect the project brief, managing change orders, and improving the briefing process in future projects.

4.7 Overview of Risk Management (RM) in Construction

By its very nature the construction industry is considered to be subject to more risk than other industries. Getting the project from the initial investment appraisal stage through to completion and into use involves a complex and time-consuming design and construction process. This involves a multitude of people, from different organisations, with different skills and interests, and a great deal of effort is required to co-ordinate the wide range of activities that are undertaken. A variety of unexpected events may occur during the process of building procurement, and many of them can cause losses to the client or other interested parties. Such events are called risks (Shen, 1999). At the macro level the event may be for example, constructing a building for a forecasted cost, time, and quality. The risk at this level will be that the actual outcome will deviate from those forecasted such as:

- The building is completed but it was delayed from the scheduled date.
- The building is completed but it was over budget.
- The building quality is not as specified.

At lower level the event, constructing a building comprise thousands of interrelated events with variety of risk degree that they will not turn out as planned. For example prolonged bad weather delaying concrete pour, failure of supplier to deliver materials on time will delay the activities, which will use these materials, or the injury of workmen when they undertake risky activities.

All construction projects involve different kinds of risk. The initial purpose of risk analysis and management process is to help a project sponsor decide if the potential benefits associated with a particular course of action (such as investment in construction) are sufficient to warrant accepting the identified risks. The second purpose is to safeguard the sponsor's interest when a course of action is selected. It is therefore important to identify the risks, establish when they might occur, what their effect might be and what the appropriate response should be (Chapman, 1995). This is clearly mentioned in the definition of risk management. It is defined as the process concerned with identifying, analysing, and responding to uncertainty (Hamilton, 1997). The principle of risk management is widely used in the construction industry, applied at various stages during the procurement process. It has been shown that proper application of risk management techniques can significantly improve the investment performance of construction projects (Flanagan and Norman, 1993).

4.7.1 Risk and Uncertainty

The future is largely unknown. Most business decision-making takes place on the basis of expectation about the future. Making the decision on the basis of assumption, expectation, estimates and forecasts of future involves taking risks. In the context of management and economics of construction projects, a working definition of risk and uncertainty would be along the following lines:

Risk and Certainty characterise situations where the actual outcome for a particular event or activity is likely to deviate from the estimate or forecast value.

Risk can travel in two directions: the outcome may be better or worse than expected. They are known as upside and downside risks. Risk and certainty will apply to the forecast price or time for the entire project or sub component, subcontract, operation or activity within it. Similarly, risk and uncertainty will be attached to assumptions about weather, inflation, strikes and other external aspects of projects. Taking these latter points into account, risk could be defined as exposure to the possibility of economic or financial loss or gain, physical danger or injury, or delay as a consequence of the uncertainty associated with pursuing a particular course of action (Chapman, 1991; Raftery 1994), where uncertainty was described as situation where it is impossible to attach a probability to the likelihood of occurrence of an event (Amos and Dent, 1997). Saito (1999) sated that risk is a measurable and countable as possibility and frequency of appearance and linked to statistical analysis, where uncertainty cannot predict frequency or appearance of a certain event. It is more desirable to make decisions under risk than decisions under uncertainty.

4.7.2 Types of Risks in Construction Projects

Risks in construction projects could be classified under many categories.

(1) According to the events outcome risk could be classified to (a) upside risk when the outcome of the event or activity is better than the original forecast and (b) downside risk when the outcome of the event or activity is worse than the original forecast.

(2) According to the possibility of occurrence there are two kinds of risks: (a) pure risk, normally arises from the possibility of accident or technical failure and (b) speculative risk, possibility of loss and gain, which may be financial, or physical.

(3) According to the possibility of reduction there are two kinds of risk: (a) diversifiable risk, if it is possible to reduce risk through pooling or risk-sharing agreement, and (b) non-diversifiable risk, if pooling agreement are ineffective in reducing risk for the participants in the pool (Williams et al., 1995).

(4) Flanagan and Norman (1993) classified construction risks to political, economic, technical, external relations, management, design, environmental, legal, operational.

(5) Perry and Hayes (1985 cited Shen, 1999) classified risks in construction projects as: physical, construction, design, political, financial, legal-contractual, and environmental.

(6) Santoso et al. (2003) classified risk as: physical risks, personal risks, technical risks, safety-accident risks, construction design causes risk, political and regulation risk, financial risk, contractual risk, and environmental regulations cause risk.

4.7.3 The Risk Management Process

Risk management process comprises identification, analysis and response strategy to all significant project risks with the aim of reducing the opportunity for and consequence of loss. The process of Risk Management can be broken down into three essential components, they are risk identification, risk analysis, and risk responses.

4.7.3.1 Risk Identification

Risk identification is a diagnostic process in which all the potential risks that could affect a construction project are identified and investigated, thus enabling the client to understand the potential risk sources at an early stage in the project. Such understanding at the project proposal stage will help clients concentrate on strategies for the control and allocation of risk (Shen, 1999). Different methods are used in risk identification. They are brainstorming, historical data, checklist, tree diagram, and influence diagrams (Hamilton, 1997; Shen, 1999, Smith, 1999).

4.7.3.2 Risk Analysis

Risk analysis is used to evaluate risks, and to ascertain the importance of each risk to the project, based on an assessment of the probability of occurrence (Likelihood) and the possible consequence of its occurrence (Severity).

Risk = Likelihood X Severity Loss/Gain (Balfour Beatty, 2000).

Risk analysis assesses both the effects of individual risks, and the combined consequences of all risks on the project objectives. The major purpose of risk analysis is to provide a project risk profile that the client can use to look ahead to possible future events and see the probability of those events occurring. The client can then decide whether or not to invest in the project, or to adopt specific strategies for dealing with the major risks. There are two techniques used in the risk analysis:

❖ *Quantitative Risk Analysis*

It is a risk analysis technique, which requires input of numerical data and carrying out of some calculations work. The quantitative risk analysis study provides some numerical results, which will allow more informed decision-making by the team.

❖ *Qualitative Risk Analysis*

It is a risk analysis technique, which involves subjective assessment based on experiences and intuition of the team, which may be used to determine risk impact. Lack of information and lack of demand for more detailed approach, and absence of numerical data related to identifying the risk are two main reasons that force the risk analyst to use the qualitative technique. This does not mean that the quantitative risk techniques are not used. Both techniques are used according to the importance of the project and the availability of information.

There are many techniques used for risk analysis. They are: sensitivity analysis, probability analysis, simulation techniques, risk premium, expected monetary value (EMV), expected net present value (ENPV), EMV using a Delphi peer group, risk-adjusted discount rate (RADR), detailed analysis and simulation, and stochastic dominance (Raftery, 1994; Shen, 1999; Smith, 1999). There is no "best" single technique, as every project will almost certainly have individual characteristics, which make it unique (Amos and Dent, 1997).

4.7.3.3 Risk Responses

Since all projects are unique and risks are dynamic throughout the life of the project, it is necessary to formulate response to the risks that are appropriate. The information gained from the identification and analysis of the risks gives an understanding of their likely impact on the project if they are raised. This in turn, enables an appropriate response to be chosen. Typically there are three main types of responses to risks: to avoid or reduce the risks, to transfer the risks, or to retain the risks.

❖ *Risk Avoidance or Reduction*

Once the risks, particularly the sources of risks, have been identified and analysed, it may be possible to formulate methods of avoiding certain risks. During the earlier stages of a project the client may take a preventive action to reduce, avoid or transfer risks. Rejecting a proposal is an obvious way of avoiding risks. However, if the client decided to proceed with a project, then risks should be reduced wherever possible. This will be normally achieved through a variety of actions including detailed design review, further geographical and / or geotechnical investigation, more detailed study of the project environment, the use of alternative contractual agreement and strategies, closer co-ordination with the project team, or the application of different technology or construction method.

❖ *Risk Transfer*

Risk transfer involves transferring the risk from one part to another, without changing the total amount of risk in the project. Risk transfer can occur between the parties involved in the project or between one party and an insurer. The decision to transfer or allocate risk to another party is implemented through an insurance policy or the conditions of contract. It is usually up to the client to initiate the transfer of risk, although there are several factors that need to be considered before any risk is transferred. First, the capability of the party whom the risk is being transferred to manage or control the risk and the acceptance of the consequence of risk transfer. The second consideration is whether or not the risk premium that would have to be paid for the transfer of a risk is greater than the cost of the consequences. There is usually little point in paying more to transfer a risk than it would cost to accept the consequences.

❖ *Risk Retention*

In some situation the only option available is to retain a risk. The party that is holding a risk might be the only one that can manage the risk or accept the consequences. The risk retained may be controllable or uncontrollable. If the risk is controllable then control may be exerted to reduce the likelihood of occurrence or the impact of the risks. It is normal for the client to be left with some risks and these are termed residual risks (Shen, 1999; Smith, 1999).

4.8 Benefits of Implementing Risk Management

Raftery (1994); Godfrey (1995); Mootanah (1998); and Hiley and Paliokostas (2001) mentioned that many benefits could be gained from applying systematic risk management process as follows:

- Better understanding of project objectives.
- Better understanding of uncertainty.
- Better responding to unexpected events.
- Effective team building and better use of skills and experience of project personnel.
- Promoting effective communication.
- Improving project management.
- Improving decision-making.
- Establishing the justification of contingencies.
- Reducing project costs.
- Providing value for money.
- Protecting the balance sheet by transferring or avoiding unaffordable risks.
- Eliminating unnecessary risks.
- Concentrate resources on what matters.

4.9 Risk Management and Managing Brief Development

The growing interest in project risk management in the UK during the 1990s has given rise to a multitude of risk management frameworks and risk analysis packages being available to the project management practitioner (APM, 1992; Simister, 1994; Chapman and Ward, 1995&1997). This is because the construction industry is recognised as a high-risk industry and projects are unique. Risk management is also increasingly popular because it provides value for money (Mootanah, 1998; HM Treasury, 1993). In addition, Latham (1994) made many recommendations for improving the performance of the construction industry and highlighted the need for risk assessment to be carried out at important stages of the construction process. Because of the dynamic nature of client organisation and the different internal and external drivers that affect brief development, risk management should be seen as a continuing activity throughout the project life cycle (Smith, 1999; Amos and Dent, 1997). The principles of risk management are widely used in the construction industry, applied at various stages during the procurement process. It is an appropriate tool that could be used to manage brief development. This is attributed to the following factors:

(1) Risk management is a well-established technique directed towards identifying, analysing and responding to the different risks that affect and hinder the achievement of client objectives.

(2) Risk management helps the project stakeholders decide if the potential benefits associated with a particular course of action are sufficient to warrant accepting the identified risks. In addition, it safeguards the sponsor's interest when a course of action has been selected (Chapman, 1995) so client satisfaction could be materialised.

(3) Risk consideration plays an important role in ensuring that best value for money (VFM) is achieved since reducing risk means increasing opportunities to add value (Mootanah, 1998).

(4) The greatest uncertainties occur in the early stages of a project when decisions of the greatest impacts are made. All risks must, therefore, be assessed and allowed for at the outset of any project. Amos and Dent (1997) stated that risks are dynamic and change during most projects therefore; risk management should be a continuing activity throughout the life of the project.

(5) The systematic approach of risk management and teamwork helps rationale and adopting the best solution through the application of pre-defined steps. In addition, feeding back the design and construction team with learned lessons will direct their attention to better management of associated risks and will improve the briefing process in future projects.

(6) Risks are not always having negative impacts on project performance but it could have positive ones (Hiley and Paliokostas, 2001). This approach emphasis and support the concept of dynamic

brief development which states that responding to different brief development drivers with their associated risk leads to achieving emerging client requirements and enhance project performance.

(7) Risk management plays a vital role in managing change orders in construction for the benefit of the client. This could be achieved by adequately studying the effects of associated risks on project's time, cost and quality, then change orders with beneficial effects and that have an acceptable risk could be approved, where downside change orders with unacceptable risks could be avoided (Smith, 1999).

4.10 Integration of Value and Risk Management

The construction industry is considered to be a highly risk industry, not only because its fragmentation and the difficulties in co-ordinating the different parties embarked on a project particularly when using procurement routes where design is separated from construction, but also because of the influence of the myriad internal and external brief development drivers. When conflicts arise between the parties involved, the risk can increase and have a serious impact upon project performance. To overcome its problems, the industry has looked to other industries for successful management techniques. Such techniques are utilised as a means of achieving value for money. This could be achieved by defining clear objectives and establishing a consensus as to how to meet these objectives, ensuring the economic soundness of the project and dealing effectively with problems, which may adversely affect project objectives. The first two of these activities are encompassed within value management, where the third one is encompassed within risk management. Whilst these disciplines have followed separate routes since their introduction into the construction industry, they have strong links.

4.11 A Comparison between Value Management and Risk Management

Originating in other industries, value management and risk management are considered an essential part of project management. They can be undertaken by a range of construction professionals but need the involvement of experienced facilitators. Value management and risk management are group activities based on systematic process and utilise multidisciplinary teams in creative workshops. Value management is a means of defining project objectives whilst risk management ensures that these objectives are not affected by future uncertain events. Value management need creativity to generate options that meet required functions, whilst risk management requires creativity when identifying and responding to potential risks. A common technique used in both is brainstorming. Value management and risk management bring value to a project. Value management enhances value by clarifying objectives, establishing good communication and preventing conflicts. Value engineering promotes the elimination of unnecessary cost and as a consequence adds value to the project. Proactive risk management add value to a project by ensuring that project risks are prevented, reduced or managed efficiently. Both techniques improve decision-making.

In spite of the similarities between value management and risk management, it may be argued that value management and risk management are fundamentally disparate in that they require a different mindset. Value management may be thought as requiring positive approach, with risk management requiring a negative frame of mind. However, in risk management, the negative phase can be said to be limited to the risk identification stage. The risk response stage requires a positive mindset in order to identify the means by which the situation may be improved (Hiley and Paliokostas, 2001).

4.12 The Argument for Integrating Value Management and Risk Management

In recent years, value management and risk management have become increasingly popular among project management practitioners. This could be attributed to many reasons such as (1) more accountable decision-making, (2) new contractual scheme, (3) the prototypic nature of construction projects and (4) the emergence of increasingly multi-faceted clients as opposed to unitary clients in the industry (Green 1996a). In addition, projects procured under the Private Finance Initiative, the public sector's underlying objectives are to achieve best value for money and optimum risk transfer (Mootanah, 1999). It is argued that value for money can be achieved either by enhancing the requirements of a project, or by reducing the cost of meeting them. The search for value for money is trying to find the best balance between meeting requirements of stakeholders and the resources available (Connaughton and Green, 1996). Finding this best balance will inevitably involve some risks and these risks have to be identified and assessed (Mootanah, 1999).

Value management and risk management are two well established disciplines recognised as a part of best practice. In Risk management when a risk is managed it is possible to achieve a cost saving and an enhancement in value. In Value Management when options are considered there may be risks associated with each proposal. Risk management and value management appear to be both compatible and complementary and therefore it is logical to argue that the potential for a common framework should be investigated (Hiley and Paliokostas, 2001).

Norton and McElligott (1995) suggested that risk management may be enhanced by value management, using the value management team to either audit or produce a project's risk management plan. They suggested that during the creativity phase alternative methods of mitigating recognised risks could be generated. Therefore, the addition of risk management can also improve awareness of the potential risks of alternative proposals (Thiry, 1997). In a combined approach there is a potential to benefit from the assembled multi-disciplinary team and also to promote the introduction of risk management into an organisation (Connaughton and Green, 1996).

4.13 The Existing Approach for Integrating Value and Risk Management

Randall (1996) argued that the acceptance and implementation of both Value Management and Risk Management as a combined approach is strengthened. Many construction clients are interested in the concept of value management and the opportunity to apply it to their projects. But many question its relationship with other management techniques, which they also regard as important and would like to implement, in particular risk management, which, like Value, has to be applied at the earliest possible stage of the project life cycle. Another driver behind this pursuit of a collaborative approach is that the time allocated to Value Management workshop is very expensive in terms of team member's' time. Workshop therefore needs to represent best value for money by maximising the use of the time allowed.

There are clear boundaries between the disciplines, but they can be difficult to define precisely. For example, Value Management is about decision-making and risk management is about carrying out decisions for the duration of the project. Similarly, Value management is about identifying solutions that represents the best balance of time, cost and quality, and Risk Management is about ensuring that the solution are risk efficient and represent an optimum balance between risk and opportunity. Results of pilot studies carried out by Randall, showed that value managers recognised that decisions on value should take risk into account and that some risk identification and analysis should be carried out on options during value workshops.

The value and risk workshop as suggested by Randall is conducted in the following manner:

(1) Information gathering is carried out jointly by value and risk facilitators, from the client-briefing meeting to agree the workshop participants and study objectives to the collection of data for the project.

(2) A briefing back is issued containing pertinent information for the project and the workshop, including risk identification form to be completed by delegates prior to the workshop. The completed risk identification forms are collected and reviewed by the risk facilitator.

(3) All participants including the risk facilitators commence the value workshop with building the Function Analysis Systems Techniques (FAST). Then every function is weighted using cost, client priority or other criteria specific to the project in hand.

(4) The first opportunity for risk intervention is when the FAST diagram is completed. Alternatively, the study by Randall, experimented risk intervention at later stage after the completion of preliminary evaluation of brainstorming ideas.

(5) Following the workshop, the project team will assume responsibility for the risk register and will meet regularly to review, amend, add or remove risks from the register as the project progresses. The remainder of risks are then considered individually and weighted, typically in respect of probability of occurrence and impact.

(6) The workshop team reconvenes after one week to review value management proposals developed, taking identified risk into account and to review the risk register.

To recap, the two disciplines are clearly essential to recognise the tangible benefits such as combining information gathering activities, maximising the use of workshop time, adding information to value hierarchy diagram, incorporate risk to option evaluation, and launch risk strategies, which have common ownership.

Kelly and Bowles (1998) stated that although value management and risk management have their own distinct framework and are separate in their own right, there are some proponents in the construction industry who advocate a combined service. This is made possible by integrating the various elements of risk management within the traditional Job Plan structure of the value management workshop. The emphasis is firmly on the qualitative risk assessment, in that there will be no use made of any of numerical risk analysis techniques. This is because of the lack of resources in terms of staff experience and software for carrying out numerical technique, the lack of demand for more detailed approach, and the absence of numerical data relating to identified risk such as the probability of occurrence and its financial implications. There are persuasive practical reasons for such a combined services. Participants spend less time in workshops and there is less in fees with the combined approach. Value management and risk management can be said to be complementary since a reduction in risk means an increase in value. The intervention points where risk management stages are most logically carried out within the Job plan are shown in figure (4.1).

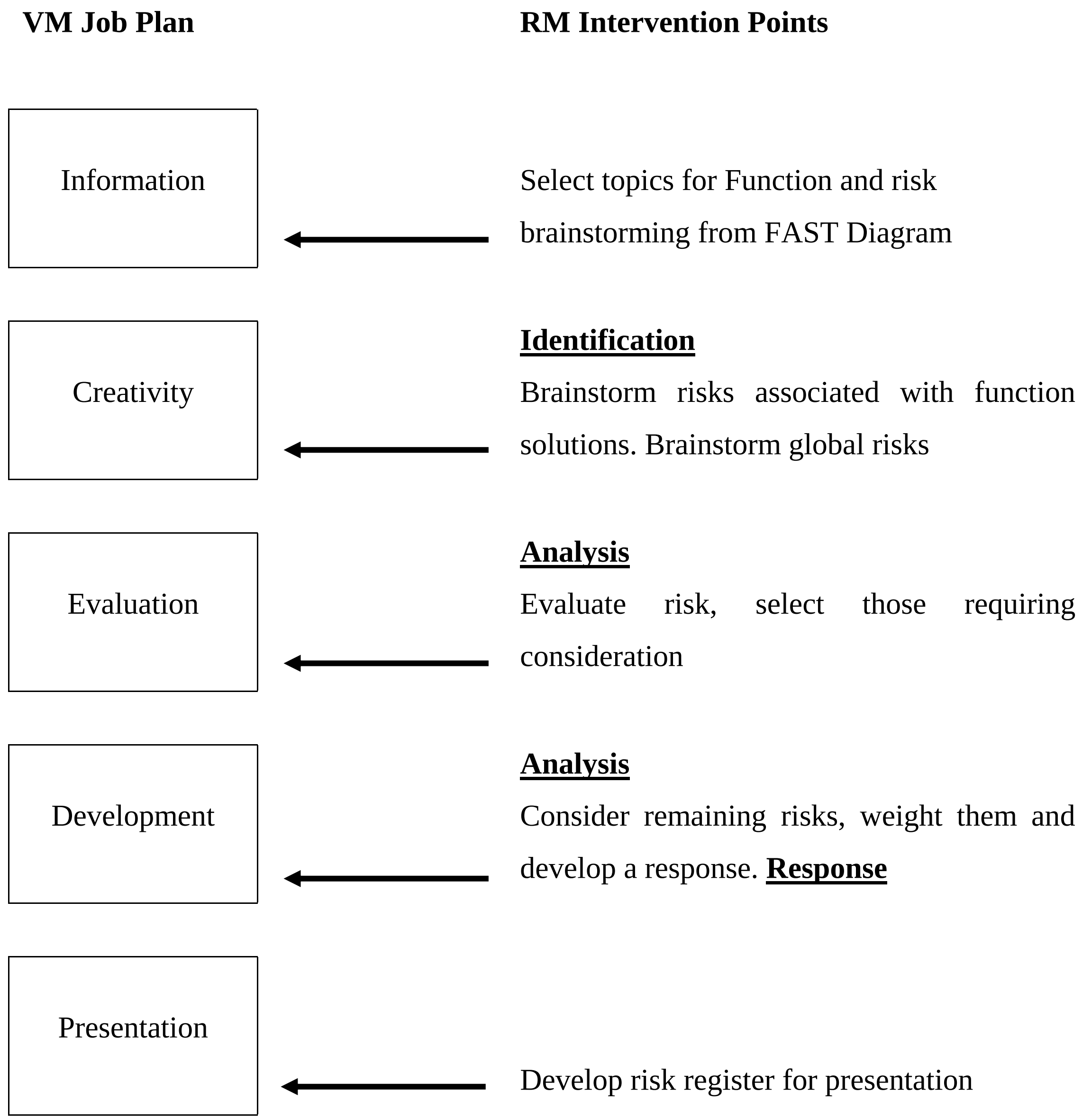


Figure 4.1 The Combination of Value Management and Risk Management

Green (1996b) stated that risk management and value management are both widely recognised to be an essential part of best practice. Although significant attention has been directed to the two topics in isolation, there has as yet been little progress in the development of an integrated approach.

The first step towards an integrated script for risk and value management is to reject the language of 'risk' and 'value' in favour of the language of *uncertainty*. Value management is primarily concerned with resolving uncertainty regarding project objectives. In contrast, risk management addresses uncertainty regarding outcomes. When expressed in these terms, the inter-dependence between risk and value management is readily apparent. The effect of unknown outcomes cannot be assessed until the objectives are clear. At the same time, the project objectives may well depend upon the identified areas of uncertainty. A feasible script, which addresses both types of uncertainty, is provided by the group decision support methodology known as 'strategic choice'.

The basic premise of strategic choice is that managerial decisions are made in conditions of uncertainty. It seeks to aid the decision-making process by conceptualising three different types of uncertainty, the first of which relates to the clarity of 'guiding values'. This type of uncertainty, labelled **UV**, is primarily caused by ambiguous objectives. A decision-making group's response to **UV** may be to seek policy guidance from a higher authority, or to commission a consensus-building exercise such as a value management exercise. The second type of uncertainty pertains to the broader environment and is labelled **UE**. This is the kind of uncertainty, which is normally dealt with through risk management techniques. Responses to **UE** are usually of a technical nature, comprising surveys, forecasting exercises or cost estimation. The third kind of uncertainty concerns 'related decision fields'. This is labelled **UR** and relates to the 'inter-connectiveness' between decision areas. In other words, uncertainty concerning the wider implications of an individual decision. The response here may be to re-frame the decision area or to consult with others beyond the immediate constituency of the problem-owners.

From a postmodernist perspective, the expressions 'risk' and 'value' do not relate to any sort of external reality, but provide the language through which managers construct their own reality. The contention is that neither value management nor risk management possess any substantive content other than the language within which there are presented. They are only implemented as discrete activities because there is an expectation that 'risk' and 'value' should be managed separately. This expectation is created by the literature, which has fabricated the misconception, that value management and risk management exist independently.

Kirk (1995) proposed a generic approach to the integration of value management programme, which include the standard Value Analysis Job Plan, with a risk management programme that includes a qualitative risk assessment, a quantitative risk analysis, and the implementation of risk mitigations. The methodology starts by preliminary risk identification in general qualitative terms. Then probabilistic analysis and Monte-Carlo simulation of project costs are carried out during the information phase. Risk mitigation is brainstormed in parallel with idea generation during creativity phase. Risks are considered as a weighted criterion in the evaluation phase. The alternatives are risk analysed during development phase. In the presentation phase, the risk assessment with suggested mitigations is presented. This is accompanied with the cost, risk analysis and new proposals and cost savings. During implementation, if these proposals have to be modified, a second risk analysis of the final proposals is performed. Kirk's risk and value management methodology concentrates on quantitative risk analysis that can be applied to project cost and schedule, although the first step does consider general risk issue in qualitative terms.

Starling (1995) made an attempt at conducting risk analysis within value management by using specific risk analysis software for carrying out an uncertainty analysis of proposals resulting from value engineering studies. This method aimed at determining the degree of uncertainty in value engineering proposals in terms of its effect on the projected savings on project costs.

Mootanah (1998) developed a conceptual framework for integrating value and risk management. The framework suggested five project phases at which the integrated value and risk management studies could be carried out in the management of a typical construction project. These phases are at: (1) project inception and feasibility phase, (2) design phase, (3) procurement phase, (4) implementation phase, and (5) completion phase and post completion. These studies will help to achieve consensus on objectives at project definition, to determine the design options at the design phase, to select the most appropriate contract strategy at procurement phase, to solve problems during implementation and to record lessons learnt for further projects.

At the very early stages of a project, the objectives are generally ill defined and soft approach will be relevant for identifying the objectives of the project stakeholders and for building consensus on those objectives. Further along the project life cycle, issues become clear and decisions can generally be made with more certainty using a Job Plan-based systematic integrated value and risk management methodology. However, where problem situations shift from clearly defined to undefined, especially where political decisions are involved, the methodology will be dealing with issues like re-structuring of objectives and stakeholders perceptions. Hence the application of any value and risk management methodology within the proposed integrated frameworks should remain dynamic and be adapted to the project management phase and to the type of problem situation. In addition, the suggested approach draws an inter-phase interface between value management and risk management.

4.14 Limitations of the Existing Approaches for Integrating Value and Risk Management

In spite of the little attention paid to the subject of the integration of value management and risk management, the methodologies and approaches described above tried to establish the basis and the theoretical foundation for the integration process. All approaches emphasised that Value Management and Risk Management are complementary techniques and there is a need and possibility for their integration. This is because best value could not be achieved unless associated risks have been managed taking into account the cost of their management. So, an elaborated compromise between value and risk has to be reached in order to achieve the client objectives and user need at the minimum cost, maximum value, on or before schedule, at the best function performance, and the optimum quality specified. In addition, the points of agreement outweigh the points of disagreement. Furthermore, Mootanah (1998) stated that all the above methodologies seem to be undergoing continuous improvement and there is no definite strategy at present amongst project management practitioners. However, they can be definitely seen as major stepping stones for exploring further the possibility of developing an integrated approach to risk and value management that will improve value and manage risk effectively for a project. The following section will identify the limitations of these approaches.

(1) Randall, emphasised the necessity of combining the two techniques. The suggested combined approach is still developing and the results of the pilot studies carried out are inconclusive. In particular the question about the extent of evaluating value management under uncertainty, and therefore conducting risk identification before of after value brainstorming remains to be answered. The pilot studies suggested that the earlier risk intervention may be more appropriate at the project inception stage and that the later risk intervention may be more appropriate when the workshop occurs later in the project life cycle. In addition, the specific combined approach adopted is value driven and utilises a dominant value Job Plan. Value is therefore the lead technique, which is used to launch risk activities. In spite of the success of using FAST for risk identification, many risk managers, have commented that the brainstorming under functions inhibits the identification of "global and intangible" risks.

(2) Kelly and Bowles, suggested an approach to the combination between Value Management and Risk Management. This approach emphasises risk qualitative assessment and do not employ any numerical risk analysis technique. In addition, the suggested approach selects topics for function and risk brainstorming during the information phase and identifies risk associated with function solutions in the creativity phase.

(3) Green, articulated that there are little progress in the development of an integrated approach of Value and Risk Management. He suggested replacing the language of "uncertainty" instead of the language of "Value" and "Risk". Based on the Strategic Choice Theory, three types of uncertainty exist. The first type could be solved by following up the Value Management techniques; the second type of uncertainty could be dealt with thorough risk management techniques. The response of the third types of uncertainty may be to re-frame the decision area or to consult with others beyond the immediate constituency of the problem-owners. A criticism of this approach is that it introduces another term, namely, uncertainty management, which may exacerbate the existing confusion concerning terminology.

(4) however, some models have some benefits such as Kirk, Starling and Mootanah who emphasised the integration of value management and risk management. According to Kirk (1995) his approach was concludes to be successful in practice, where Starling used uncertainty analysis at later stages after the value engineering proposals were developed. Finally, Mootanah's approach extends the use of value management and risk management to the completion and post completion phase.

(5) All the described approaches manipulated the process of integrating value and risk management from the theoretical point of view. Little has applied it into practice to solve engineering or construction problems such as managing brief development or managing project change orders.

(6) There is no clear use of the information management or information technology in integration of value management and risk management.

4.15 Conclusions

Permitting brief development throughout the project life cycle as an approach to overcome the limitations of the current briefing process necessitated the importance to establish the basis of controlling and managing brief development. Since brief development either add value or risk to the project or could be both, the two well-established disciplines of Value Management and Risk Management which are recognised as a part of best practice were the most appropriate tools to manage brief development. The links between them are strong since best value could not be achieved unless associated risks have been managed. In order to establish the basis to manage brief development, this chapter was devoted to examine the application of value management and risk management in construction and investigate the possibility and argument for their integration.

This chapter was divided into two parts. The first part reviewed and examined the value management and risk management techniques and their application in the construction industry respectively. It concluded that value management is concerned with achieving client objectives at the required quality and at the most cost-effective manner where risk management aims to identify and analyse associated risks that threat the project success and then prepare and implement the proper response to mange these risks. Definitions of related terms and different types of values and risks were presented. In addition, the value process with its components of value planning, value reviewing, value engineering and value management was explained. Six milestones were identified as the opportunities to achieve better value of money. Furthermore, the value management procedures and the risk management process were explained. Finally, the benefits of implementing value management and risk management as well as justifications of using both techniques to manage brief development throughout the project life cycle were explained.

The second part investigated the potential and possibility to integrate value management and risk management in construction. Although little progress in developing an integrated approach was articulated, many approaches were presented. These approaches seem to be undergoing continuous improvement and there is no definite strategy at present amongst project management practitioners. However, they could be viewed as a major move for developing an integrated approach to value and risk management. Analysis of these approaches showed the importance and possibility of integrating the two techniques. This is because risk management could be enhanced by maximising the use of the value management workshop and its team and that best value could not be achieved unless associated risks have been managed. In addition, the benefits of using VM and RM attracted many clients to apply the two concepts in their projects. Furthermore the points of agreement outweigh the points of disagreement.

Randall, stated that the suggested combined approach is still developing and the results of the pilot studies carried out are inconclusive. In particular the question about the extent of evaluating value management under uncertainty, and therefore conducting risk identification before of after value brainstorming still needs to be answered. Kelly and Bowles emphasized the use of qualitative risk assessment and their suggested approach selected topics for risk brainstorming during the information phase and identification of risk associated with function is carried out during the creativity phase. Green, suggested replacing the language of "uncertainty" instead of the language of "Value" and "Risk". This approach was criticized because of the introduction of another term, namely, uncertainty management, which may exacerbate the existing confusion concerning terminology. Kirk, Starling and Mootanah emphasised the integration of value management and risk management. Kirk's approach was concluded to be successful in practice, where Starling used uncertainty analysis at later stages after the value engineering proposals were developed. Finally, Mootanah's approach extends the use of the use of value management and risk management to the completion and post completion phase.

All the described approaches manipulated the process of integrating value and risk management from the theoretical point of view. Little has applied it into practice to solve engineering or construction problems such as managing brief development or managing project change orders. In addition, there is no clear use of the information management or information technology in integration of value management and risk management.

Because of the importance to build a firm understanding of the drivers that lead to brief development, the next chapter will focus on identifying, quantifying, and classifying the brief development drivers as well as establishing the relationship between the brief development drivers and the project team members in order to identify the originators of brief development, the value sources and risk sources to the project from the client's point of view.

Chapter 5

Drivers for Dynamic Brief Development in Construction

5.1 Introduction

Supporting the Dynamic Brief Development concept and ensuring its successful implementation, as an approach to overcome the limitations of the current briefing process, necessitated the importance of establishing a firm understanding of the drivers that lead to brief development. In order to achieve this aim, this chapter focuses on four important issues. They are the identification, quantification and classification of the brief development drivers as well as the identification of the originators of brief development, value sources and risk sources to the project from the client' point of view. Firstly, literature review and case studies were used to identify and validate the brief development drivers where documentary data and unstructured interviews were used to collect information about the project history and the project brief at different stages as well as investigate the way in which the project brief was developed. Secondly, a survey questionnaire was designed and issued to quantify the brief development drivers. A three-stage data analysis was adopted to analyse the questionnaire responses. They were the measure of central tendency and dispersion, relative importance index and Bivariate analysis. Thirdly, a holistic approach was developed to classify the brief development driver as internal, external and internal and external drivers. Finally, a relationship matrix between the brief development drivers and the project team members was created in order to identify the originators of brief development, the value sources and risk sources to the project from the client's point of view.

5.2 Identification of the Brief Development Drivers

The importance of the brief development concept called for the identification of the drivers that lead to brief development. This was achieved through the use of diverse and complementary research methods. Firstly, literature review based on textbooks, professional journals and magazines, conference and seminar proceedings, dissertations and theses, organisations and government publications as well as Internet and related websites resulted in identifying a group of the brief development drivers. In order to complete the picture of these drivers and validate the identified drivers, 36 recently completed construction projects were collected and analysed. These projects were gathered from the United Arab Emirates construction industry and represented different types of buildings ranging from residential villas to commercial buildings, urban design projects, and office buildings. In addition, they represent different client categories, ranging from private clients to investment companies and government authorities. Furthermore, the selected case studies were different in their cost, duration, and quality. The information obtained was classified into two main types. Firstly, general project information which included (project type, project components, project cost, project duration, project quality, contract type) and secondly, the development of the project brief which included (development type, development driver, development stage, development effects on cost, time, and quality, and steps adopted to manage brief development). The case studies used in this research are attached in appendix (H).

The use of case studies confirmed the identified drivers and added new drivers, which were not covered by current literature. These new drivers were specific to the culture of the surveyed society. Each case study comprised a detailed inspection of documentary data (project archive files) to collect information about the project history and the project brief at different stages. Particular attention was paid to gathering information from the correspondence between the related parties such as client-designer, client-funding bodies, designer-other consultants and designer-government authorities, minutes of meetings, internal memos, drawings and specifications. Following the examination of the project files, an unstructured interview was held with the project architect, when appropriate, in order to investigate the way in which the project brief was developed (Othman et al, 2004a).

Triangulation or in other words using more than one source of evidence (project documentation, and the recollection of the project architect) helped improve the validity of the collected brief development drivers by verifying findings of one source with other sources as well as enabled increase background knowledge. In an effort to ensure the reliability of the data, data collection and questioning concentrated on facts and events, rather than highly subjective interpretations (Yin, 1989; MacPherson et al., 1993; Maxwell, 1996). Literature review and case study resulted in the identification of 47 brief development drivers. The work was reviewed and refined on a regular basis in order to omit repeated drivers and merge similar ones. The end result was the identification of 30 drivers of brief development. Table (5.1) lists the identified brief development drivers and indicates whether the driver was identified from literature, case study or both. Since, the concept of Dynamic Brief Development extends brief development throughout the project life cycle, therefore the case studies covered all project stages from the appraisal stage till the after practical completion. Analysis of case studies showed that most of the drivers that affected the project brief occurred during the construction stage where it is expensive and difficult to execute changes, see figure (5.1). Please note that the drivers in "*italics*" represent the drivers for which there is no allowance under existing briefing systems and are extracted from case studies.

No.	Brief Development Drivers	Literature Review	Case Study
1	Stakeholders change project requirements and have second thought at later stages (Barrett and Stanley, 1999)	✓	✓
2	Uncoordinated and incorrect construction documents (O'Leary, 1992)	✓	✓
3	Brief information is still being given during later design and construction stages (Barrett and Stanley, 1999)	✓	✓
4	Materials are no longer available in market and use better substitute materials (Tenah, 1985)	✓	✓
5	Lack of information provision (Barrett and Stanley, 1999)	✓	✓
6	Meeting new technology changes (PMI, 2000)	✓	✓
7	*Lack of regulatory up-dating*		✓
8	Project users are not involved in the briefing process (Kernohan et al., 1992)	✓	✓
9	Unforeseen conditions (O'Brien, 1998)	✓	✓
10	*Lack of understanding of different users' culture and traditions*		✓
11	*Eliminate proven poor quality materials and equipment*		✓
12	Lack of design experience (ICE, 1996a)	✓	✓
13	Changing government regulation and codes (O'Leary, 1992)	✓	✓
14	Responding to market demand (Smith and Wyatt, 1998)	✓	✓
15	Improper feasibility studies (Valence, 1999)	✓	✓
16	Restricted design fees (ICE, 1996a)	✓	
17	Lack of understanding of the client organizations (Barrett and Stanley, 1999)	✓	✓
18	Inappropriate communication between the client and the designer (Barrett and Stanley, 1999)	✓	✓
19	Unclear and incomplete project brief (Barrett and Stanley, 1999)	✓	✓
20	Designers ignore the client role and behave unilaterally (Kelly et al., 1992)	✓	✓
21	*Lack of communication and co-ordination between government authorities and design firms over planning and approvals*		✓

22	Lack of presentation and Visualisation of design (Barrett and Stanley, 1999)	✓	✓
23	*Users exaggerate their needs*		✓
24	*Upgrade project facilities*		✓
25	*Project users appear at later stages*		✓
26	Inadequate available design time (ICE, 1996a)	✓	
27	*Lack of functional, aesthetic, safety requirements and constructability*		✓
28	Lack of consideration of environmental requirements (Best and Valence, 1999)	✓	
29	Whole project life not considered (CIB, 1996)	✓	✓
30	Initiating value engineering changes (Stocks and Singh, 1999)	✓	

Table 5.1 The Brief Development Drivers

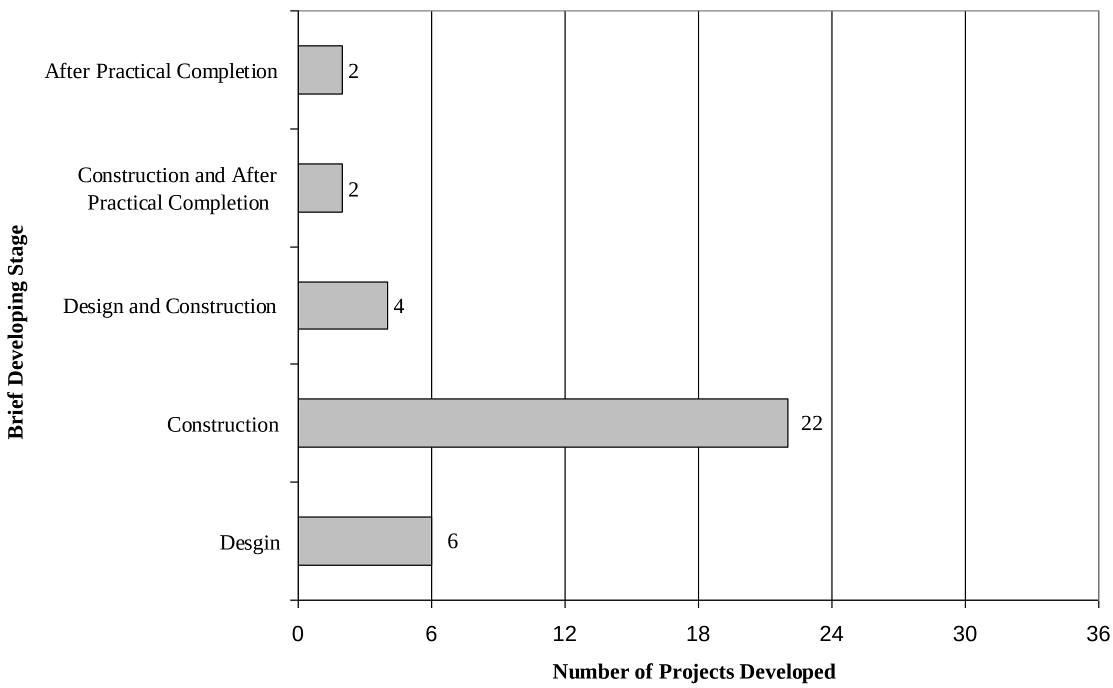


Figure 5.1 The Number of Projects Developed against Brief Development Stages

5.2.1 The Rationale behind the Brief Development Drivers

Many of the drivers identified by the literature review were confirmed by the analysis of the case studies as shown above. These drivers can be considered in 12 groups and the rationale behind their occurrence was investigated in order to identify their role in developing the project brief.

5.2.1.1 Drivers Relating to Communication, Clarity and Understanding (Nos. 19, 18, 17, 20 & 22)

Barrett and Stanley (1999) stated that very few buildings finish on time or at the right price and clients often criticise the fact that the finished building is not what they expected. Clients, particularly naive ones, may find it difficult to describe their objectives and operations to another party, which leads to the production of unclear and incomplete project brief. This becomes a greater problem when the designer is not skilled in the art of questioning. In addition, lack of presentation and visualisation techniques inhibit the client's understanding of project design and what the building will look like. It would appear that at one or more stages of the construction process there must be a lack of communication between the parties involved. Kelly et al. (1992) and analysis of case studies showed that architects are more likely to gain kudos from peer approval than from the satisfaction of their clients and may ignore the role of the client and behave unilaterally. These are factors, which have resulted in clients’ dissatisfaction and driven them to develop the project brief by changing, modifying, omitting and adding to its contents.

5.2.1.2 Drivers Relating to Feasibility Studies (No. 15)

A Feasibility Study was defined as a study to determine the probability that a specific real estate proposal will meet the objectives of the developer and / or investor (Collins, 1999). Valence (1999) stated that there are numerous examples of projects proceeding to detailed design stage without proper feasibility studies. Improper feasibility studies and the absence of reasonable alternative options including a no-build option lead to the failure of the project and the project brief to meet the client objectives as well as market and business needs.

5.2.1.3 Drivers Relating to Value (No. 30)

Value Engineering was defined as the process of relating the function, the quality and the cost of the project in the determination of optimum solutions for the project (Omigbodun, 2001). Initiating Value Engineering changes contributes to the production of better and smarter designs (Stocks and Singh, 1999). This could be achieved through developing the project brief by improving functionality (AMEC, 1999), eliminating unnecessary costs (Dell'Isola, 1997), simplifying design, using substitute cheaper materials that have the same or better quality, using substitute construction methods and equipment that have greater capacities, higher efficiencies, higher speeds, and lower operating costs, for instance (Tenah, 1985).

5.2.1.4 Drivers Relating to Project Users (Nos. 8 & 10)

An example of this in the case study was a housing project consisting of 400 houses designed by a foreign consultant who did not adequately understand the culture and traditions of the end users. After the practical completion stage of the project, the users implemented significant changes in order to meet their requirements such as privacy and the ability to add more rooms for future increase in their family sizes. Mustapha and Bintaher (2000) stated that the needs of the occupants may change, therefore housing cannot be considered as a final product but rather a process that needs to be continuously updated. The development of the project brief should highlight to the client organisation the importance of involving project users in the briefing process and understanding their requirements, culture and traditions.

5.2.1.5 Drivers Relating to Co-Ordination and Accuracy (No. 2)

Changes in the scope or details of construction originate from various sources. One of the main sources is the faulty construction documentation, which generates the need for alternative materials or processes (O'Leary, 1992). Uncoordinated and incorrect construction documentation can emerge from the unfamiliarity of the designer with the project, time shortage, misunderstanding, information overload, over manning for example (Wantanakorn et al., 1999). This leads to development of the project brief in order to rectify the incorrect project documentation and resolve the contradictions in them in an endeavor to ensure client requirements are correctly reflected.

5.2.1.6 Drivers Relating to Inadequate Provision of Information (Nos. 3, 28 & 5)

The case study project was a residential compound in the desert. It consisted of 35 buildings. The project cost was Dirhams (DHS) 53,760,000 and the construction period was 24 months. It was the first project of its kind to be constructed in the area and as a result, brief information was being delivered during late design and into construction. Lack of information for items such as soil nature and electricity load required resulted in changing the structural design from shallow foundation to deep piles and changing the electricity connection cable to suit the project size. Accordingly, the project handover was delayed by about 180 days. In addition, the omission to consider environmental requirements resulted in design changes to suit the area weather and shift the water tanks from exposed to underground water tanks to protect them from heat and sand storming. As a result, the development of project brief resulted in increasing the project cost by DHS 6,009,080 and the design and construction period by 330 days.

5.2.1.7 Drivers Relating to Regulations and Technology Advancement (Nos. 7, 13, 21 & 6)

One project in the case studies was a commercial complex consisting of basement floor (2 cinemas), ground and mezzanine floors (showrooms), 12 typical residential floors, roof, swimming pool, health club, 6 lifts, 4 escalators, central gas system, central water filtration system and central dish antenna. The cost of the project was DHS 76,960,000 and the construction period was 20 months. Changes in government regulations and codes during the course of the project and the failure of the designer to incorporate these changes, meant the basement had to change from cinema to shopping centre. Additionally, the lack of communication and co-ordination between government authorities and design firms over planning and approvals caused extra spaces and equipment for anticipated telecommunication connections meant substantial changes to the brief. These factors resulted in 25 days extra for re-design and approvals and DHS 246,667 as extra design cost. However, in mitigation these changes reduced the construction period by 60 days and the construction cost by DHS 725,000.

5.2.1.8 Drivers Relating to Quality and Sustainability (Nos. 27, 29, 24 & 11)

The case study project was a refurbishment and modification of an existing residential complex and the construction of new recreation area, fountains, swimming pool and car parking. The client objective was to upgrade the project facilities and add new services in order to enhance the project performance, increase its rent and attract new tenants. Many of the materials and equipment used in the existing project such as finishes, sanitary ware, fire fighting systems and lifts were proven poor quality and the maintenance cost as well as the whole project life were not considered. In addition, lack of functional, aesthetic and safety requirements resulted in development of the original brief in order to meet the client objectives. This development included the re-design of the flats and circulation areas, changes to internal and external finishing, the construction of new aesthetic facades, enhanced safety requirements, installation of high quality durable materials and equipment for instance. In spite of the cost, time and effort spent in developing the original brief, client objectives and satisfaction were achieved, annual income was increased, and the project performance was enhanced.

5.2.1.9 Drivers Relating to Design Cost and Time (Nos. 26 & 16)

All members of the design team have target dates by which their documentation must be delivered. Concern about meeting deadlines limits the time available for cost comparisons and value management. An inadequate budget for completing a design properly encourages designers to take shortcuts in the design process and can adversely affect the completed facility (ICE, 1996a). These are some factors that may drive the client and the designer to develop the project brief in a later endeavor to achieve maximum value and complete the design properly.

5.2.1.10 Drivers Relating to Unforeseen Conditions (No. 9)

Unforeseen conditions cause brief development, as the conditions of the field do not match the contract document. This most often occurs with regard to underground conditions, such as uncharted utilities, uncharted existing foundations, rock or other strata at higher elevation than expected, high ground water, and so on (O'Brien, 1998). Such conditions force the client and the designer to change and modify the project brief in an attempt to overcome these obstructions and deal with unexpected circumstances.

5.2.1.11 Drivers Relating to Market Conditions and User Demands (Nos. 1, 25, 23 & 14)

A case study project was designed to be a commercial building. After the design was completed and the building license issued, the client received an offer to lease the building for 20 years if the design was changed to a medical centre provided with the latest technological equipment and facilities. Because of the shortage of the market demand for commercial buildings and the business opportunity offered, the client decided to change the project design accordingly. The development of the project brief, which happened at the end of the pre-construction period, resulted in 100 extra days and additional cost of DHS 298,908 for re-design and approvals. A further 180 days were required to find a funding body to finance the extra DHS 2,104,318 for hospital equipment. The benefits that the client gained however far outweighed the increases in cost and time. The annual return for the commercial building was DHS 550,000 excluding the maintenance cost, which was the responsibility of the client, whereas the annual return of the medical centre was DHS 1,000,000 excluding the operation and maintenance cost, which was the responsibility of the medical centre.

5.2.1.12 Drivers Relating to Lack of Design Expertise (Nos. 12 & 4)

An example from the case study was a commercial building. Its facades were covered with curtain walls and most of the specified materials were imported. The rapid material and technology improvement, coupled with the lack of designer experience to follow up these improvements meant many of the specified materials were no longer produced or available in market. As a result, the client had to change the design of the facades and decided to use locally made materials. This development of the project brief enhanced the project performance. Firstly, the re-design of the project facades reduced the air-conditioning cooling capacity required and became more suitable for a country of hot and humid climate. In addition, these developments to the project brief minimised the project duration by eliminating the time required to import material from abroad and reduced the project cost through using locally made materials (Tenah, 1985). The construction period was reduced by 90 days and the cost was reduced by DHS 272,130.

As important as identification of the brief development drivers, quantification of these drivers plays an important role in understanding the importance of each driver. The following section will investigate the quantification of the brief development drivers.

5.3 Quantification of the Brief Development Drivers

A 530 survey questionnaire was designed and issued. The aim of the questionnaire was to quantify the brief development drivers in order to direct the attention of clients' organisations and construction professionals to the most influential drivers, so particular attention could be paid to manage them for the benefit of the project. The questionnaire was answered by the following categories: (1) clients' organisations, (2) end-users, (3) design firms, (4) constructors, (5) suppliers, (6) government authorities and (7) funding bodies. The questionnaire consisted of three sections, the first one was designed to obtain general information of the surveyed categories. It included information about the organisation name, organisation address, contact phone number, contact fax number, the respondent designation, and the organisation e-mail address. The second section investigated the perception of the brief development concept. Questions about the probability of brief development occurring during construction, stages of brief development, the parties responsible for brief development, impacts of brief development were asked. Finally, the third section was designed to quantify the 30 brief development drivers. A Likert scale of 1 to 5 was employed to measure the respondents' attitudes about the brief development drivers. The scale varies from very low influence (=1) to very high influence (=5). Although there are many forms of scaling, the Likert scale was adopted because it is commonly used (Bernard, 2000), simple to construct, permits the use of latent attitudes and it is likely to produce a highly reliable scale (Baker, 1997). Out of 530 questionnaires issued, a total of 261 completed and returned. This represents a response rate of 49.25%, which is considered a good rate of responses that will support the quantification of the brief development drivers and result in reliable findings. Table (5.2) summarises the number of planned and achieved questionnaires as well as the response rates of each surveyed category.

Surveyed Category	Questionnaire planned	Questionnaire achieved	Response rate (%)
Client Organisation	70	38	54.28
End Users	131	85	64.88
Design Firms	54	35	64.81
Constructor	96	48	50
Suppliers	21	14	66.67
Government Authorities	140	71	50.71
Funding Body	18	8	44.44
Total	530	261	49.25

Table 5.2 The Number of Planned and Achieved Questionnaires with their Response Rates

A three-stage data analysis approach was adopted. The first stage was simply to measure the central tendency and dispersion of the questionnaire responses. Measure of central tendency was used to get some overall measure of the typical value for each variable. This was done by calculating the most widely used measures, the mean, the median and the mode. Each measure of central tendency carries important information about the value of each variable. Measure of dispersion was used to know how homogenous or heterogeneous the collected data is. This was carried out by calculating its most useful measures, the variance and the standard deviation (Bernard, 2000). Secondly, since not all brief development drivers have the same influence on brief development, the well-established relative importance index route was used to determine the relative importance of the brief development drivers (Olomolaiye et. al 1987; Shash 1993). In order to investigate the correlation between the brief development drivers, the third stage established the linear relationship between the drivers using the Bivariate analysis. The data were analysed with the aid of Microsoft Excel spreadsheet and the Statistical Package for Social Sciences (SPSS) computer software (Kirkpatrick and Feeney, 2001).

5.3.1 Measure of Central Tendency and Dispersion

The analysis of the collected data showed the close values of means, medians and modes that tend to typical central values and showed also the lower values of variances and standard deviations, see table (5.3). This ensures the quality and the homogeneity of the collected data as well as the low degree of dispersion of these data, which will result in reliable recommendations for client organisations and construction professionals. Figure (5.2) rated drivers according to their means using clustered columns chart on a scale of 5.

Brief Development Drivers	Mean	Median	Mode	Variance	Standard Deviation
Stakeholders change project requirements and have second thought at later stages	5.00	5.00	5.00	0.000	0.000
Uncoordinated and incorrect construction documents	5.00	5.00	5.00	0.000	0.000
Brief information is still being given during later design and construction stages	4.91	4.50	5.00	0.833	0.913
Materials are no longer available in market and use better substitute materials	4.84	4.50	5.00	0.735	0.857
Lack of information provision	4.81	4.50	5.00	0.690	0.831
Meeting new technology changes	4.79	4.50	5.00	0.672	0.820
Lack of regulatory up-dating	4.76	4.50	5.00	0.634	0.796
Project users are not involved in the briefing process	4.72	4.50	5.00	0.600	0.775
Unforeseen conditions	4.72	4.50	5.00	0.600	0.775
Lack of understanding different users' culture and traditions	4.33	4.00	5.00	1.159	1.077
Eliminate Proven Poor Quality Materials and Equipment	4.31	4.00	5.00	1.148	1.071
Lack of design experience	4.29	4.00	5.00	1.124	1.060
Changing government Regulation and codes	4.29	4.00	5.00	1.124	1.060
Responding to market demand	4.28	4.00	5.00	1.117	1.057
Improper feasibility studies	4.22	4.00	5.00	1.074	1.036
Restricted design fees	4.15	4.00	5.00	1.035	1.017
Lack of understanding of the client organizations	4.05	4.00	4.00	1.004	1.002
Inappropriate communication between the client and the designer	4.02	4.00	3.00	1.000	1.000

Unclear and incomplete project brief	3.87	4.00	4.00	1.024	1.012
Designers ignore the client role and behave unilaterally	3.85	4.00	4.00	1.032	1.016
Lack of communication and co-ordination between government authorities and design firms over planning and approvals	3.72	4.00	4.00	1.114	1.056
Lack of presentation and Visualisation of design	3.49	3.00	4.00	1.355	1.164
Users exaggerate their needs	3.44	3.00	4.00	1.296	1.139
Upgrade project facilities	3.36	3.00	4.00	1.195	1.093
Project users appear at later stages	3.24	3.00	4.00	1.085	1.041
Inadequate available design time	3.11	3.00	4.00	1.020	1.010
Lack of functional, aesthetic, safety requirements and constructability	3.07	3.00	3.00	1.008	1.004
Lack of consideration of Environmental Requirements	2.50	2.00	3.00	1.378	1.174
Whole project life not considered	2.37	2.00	3.00	1.203	1.097
Initiating value engineering Changes	2.34	2.50	2.00	0.553	0.744

Table 5.3 The Brief Development Drivers with their Measures of Central Tendency and Dispersion

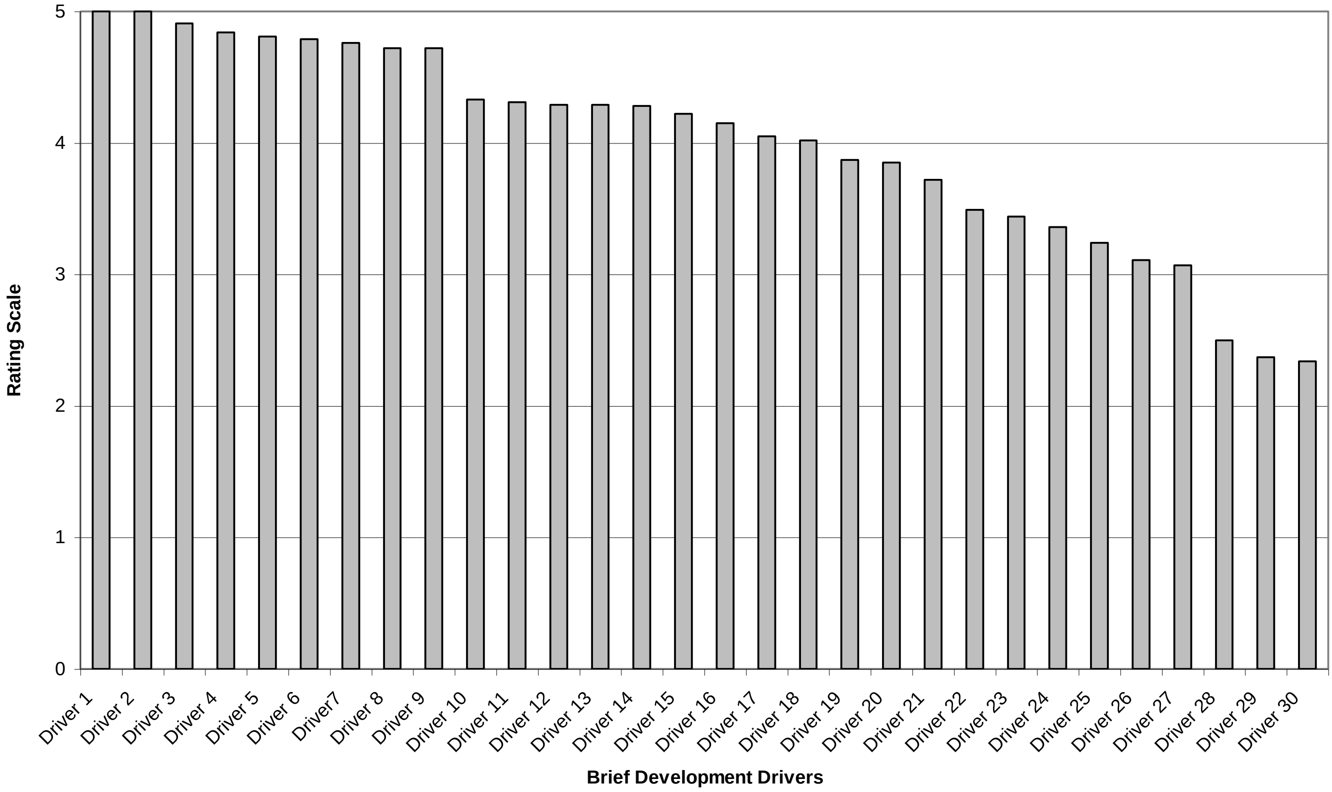


Figure 5.2 Rating the Brief Development Drivers on a Scale of 5

5.3.2 Relative Importance of Brief Development Drivers

The numerical scores from the questionnaire responses provided an indication of the varying degree of influence that each driver has on developing the project brief. To further investigate the data, the well-established relative importance index technique was used to determine the relative importance of drivers and rank them according to their influences (Olomolaiye et. al 1987; Shash 1993) calculated using the following formula:

$$\textbf{Relative Importance Index} = \frac{\sum \mathbf{w}}{\mathbf{A \times N}}$$

Where w = weighting given to each driver by the respondents and range from 1 to 5 where 1= very low influence and 5 = very high influence; A = highest weight (5 in our case); and N = total number of sample (Kometa and Olomolaiye, 1997). The relative importance index ranges from zero to one. As would be expected, while some drivers have very high influence on brief development, others do not. For example "stakeholders change project requirements and have second thoughts at later stages, uncoordinated and incorrect construction documents, brief information is still being given during later design and construction stages, materials are no longer available in market and use better substitute materials" are significant. The least influential drivers were identified as "Lack of functional, aesthetic, safety requirements and constructability, lack of consideration of environmental requirements, whole project life-cycle not considered, and initiating value engineering changes". Table (5.4) provides a full list of the overall relative importance indices and ranking of drivers. The numbers in brackets in the "Rank" column represents the sequential ranking, as some drivers have similar relative important index as in the case of the first two drivers.

Brief Development Drivers	**Percentage of Respondents Scoring**			**Relative Importance Index**	**Rank**	**Final Rank**
	< 3	**3 - 4**	**> 4**			
Stakeholders change project requirements and have second thought at later stages	0.00	0.00	100	1.000	(1)	1
Uncoordinated and incorrect construction documents	0.00	0.00	100	1.000	(1)	2
Brief information is still being given during later design and construction stages	0.00	9.20	90.80	0.982	2	3
Materials are no longer available in market and use better substitute materials	0.00	15.71	84.29	0.969	3	4
Lack of information provision	0.00	19.16	80.84	0.962	4	5
Meeting new technology changes	0.00	20.69	79.31	0.959	5	6
Lack of regulatory up-dating	0.00	24.14	75.86	0.952	6	7
Project users are not involved in the briefing process	0.00	27.59	72.41	0.945	(7)	8
Unforeseen conditions	0.00	27.59	72.41	0.945	(7)	9
Lack of understanding different users' culture and traditions	0.00	47.51	52.49	0.865	8	10
Eliminate proven poor quality materials and equipment	0.00	51.34	48.66	0.863	9	11
Lack of design experience	0.00	48.66	51.34	0.857	(10)	12
Changing government regulation and codes	0.00	52.49	47.51	0.857	(10)	13
Responding to market demand	0.00	49.04	50.96	0.856	11	14
Improper feasibility studies	0.00	55.94	44.06	0.844	12	15

Restricted design fees	0.00	52.87	47.13	0.831	13	16
Lack of understanding of the client organisations	0.00	81.61	18.39	0.810	14	17
Inappropriate communication between the client and the designer	0.00	62.45	37.55	0.803	15	18
Unclear and incomplete project brief	0.00	86.59	13.41	0.775	16	19
Designers ignore the client role and behave unilaterally	0.00	81.23	18.77	0.771	17	20
Lack of communication and co-ordination between government authorities and design firms over planning and approvals	0.00	89.66	10.34	0.745	18	21
Lack of presentation and visualisation of design	12.26	87.74	0.00	0.697	19	22
Users exaggerate their needs	15.71	84.29	0.00	0.689	20	23
Upgrade project facilities	18.01	81.99	0.00	0.672	21	24
Project users appear at later stages	24.14	75.86	0.00	0.648	22	25
Inadequate available design time	28.35	71.65	0.00	0.623	23	26
Lack of functional, aesthetic, safety requirements and constructability	13.41	86.59	0.00	0.615	24	27
Lack of consideration of environmental requirements	41.38	58.62	0.00	0.500	25	28
Whole project life not considered	46.36	53.64	0.00	0.474	26	29
Initiating value engineering changes	66.28	33.72	0.00	0.467	27	30

Table 5.4 The Brief Development Drivers with their Relative Importance Indices

Analysis showed that the brief development drivers could be classified according to their relative importance indices into three categories, see figure (5.3).

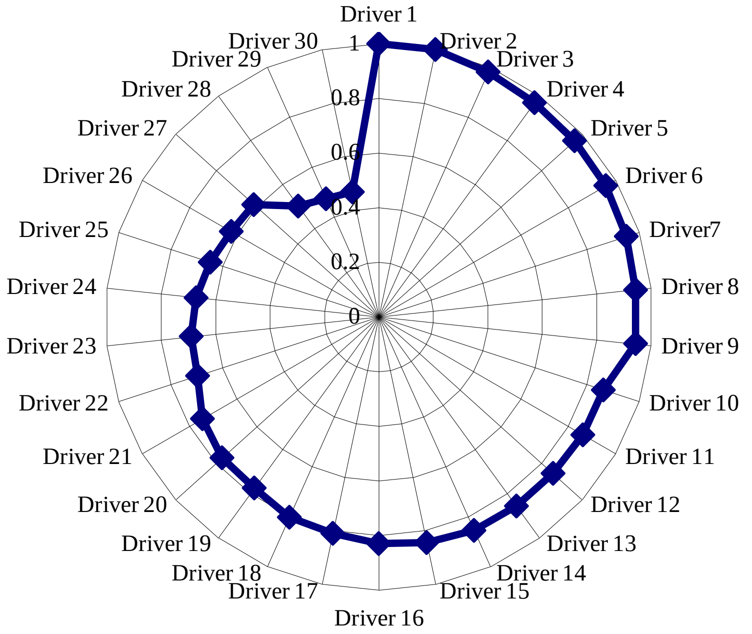


Figure 5.3 The Relative Importance Indices of the Brief Development Drivers

Firstly, the very high influential drivers which their relative importance indices above 0.800. This includes the following drivers:

- Stakeholders change project requirements and have second thought at later stages.
- Uncoordinated and incorrect construction documents
- Brief information is still being given during later design and construction stages
- Materials are no longer available in market and use better substitute materials
- Lack of information provision
- Meeting new technology changes
- Lack of regulatory up-dating
- Project users are not involved in the briefing process
- Unforeseen conditions
- Lack of understanding different users' culture and traditions
- Eliminate proven poor quality materials and equipment
- Lack of design experience
- Changing government regulation and codes
- Responding to market demand

- Improper feasibility studies
- Restricted design fees
- Lack of understanding of the client organisations
- Inappropriate communication between the client and the designer

Secondly, the average to high influential drivers, which their relative importance indices lie between 0.600 and 0.800. This includes the following drivers:

- Unclear and incomplete project brief
- Designers ignore the client role and behave unilaterally
- Lack of communication and co-ordination between government authorities and design firms over planning and approvals
- Lack of presentation and visualisation of design
- Users exaggerate their needs
- Upgrade project facilities
- Project users appear at later stages
- Inadequate available design time
- Lack of functional, aesthetic, safety requirements and constructability

Finally, the very low to low influential drivers, which their relative importance indices are less than 0.600. This includes the following drivers:

- Lack of consideration of Environmental Requirements
- Whole project life not considered
- Initiating value engineering Changes

5.3.3 Bivariate Analysis of the Brief Development Drivers

Because of the importance to investigate the correlation between the brief development drivers, Bivariate analysis was carried out to establish the linear relationship between the different drivers using the most common measure of correlation, Pearson's *r* (Clarke and Cooke, 1992). Bivariate analysis is concerned with the analysis of two variables at a time in order to uncover whether the two variables are related and to what extent the variation in one variable coincides with the variation in another variable. Bivariate analysis with the aid of Statistical Package for Social Sciences (SPSS) computer software was used to generate the correlation matrix, an extract of which is shown in table (5.5). The chief feature of using Pearson's *r* is that the correlation coefficient will almost certainly lie between 0 (zero or no relationship between the two drivers) and 1 (a perfect relationship), which indicates the strength of a relationship. The closer the coefficient is to 1, the stronger the relationship, the closer it is to zero, the weaker the relationship. The coefficient will be either positive or negative, this indicates the direction of a relationship (Bryman, 2001).

Brief Development Driver	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30
Driver (1)	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (2)	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (3)	-0.44	-0.44	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (4)	-0.38	-0.38	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (5)	-0.34	-0.34	0.99	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (6)	-0.32	-0.32	0.99	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (7)	-0.27	-0.27	0.98	0.99	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (8)	-0.22	-0.22	0.97	0.99	0.99	0.99	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (9)	-0.22	-0.22	0.97	0.99	0.99	0.99	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (10	-0.69	-0.69	-0.35	-0.41	-0.44	-0.46	-0.50	-0.55	-0.55	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (11)	-0.83	-0.83	-0.14	-0.20	-0.24	-0.26	-0.31	-0.36	-0.36	0.98	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (12)	-0.65	-0.65	-0.40	-0.46	-0.50	-0.51	-0.56	-0.60	-0.60	1.00	0.96	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (13)	-0.83	-0.83	-0.15	-0.21	-0.25	-0.27	-0.32	-0.37	-0.37	0.98	1.00	0.97	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (14)	-0.34	-0.34	-0.69	-0.74	-0.77	-0.78	-0.81	-0.84	-0.84	0.92	0.81	0.94	0.81	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (15)	-0.84	-0.84	-0.12	-0.19	-0.23	-0.25	-0.29	-0.34	-0.34	0.97	1.00	0.96	1.00	0.80	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (16)	-0.44	-0.44	-0.62	-0.67	-0.70	-0.71	-0.74	-0.78	-0.78	0.95	0.87	0.97	0.87	0.99	0.86	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (17)	-0.67	-0.67	0.96	0.94	0.92	0.92	0.90	0.87	0.87	-0.07	0.15	-0.13	0.14	-0.46	0.16	-0.37	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (18)	-0.48	-0.48	-0.58	-0.63	-0.67	-0.68	-0.71	-0.75	-0.75	0.96	0.89	0.98	0.89	0.99	0.88	1.00	-0.33	1.00	-	-	-	-	-	-	-	-	-	-	-	-
Driver (19)	-0.45	-0.45	1.00	1.00	0.99	0.99	0.98	0.97	0.97	-0.33	-0.12	-0.39	-0.13	-0.68	-0.11	-0.60	0.96	-0.57	1.00	-	-	-	-	-	-	-	-	-	-	-
Driver (20)	-0.45	-0.45	1.00	1.00	0.99	0.99	0.98	0.97	0.97	-0.33	-0.12	-0.39	-0.13	-0.68	-0.10	-0.60	0.96	-0.57	1.00	1.00	-	-	-	-	-	-	-	-	-	-
Driver (21)	-0.11	-0.11	0.94	0.96	0.97	0.98	0.99	0.99	0.99	-0.64	-0.46	-0.68	-0.47	-0.89	-0.44	-0.84	0.81	-0.82	0.94	0.94	1.00	-	-	-	-	-	-	-	-	-
Driver (22)	-0.42	-0.42	-0.64	-0.68	-0.71	-0.73	-0.76	-0.79	-0.79	0.94	0.85	0.96	0.86	1.00	0.84	1.00	-0.39	1.00	-0.62	-0.62	-0.85	1.00	-	-	-	-	-	-	-	-
Driver (23)	-0.65	-0.65	-0.40	-0.46	-0.49	-0.51	-0.55	-0.60	-0.60	1.00	0.96	1.00	0.97	0.94	0.96	0.97	-0.12	0.98	-0.38	-0.38	-0.68	0.96	1.00	-	-	-	-	-	-	-
Driver (24)	-0.71	-0.71	-0.33	-0.39	-0.43	-0.45	-0.49	-0.54	-0.54	1.00	0.98	1.00	0.98	0.91	0.98	0.95	-0.05	0.96	-0.32	-0.31	-0.62	0.94	1.00	1.00	-	-	-	-	-	-
Driver (25)	-0.69	-0.69	-0.35	-0.41	-0.45	-0.46	-0.51	-0.55	-0.55	1.00	0.98	1.00	0.98	0.92	0.97	0.95	-0.07	0.96	-0.33	-0.33	-0.64	0.95	1.00	1.00	1.00	-	-	-	-	-
Driver (26)	-0.79	-0.79	-0.21	-0.28	-0.32	-0.33	-0.38	-0.43	-0.43	0.99	1.00	0.98	1.00	0.85	1.00	0.90	0.07	0.92	-0.20	-0.20	-0.52	0.89	0.98	0.99	0.99	1.00	-	-	-	-
Driver (27)	-0.75	-0.75	0.92	0.89	0.87	0.86	0.84	0.81	0.81	0.05	0.26	-0.01	0.25	-0.36	0.27	-0.26	0.99	-0.22	0.93	0.93	0.74	-0.28	-0.01	0.06	0.04	0.18	1.00	-	-	-
Driver (28)	-0.76	-0.76	-0.25	-0.31	-0.35	-0.37	-0.41	-0.46	-0.46	0.99	0.99	0.99	0.99	0.87	0.99	0.92	0.03	0.93	-0.23	-0.23	-0.55	0.91	0.99	1.00	0.99	1.00	0.15	1.00	-	-
Driver (29)	-0.73	-0.73	-0.30	-0.37	-0.40	-0.42	-0.46	-0.51	-0.51	1.00	0.99	0.99	0.99	0.90	0.98	0.94	-0.02	0.95	-0.29	-0.29	-0.60	0.93	0.99	1.00	1.00	1.00	0.09	1.00	1.00	-
Driver (30)	0.68	0.68	0.36	0.42	0.46	0.47	0.52	0.56	0.56	-1.00	-0.97	-1.00	-0.98	-0.92	-0.97	-0.96	0.08	-0.97	0.34	0.34	0.65	-0.95	-1.00	-1.00	-1.00	-0.99	-0.03	-0.99	-1.00	1.00

Table 5.5 The Correlation Matrix Showing the Relationship between the Brief Development Drivers

To illustrate these features and apply them to our case, three examples extracted from the correlation matrix will be explained. The scatter diagram for 10th and 12th ranked drivers is presented in figure (5.4) and shows a perfect positive relationship, with a Pearson's *r* correlation of +1. This means that, as the lack of understanding of different users' culture and traditions increase, the lack of design experience increases by the same amount. In other words the different user's culture and traditions will be fully perceived and reflected in design if the designer is experienced and possess the art of questioning, extracting and analysing information from the user.

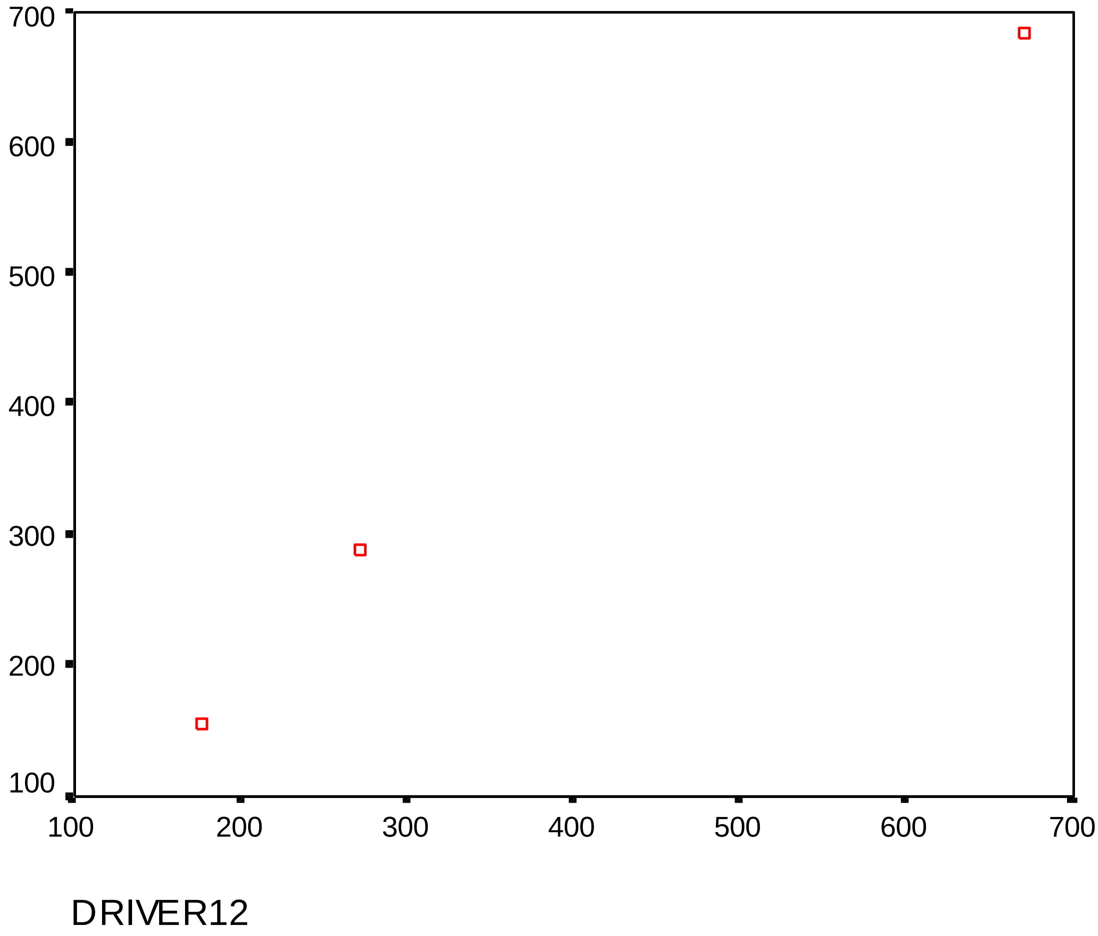


Figure 5.4 Scatter Diagram Showing a Perfect Positive Relationship between Driver 10 and Driver 12

The scatter diagram for 23rd and 30th ranked drivers, which is presented in figure (5.5) shows a perfect negative relationship with a Pearson's *r* correlation of -1. This means that, as project users exaggerate their needs in an effort to enhance the facility function and performance, the initiation of value engineering changes will reduce.

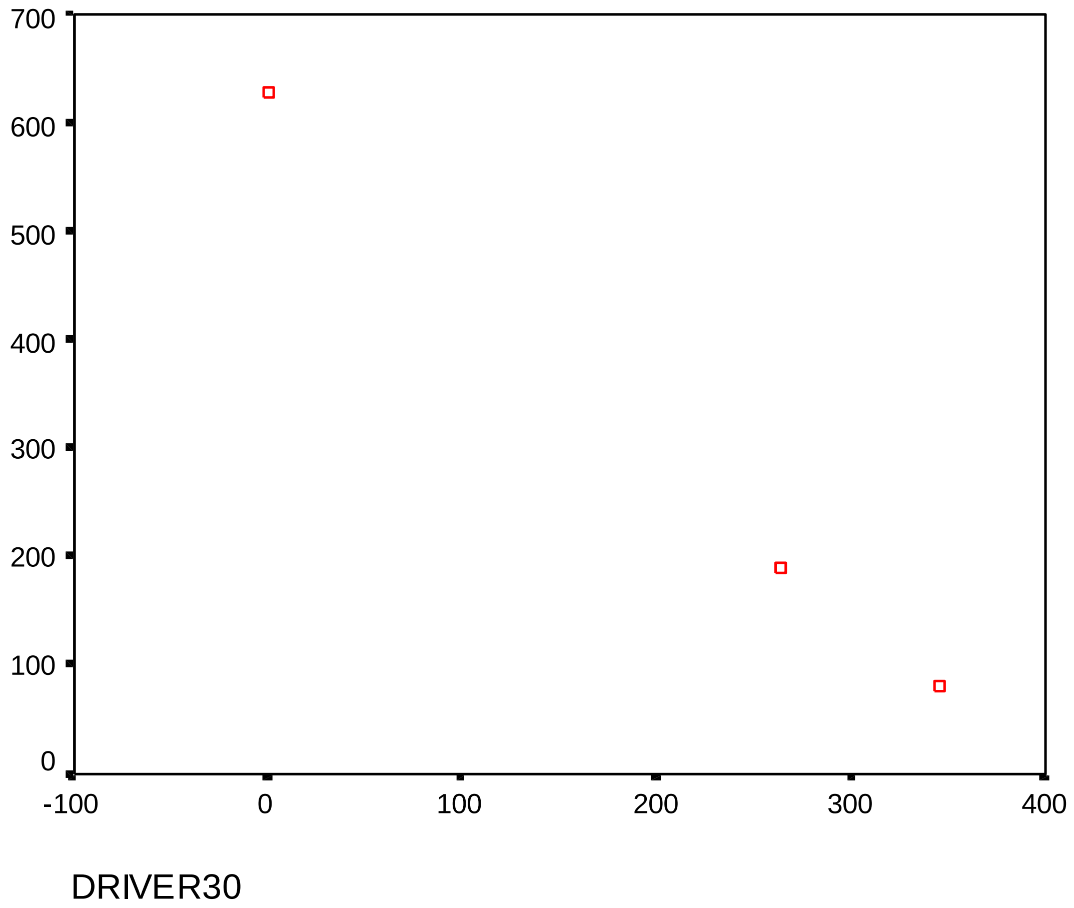


Figure 5.5 Scatter Diagram Showing a Perfect Negative Relationship between Driver 23 and Driver 30

Finally, figure (5.6) shows that there is no correlation between the 15th and 20th ranked drivers as the correlation is close to zero and there is no apparent pattern in the scatter diagram. The designer may not ignore the client role but the project feasibility study was not properly prepared. This means that the variation in each driver is associated with other drivers than the ones present in this analysis (Bryman, 2001) as driver 15 is associated with drivers 28 and 29, where driver 20 is related to drivers 21 and 27 for instance.

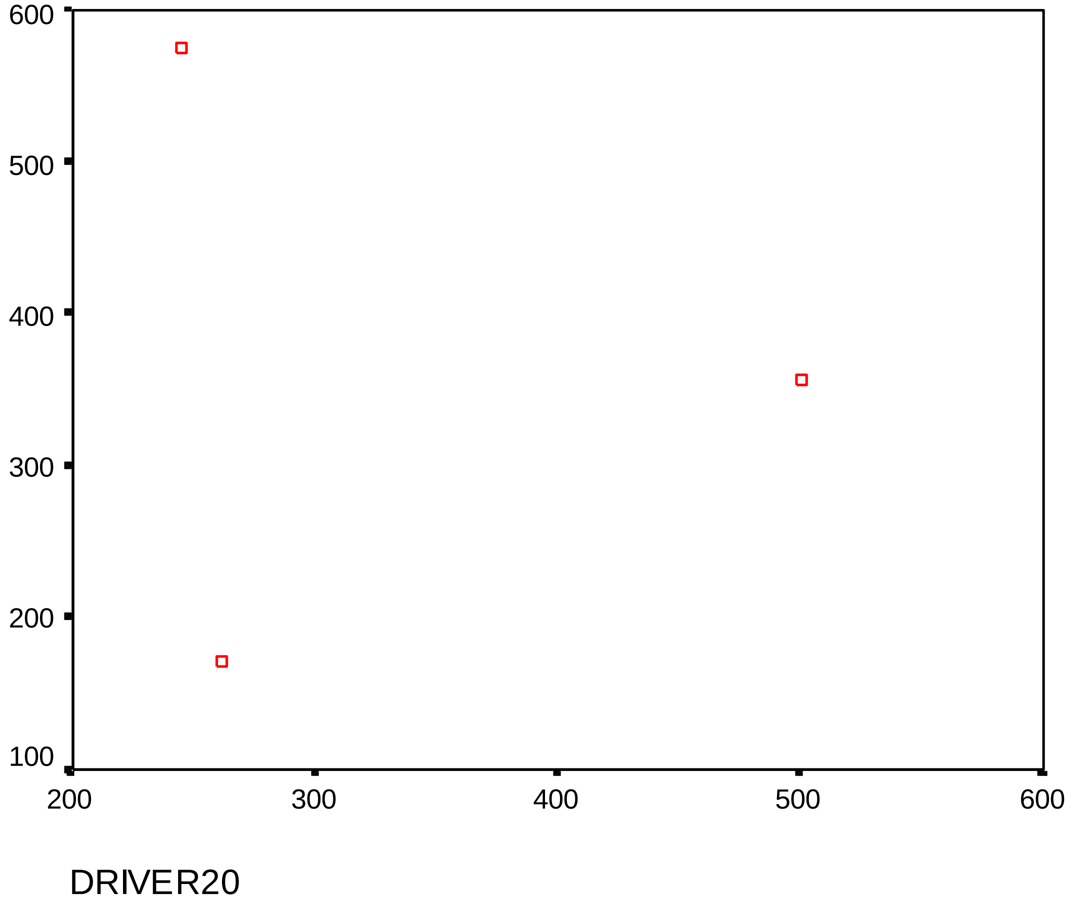


Figure 5.6 Scatter Diagram Showing No Relationship between Driver 15 and Driver 20

The above emphasises that understanding the correlation between the brief development drivers will enable client organisation achieve their emerging requirements, meet user needs, cope with regulation changes, exploit business opportunities, adapt to technology improvement, add more value and manage associated risks.

Because of the importance of the classifying the brief development drivers, the following section will investigate the classification of these drivers.

5.4 Classification of the Brief Development Drivers

As mentioned in chapter 3, project changes were classified under different categories depending on different perspectives. They were classified on the basis of the need to change to elective changes and required change and they can occur at any time of a project. According to the source of change, project changes were classified to legislative changes, design changes, client changes, contractor changes, and site conditions changes. In addition, based on the time of change, changes were classified to design development changes and post-fixity changes. In addition, analysis of case studies highlighted 12 groups, which helped categorise projects that have similar brief development reasons. These groups were identified as: (1) drivers relating to communication, clarity and understanding, (2) drivers relating to feasibility studies, (3) drivers relating to value, (4) drivers relating to project users, (5) drivers relating to co-ordination and accuracy, (6) drivers relating to inadequate provision of information, (7) drivers relating to regulations and technology advancement, (8) drivers relating to quality and sustainability, (9) drivers relating to design cost and time, (10) drivers relating to unforeseen conditions, (11) drivers relating to market conditions and user demands, and (12) drivers relating to lack of design expertise

The above-mentioned classifications helped establish the approach adopted to classify brief development drivers. Because of the complexity of the construction process and the different brief development drivers that influence its products as well as the internal and external factors that initiate these drivers, a holistic approach based on considering the project as an entity that, effects and gets affected by its internal factors and external surrounding factors. The approach classified the brief development drivers to internal development drivers, external development drivers, and internal and external development drivers. A classification matrix was developed to identify the category of each driver, see table (5.6). The advantage of classifying brief development drivers is to determine the drivers, which are related through a common characterises and highlights the drivers that appear in several categories which could considered as a common drivers (Zaimi, 1997). The internal project factors used to create the following matrix were: (1) Client Organisation, (2) End User, (3) Design Firm, (4) Constructor, and (5) Supplier, where the external project factors were: (1) Economy, (2) Policy, (3) Technology, (4) Society, and (5) Environment.

No.	Brief Development Drivers	Internal Project Factors					External Project Factors				
		Client	**End User**	**Design Firm**	**Constructor**	**Supplier**	**Economy**	**Policy**	**Technology**	**Society**	**Environment**
1	Stakeholders change project requirements and have second thought at later stages	*	*							*	
2	Uncoordinated and incorrect construction documents			*							
3	Brief information is still being given during later design and construction stages	*	*	*		*		*			
4	Materials are no longer available in market and use better substitute materials			*		*			*		
5	Lack of information provision	*	*	*	*	*	*	*	*	*	*
6	Meeting new technology changes	*	*	*	*	*		*	*		*
7	Lack of regulatory up-dating			*				*			
8	Project users are not involved in the briefing process	*	*	*							
9	Unforeseen conditions										
10	Lack of understanding different users' culture and tradition		*	*							
11	Eliminate proven poor quality materials and equipment	*	*			*	*		*		
12	Lack of design experience			*							
13	Changing government regulation and codes							*			
14	Responding to market demand	*	*	*			*				
15	Improper feasibility studies			*							

16	Restricted design fees	*						*			
17	Lack of understanding of the client organisations	*		*							
18	Inappropriate communication between the client and the designer	*		*							
19	Unclear and incomplete project brief	*	*	*							
20	Designers ignore the client role and behave unilaterally	*		*							
21	Lack of communication and co-ordination between government authorities and design firms over planning and approvals			*				*			
22	Lack of presentation and visualisation of design			*							
23	Users exaggerate their needs		*								
24	Upgrade project facilities	*	*								
25	Project users appear at later stages	*	*								
26	Inadequate available design time	*	*	*							
27	Lack of functional, aesthetic, safety requirements and constructability			*							
28	Lack of consideration of environmental requirements			*				*			*
29	Whole project life not considered			*			*				*
30	Initiating value engineering changes	*		*			*	*			

Table 5.6 The Classification Matrix of the Brief Development Drivers

5.4.1 Internal Brief Development Drivers

These are the drivers, which are initiated by internal project factors such as client organisation, end user, designer, constructor, or supplier. Analysis of the above matrix showed that the internal brief development drivers are:

- Uncoordinated and incorrect construction documents
- Project users are not involved in the briefing process
- Lack of understanding different users' culture and tradition
- Lack of design experience
- Improper feasibility studies
- Lack of understanding of the client organisations
- Inappropriate communication between the client and the designer
- Unclear and incomplete project brief
- Designers ignore the client role and behave unilaterally
- Lack of presentation and visualisation of design
- Users exaggerate their needs
- Upgrade project facilities
- Project users appear at later stages
- Inadequate available design time
- Lack of functional, aesthetic, safety requirements and constructability

5.4.2 External Brief Development Drivers

These are the drivers, which are initiated by external project factors such as economy, policy, technology, society, or environment. Analysis of the above matrix showed that the external brief development drivers are:

- Changing government regulation and codes

5.4.3 Internal and External Brief Development Drivers

These are the drivers, which are initiated by both internal and external factor. These drivers could be considered as common drivers as they appear in several categories. Analysis of the above matrix showed that the internal and external brief development drivers are:

- Stakeholders change project requirements and have second thought at later stages
- Brief information is still being given during later design and construction stages
- Materials are no longer available in market and use better substitute materials

- Lack of information provision
- Meeting new technology changes
- Lack of regulatory up-dating
- Eliminate proven poor quality materials and equipment
- Responding to market demand
- Restricted design fees
- Lack of communication and co-ordination between government authorities and design firms over planning and approvals
- Lack of consideration of environmental requirements
- Whole project life not considered
- Initiating value engineering changes

Since “unforeseen conditions” driver is not initiated by any of the internal or external project factors, this driver was not classified under any of the classified categories.

5.5 Originators, Value and Risk Sources to the Project Brief from the Client’s Point of View

The increasing awareness to achieve client satisfaction as the core of the construction industry (Latham, 1994) necessitated the importance to undertake a brainstorming session aimed to investigating the relationship between the brief development drivers and the project team members in order to identify the originators of brief development, the value sources and the risk sources to the project brief from the client's point of view. The project team members used to create this relationship were (1) Client Organisation, (2) End User, (3) Design Firm, (4) Constructor, (5) Supplier, (6) Government Authority, and (7) Funding Body. Within this research invitations were directed to the clients' organisations that responded to the survey questionnaire. Out of 38 invitations issued a total number of 12 clients organisations agreed to attend the session. Table (5.7) summarises the results of the brainstorming session in a matrix form. Brief development originator could be defined as the person or authority that begins, initiates or be the cause of brief development either by modification, omission, or addition to the brief document contents (Merriam-Webster Dictionary, 2000) that will affect the final product and hence affect the achievement of the client objectives, needs and satisfaction. Based on the above definitions of value and risk, value source to the client could be defined as the person or authority that could improve the function of the project at no extra cost or by maintaining the function and removing the unnecessary cost in away that achieve client requirements and enhance the performance of the project. Risk source to the client could be defined as the person, authority or event that either threats the achievement of the client objectives or loses an opportunity to improve the project performance.

5.5.1 Project Team Members as Originators of Brief Development

Analysis of the matrix and feedback from the discussion in the brainstorming session showed that clients' organisations were the key originators of brief development as they may change their requirements and have second thoughts at later stages as well as
provide brief information at later design and construction stages. End users were considered as brief development originators when they modify the facility design to meet their requirements, traditions and culture particularly if they were not involved in the briefing process or they appear at later stage. A case study showed that the client organisation changed the project design from a commercial building to a medical centre equipped with all technological equipment in order to respond to market demand and exploit the business opportunity offered to lease the building for 20 years.

Design firms were deemed as brief development originators when they do not have the art of questioning and eliciting clients’ requirements which generates incomplete brief. In addition, their lack of experience may result in producing uncoordinated and incorrect construction documents, non producible materials or technologies. Constructors may be regarded as brief development originators when they provide the design firm with information were not available during the briefing and design stages such as unforeseen conditions or environmental requirements which forces the design firm to modify the design to adapt to these situations. Suppliers play their role in developing the project brief by providing the client organisation and design firms with information related to materials unavailability and poor quality materials as they are closer to manufactures than other parties. The role of government authorities and funding bodies as brief development originators appear when the project design violates building regulations and codes as well as the design is over budget (Othman et. al, 2004b).

5.5.2 Project Team Members as Value Sources

Clients considered themselves as value sources as they modify the project brief to meet their emerging requirements, enhance their project performance, respond to market demand, upgrade project facilities, and include new information, which were not available during the design stage. End users were regarded as value sources to the client when they continue renting the building and enhancing its performance as well. Design firms and constructors could be deemed as value sources to the client when they use their design experience and construction knowledge to advice the client to choose better solutions that achieve his objectives, select better materials, and use effective construction methods that facilitate the construction process and reduce life cycle costing of the project. Suppliers play their role as value sources to the client when they provide information of better substitute materials and recently produced equipments. Government authorities and funding bodies were regarded as value sources to the client by guiding the design firms and construction companies to comply with regulations and codes such as (safety codes and environmental requirements) which enhance the performance of the building and escalate its demand as well as keeping the project within the allocated budget. Feedback from projects executed under the supervision of government authorities and funding bodies enable them to advise design firms to select proper materials and equipments (Othman et. al, 2004b).

5.5.3 Project Team Members as Risk Sources

Analysis of the matrix showed that the risk that could be originated by clients' organisations, particularly naïve ones who does not possess enough construction knowledge, emerged from their inability to describe their requirements and business objectives to the designer. In addition, inadequate available design time due to the client hastiness to complete the project as fast as possible inhibits the designer from presenting thorough alternatives and results in producing uncoordinated and incorrect construction documents. End users were considered as risk source to the client when they were not involved in the briefing process and their requirements were not reflected in the facility design. This will tend either to change the produced facility to match their needs or the building will suffer from being vacant if it does not fulfil users requirements. Projects' clients blame design firms for not playing their role as clients' advisors. Clients viewed design firms as risk sources because they are the cause of the production of uncoordinated and incorrect construction documents, specifying building materials or technologies, which either not produced anymore or not up to date as well as ignoring the role of the client and behave unilaterally. This could result in hindering the construction process in terms of contradictions between the construction documents, time delay due to selecting and importing substitute material and modern technologies as well as future changes as a consequence of adopting decisions which do not reflect the client's point of view. Analysis of the matrix showed that the risk that could be originated by constructors may arise from their lack of experience in reviewing construction documents which may lead to delay due to time required for documents corrections and rework. In addition, constructors' lack of organising construction items as early as possible such as ordering materials that may not produced anymore may result in additional time for selecting and importing alternative materials. Material suppliers were considered as risk sources when they can not provide the project with suitable materials or equipment which commensurate with the project budget, time of delivery and matches with project design. Finally, government authorities and funding bodies were considered as risk sources to the client due to their lack of regulatory updating, communication and co-ordination with design firms over planning and approvals, improper feasibility study and lack of responding to market demand (Othman et. al, 2004b).

5.6 Conclusions

The importance of the Dynamic Brief Development concept as an approach to achieve client satisfaction, respond to the different influences that affect the project brief, manage project change orders effectively, and improve the briefing process, called for building a clear and firm understanding of the brief development drivers. This was achieved through focusing on four important issues. They were identifying, quantifying and classifying the brief development drivers as well as identifying the originators of brief development, value sources and risk sources to the project from the client's point of view. Different research methods were used to identify these drivers. Literature review and analysis of 36 case studies identified 47 brief development drivers. Many of the drivers identified by literature review were confirmed by case studies where new drivers were added. The new drivers reflected the culture and tradition of the surveyed society. All the identified drivers were reviewed on regular basis in order to omit repeated ones and merge similar drivers to produce a list of 30 brief development drivers. Documentary data was investigated to collect information about the project history and the development of project brief at different stages. Furthermore, unstructured interviews were undertaken with the project architect to investigate the way in which the project brief was developed.

After the drivers have been identified, it was necessary to quantify them in order to explore the most influential drivers that affect the project brief, so particular attention could be paid to them. This was done by designing and issuing a survey questionnaire to quantify the brief development drivers. A three-stage data analysis approach was used. Firstly the measure of central tendency and dispersion was carried out using the most common measures: the mean, median, mode, variance and standard deviation. Results showed the quality and homogeneity of the data collected, which ensure reliable research recommendations. Secondly, the well-established relative importance index was used to rank drivers according to their importance on developing the project brief. Finally, the Bivariate analysis was used to investigate the correlation between the different drivers through the creation of a correlation matrix.

In order to complete the picture of the identified and quantified drivers, it was important to classify the brief development drivers in order to determine the drivers, which are related through a common characterises and highlights the drivers that appear in several categories which could considered as a common drivers. An approach was developed based on considering the project as an entity that effects and get affected by its internal and external factors. Brief development drivers were classified as internal drivers, external drivers or internal and external drivers.

The last part of this chapter established a relationship matrix between the brief development drivers and the project team members in order to identify the originators of brief development, value sources and risk sources to the project from the client point of view.

The next chapter will introduce the Value and Risk Management Protocol (VRMP), which was designed to manage brief development in construction.

No.	Project Team Members	Development Originator							Value Source to Client							Risk Source to Client						
	Brief Development Drivers	**Client Organisation**	**End User**	**Design Firm**	**Constructor**	**Supplier**	**Govern. Authority**	**Funding Body**	**Client Organisation**	**End User**	**Design Firm**	**Constructor**	**Supplier**	**Govern. Authority**	**Funding Body**	**Client Organisation**	**End User**	**Design Firm**	**Constructor**	**Supplier**	**Govern. Authority**	**Funding Body**
1	Stakeholders change project requirements and have second thought at later stages	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	Uncoordinated and incorrect construction documents			X													X	X	X	X	X	X
3	Brief information is still being given during later design and construction stages	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	Materials are no longer available in market and use better substitute materials	X		X		X							X					X	X	X		
5	Lack of information provision	X	X	X	X	X	X	X								X	X	X	X	X	X	X
6	Meeting new technology changes	X	X			X	X											X	X	X	X	
7	Lack of regulatory up-dating			X			X										X	X	X		X	
8	Project users are not involved in the briefing process	X		X												X	X	X				
9	Unforeseen conditions															X	X	X	X	X	X	X

10	Lack of understanding different users' culture and tradition		X	X													X	X				
11	Eliminate proven poor quality materials and equipment	X	X			X	X			X			X	X				X	X	X		
12	Lack of design experience			X												X	X	X	X	X	X	X
13	Changing government regulation and codes						X										X	X	X	X	X	
14	Responding to market demand	X	X							X								X	X	X		X
15	Improper feasibility studies			X														X				X
16	Restricted design fees	X					X										X	X	X	X	X	X
17	Lack of understanding of the client organisations	X		X												X		X				
18	Inappropriate communication between the client and the designer	X		X												X		X				
19	Unclear and incomplete project brief	X	X	X												X	X	X				
20	Designers ignore the client role and behave unilaterally			X														X				
21	Lack of communication and co-ordination between government authorities and design firms over planning and approvals			X			X											X			X	
22	Lack of presentation and visualisation of design			X													X	X	X	X		X
23	Users exaggerate their needs		X							X							X	X	X	X		
24	Upgrade project facilities	X	X						X	X							X	X	X	X		
25	Project users appear at later stages		X							X							X	X	X	X		

26	Inadequate available design time	X		X													X	X	X	X	X	X
27	Lack of functional, aesthetic, safety requirements and constructability			X													X	X	X	X	X	
28	Lack of consideration of environmental requirements	X	X	X	X		X										X	X	X		X	
29	Whole project life not considered	X		X													X	X	X	X		X
30	Initiating value engineering changes																					

Table 5.7 Originators of Brief Development, Value Sources and Risk Sources to the Project from the Client's Point of View

Chapter 6

The Value and Risk Management Protocol (VRMP)

6.1 Introduction

The Dynamic Brief Development concept presented by this research as an approach to overcome the limitations of the briefing process necessitated the importance to develop a system to manage and control brief development throughout the project life cycle. This system is intended to utilise the value opportunities in brief development drivers and manage associated risks in order to achieve client satisfaction, manage project change orders effectively, and improve the current briefing process. This chapter is devoted to present that system which is called the Value and Risk Management Protocol (VRMP). Firstly, the need for the protocol was defined and its aims and objectives were established. Secondly, the key principles behind the protocol were explained. Then the conceptual description of the protocol was presented. Because of the need to select an appropriate technique to represent the protocol, a revision of models, modelling process and modelling tools was carried out. The functional representation and contents of the protocol was described in detail. In order to show how the VRMP will be implemented, application of the protocol on a real case study was presented. Finally, the benefits and limitations of the protocol were identified.

6.2 The Value and Risk Management Protocol (VRMP)

Protocol was defined as the rigid code of etiquette prescribing the forms and procedures for various ceremonies and social functions in government, military, and diplomatic circles (Merriam-Webster Dictionary, 2000). The Value and Risk Management Protocol (VRMP) (hereinafter referred to as "the protocol" or the "VRMP") is the representation of the proposed framework for managing and controlling brief development in construction. It describes the functions and activities that need to be undertaken, as well as the tools and techniques required, to effectively enable clients' organisations and construction professionals adopt the proper decision to develop the project brief. In addition, it aims to achieve client satisfaction, manage the project change orders effectively and improve the briefing process through learned lessons and feedback.

6.2.1 The Need for Effective Value and Risk Management Protocol

The need for effective protocol for managing brief development stems from the necessity of the Dynamic Brief Development (DBD) concept. This concept emerges from the deficiencies of the current briefing theories in achieving client satisfaction, the importance to adapt to the influence of brief development drivers, the need to manage project change orders effectively, the necessity to improve the briefing process as well as the limited research work focused on managing brief development (Othman et al., 2004a; Hegazy et al., 2001; Gardiner and Simmons, 1992). The brief development concept states that developing the project brief enables achieving emerging clients requirements, meeting user needs, coping with regulation changes, exploiting business opportunities and adapting to technology improvement. On the other hand permitting brief development throughout the project life cycle without establishing the procedures and drawing the boundaries that control that development leaves the project brief uncontrolled and jeopardise the achievement of clients objectives and satisfaction. This necessitated the need to develop a system that is capable to manage brief development for the benefit of the client. Since brief development either adds value or risk to the project or could add both, the well-established methodologies of value management and risk management were the most appropriate tools that could manage brief development in construction. Both disciplines were integrated to form the basis of the suggested protocol. Information management and information technology supported the protocol in terms of creating, classifying, storing, retrieving, sharing and updating data.

6.2.2 Aims and Objectives of the Value and Risk Management Protocol

The Value and Risk Management Protocol (VRMP) is a decision making tool designed to manage and control brief development throughout the project life cycle. It aims to enable clients' organisations and construction professionals adopt the proper decision to develop the project brief based on value addition and risk management in an endeavor to achieve client satisfaction. In addition, it aims to respond in an innovative manner to the influence of the different brief development drivers and manage project change orders effectively as well as improves the performance of the briefing process through feedback and learned lessons. The above aims could be achieved through a set of interrelated objectives as follows:

(1) Adequate identification of brief development problem.

(2) Better understanding of the client objectives.

(3) Generating, evaluating and selecting the best alternative that will achieve these objectives at the most cost - effective manner.

(4) Implementing the selected alternative, monitoring its execution and feeding back the client organisation, design and construction team with comments and learned lessons.

6.2.3 The key principles behind the Value and Risk Management Protocol

Since the suggested protocol will be applied throughout the project life cycle, and because of the diversity of characteristics, requirements, and decisions to be achieved at each stage, the Value and Risk Management Protocol is based on a number of key principles as follows:

6.2.3.1 Whole Project View

The Dynamic Brief Development concept has to cover the whole life of the project from recognition of a need to the operation and maintenance of the finished facility. It is intended to respond to the different drivers that affect the project brief in a way that achieves best value and avoids associated risk to achieve client and user satisfaction. In addition, it aims to manage change orders and improve the briefing process for future projects. This approach ensures that all the issues that face the project throughout its life cycle are considered from a business and technical point of view.

6.2.3.2 Dynamism and Flexibility

The need to achieve the emerging client requirements, meet user needs, cope with regulation changes, exploit business opportunities and adapt to technology improvement necessitated that the briefing process should be an ongoing process and that the project brief to be a dynamic and live document that needs to be continually developed. The suggested protocol has to be dynamic and flexible to adapt, manage and control brief development under the different brief development drivers (Othman et al., 2004a).

6.2.3.3 Stakeholders Involvement

Successful dynamic brief development relies upon the right people having the right information at the right time. Best results are achieved when the concerned parties are working in a collaborative team environment and having the same objectives. Involving the project stakeholders emphasises that their views, objectives and requirements are well understood and adequately reflected in the decision to develop the project brief. In addition, their participation in the decision process ensures their commitment to implement the selected decision.

6.2.3.4 Co-ordination and Communication

The need for effective co-ordination between the project team members is essential. The party who initiates brief development has to inform other parties in order to manage brief development effects on other disciplines. Decisions adopted by brief development team and decision-makers have to be circulated to all parties in order to arrange for implementation. In order to close the loop, clients organisations and construction professionals have to be fed back with learned lessons, comments and corrective actions taken during the implementation and monitoring functions in order to improve the design and construction process in future projects.

6.2.3.5 Feedback

Feeding back the client organisation as well as the design and construction team with learned lessons of brief development and comments from the facilities management team and end users will enhance the effectiveness of the briefing process in future projects. The measuring brief development milestones identified by (Othman et al., 2004a) throughout the project life cycle will facilitate recording, authenticating and updating brief development information. The creation, maintenance and use of brief development archive will aid the process of continual improvement in design and construction.

6.2.36 Rational

The rational of selecting the brief development decision based on the scientific steps of decision making process ensures that the development issue in hand has been thoroughly studied and all the pertinent information was collected, all the concerned parties were consulted and all the alternatives were generated and adequately evaluated. This approach prevents random decisions, which may lead to project failure in terms of cost and time overrun and poor quality and may jeopardise the achievement of client objectives and user needs.

6.2.3.7 Creativity

The need to respond to the brief development drivers in an innovative manner in order to achieve better values and avoid associated risks entails the generation of creative alternatives that achieve client objectives at the most cost-effective manner. Brainstorming sessions as well as the participation of diverse team member creates atmosphere where creative and unusual ideas are generated and the combination and improvement of ideas are encouraged.

6.2.4 The Conceptual Description of the Protocol

The VRMP is a decision making tool which encompasses a methodology for systematic, gradual and team wise guiding of client organisation and construction professionals to adopt the proper decisions to develop the project brief. The contents of the protocol are based on the systematic steps of the decision making process. These steps consist of three phases: (1) Intelligent phase, (2) Design Phase, and (3) Choice Phase. The intelligent phase encompasses the recognition of the need for a decision, the design phase encompasses (a) Identification of objectives, (b) Search for reasonable alternatives, (c) Evaluation of alternatives, where the choice phase encompasses (a) Selection of the best alternatives and (b) Implementation (Simon 1960; Mintzberg 1976; Schultheis and Sumner 1989 cited Dilworth, 1992). In addition, the Simple Multi Attribute Rating Technique (SMART) was used to formulate the Value and Risk Management Protocol (Edwards, 1977; Edwards and Newman, 1982; Edwards et al., 1988 cited Green, 1992).

6.2.4.1 The Pre-Study Phase: (Intelligent Phase)

The main objective of the pre-study phase is to identify the brief development problem. It is necessary to make sure that the study team is well assembled, empowered and co-ordinated, the study is properly targeted and that there is sufficient pertinent information available for the actual study. The importance of this phase stems from the essence of collecting, verifying and classifying brief development data as well as defining brief development in terms of its nature, driver, stage, initiator, value sources, and risk sources. Clear and thorough understanding of the problem in hand will facilitate and enable the study team accomplishes the study objectives and achieve client satisfaction. The activities to be carried out during this phase are:

- Assembling and Empowering The Team
- Investigating Brief Development Data
- Defining Brief Development

6.2.4.2 The Study Phase: (Design Phase)

The main objective of the study phase is to structure the development objectives and scrutinise alternative solutions. It is of prime importance to ensure that the multi-disciplinary team is mobilised to conduct the brief development study. The activities to be carried out during this phase are:

- Defining Objectives
- Developing Objectives Value Hierarchy
- Allocating Importance Weight
- Defining Associated Risks
- Generating Alternatives
- Evaluating Alternatives

6.2.4.3 The Post-Study Phase: (Choice Phase)

The focus of this phase is to ensure that the developed alternatives are presented, the best one is selected, implemented and monitored and the client organisation, design and construction teams are fed back with comments and learned lessons in order to improve the briefing process for future project. The activities to be undertaken during this phase are:

- Presenting Alternatives
- Selecting the Best Alternatives
- Implementing the Selected Alternative
- Monitoring and Feeding back

In order to build the model of the Value and Risk Management Protocol, the following section will review models and the modelling process

6.3 Models and The Modelling Process

Models are description of systems. A model could be defined as an abstract representation of some real world process, system or sub-system. The descriptions of a model can take one of three forms: Schematic, physical or mathematical.

Schematic : Graphs, maps, or charts.
Physical : Globes, ionic models or scale model.
Mathematical : Equations or mathematical expressions.

Models are developed when the need for a decision is recognised and when one seeks to understand how the real world works. Models can be used to describe what a system is (descriptive model), what it does (functional model), or what it works on (data model) (Chung, 1989). Other types of models which describe a particular view (s) of a system are summarised in table (6.1) (Kamara, 1999)

Type of Model	Definition
Conceptual Model	A schema or a method which closely describes the behaviour of a system, but is not intuitive to the uninstructed observer as it is developed on a set of modelling and interpretative rules
Data Model	The formal conceptual representation of a database physical implementation
Information Model	A formal description of types of ideas, facts and processes which together form a model of a portion of interest of the real world and which provides an explicit set of interpretation rules
Object-Oriented Model	A model that describes the information requirements for a task with respect to the required object types, their attributes, associations and the operations performed on or by them
Physical Model	A scaled down replica of the actual physical system
Process Model	A representation of a set of consecutive steps or activities with an end product or service being delivered
Product Model	The digital representation of the totality of data elements that completely define a product for all applications over its expected life, and facilitates the unambiguous transfer of such information

Table 6.1 Types of Models and their Definitions

The development of models is necessary to facilitate understanding of an existing or intended system, and the communication of its structure and behaviour to others. Modelling also provides a logical step to automation (Chung, 1989; Kartam et al., 1997; Booch et al., 1998). The modelling process consists of three interrelated steps: (1) Abstraction and model construction, (2) Validation and (3) Application. When a simple model has been developed, it is then tested to see if it is adequate for the intended use. If it is not, it may be improved by the abstraction of additional features of the real world until the model is considered valid. Validation of a model means gaining confidence that the information it provides about the real world is accurate for its intended purposes. The model can be put to use once it appears to be a valid representation of the real world (Dilworth, 1992).

6.3.1 Modelling the Value and Risk Management Protocol

Modelling provides a powerful framework to formulate and solve engineering problems. It can systematise the everyday administrative and contingency procedures that do not go as planned. Defining clear administrative models promote smooth contractual resolutions, just as construction scheduling tools promote harmonised project activities. Modelling can help reducing employees frustration and increasing their confidence in management which could be affected by changing procedures due to adopting decisions which do not adequately studied. (Dilworth, 1992).

Managing Brief Development is a multi-disciplinary process, performed in a series of interrelated steps in order to enable client organisations and construction professionals adopt the prudent decision to develop the project brief. If the procedures to manage brief development cannot be reduced to the primitives of a simple model then they could lead to complications. Modelling the Value and Risk Management Protocol will facilitate effective management of dynamic brief development, diminish confusion, lessen personality conflict, maintain focus on project completion and achieve better decisions. Modelling requires the formidable tasks of determining the events that must take place, ascertaining their sequential relationship and presenting this information in a network. Based on the characteristics of the Value and Risk Management Protocol, the process model was the appropriate model to represent the activities that is being proposed to manage brief development in construction.

6.3.2 Reviewing of Modelling Tools

The need for a suitable tool to represent the Value and Risk Management Protocol (VRMP) as an approach to manage brief development necessitated a review of process modelling tools. The selection of a modelling methodology is usually based on a set of criteria which can include: the ability to adequately represent the intended functions and interrelationship, ease of use and understanding, availability of methodology (including associated software tools), applicability (with respect of how it has been used in the past), robustness, and standardisation (Chung, 1989; Sanvido et al., 1990; Anumba et al., 1998). The criteria for representing the Value and Risk Management Protocol include:

(1) The possibility to achieve the objectives of the modelling exercise in terms of representing the process and activities for the proposed protocol.
(2) Ease of use and understanding particularly for the intended users of the methodology.
(3) Applicability to the construction industry.
(4) The potential for computer implementation of the methodology.

The following section will investigate the existing process modelling methodologies.

6.3.2.1 Hierarchy Plus Input-Process-Output (HIPO)

This methodology uses diagrams to describe input, output, and functions of a system. Figure (6.1) shows visual table of contents includes: tree diagram showing hierarchy of functions. In addition, overview diagram shows major functions of the system, where detailed diagrams describe specific functions. HIPO has been used in software development for documenting system structure and the design and analysis of systems. This methodology considered to be limited in its ability to show detailed information about a system (Chung, 1989).

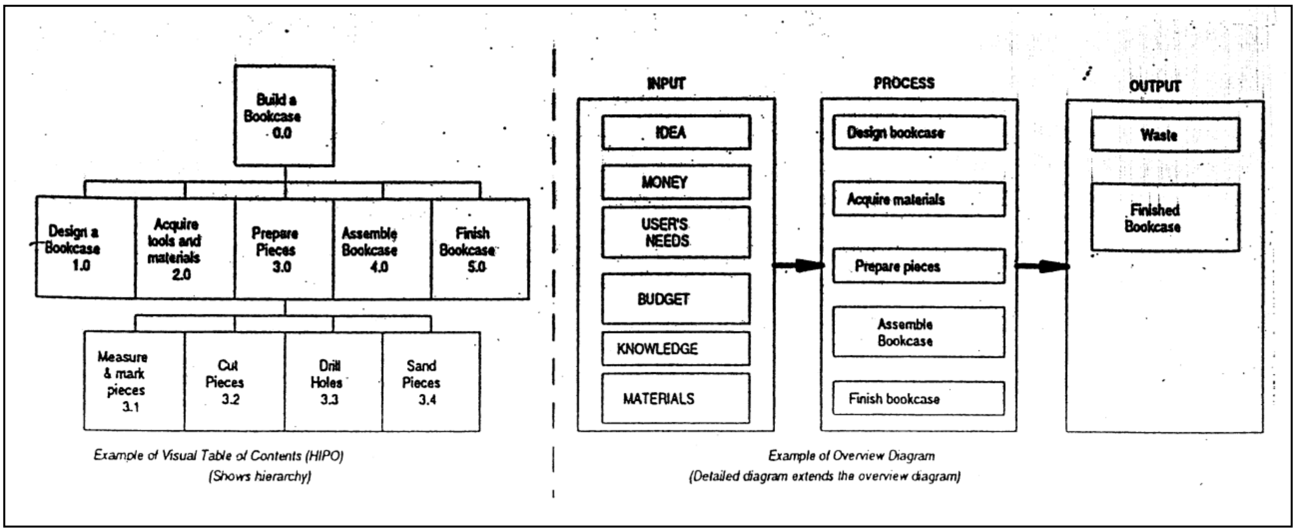


Figure 6.1 Example of HIPO Model Diagram

6.3.2.2 *Data Flow Diagrams (DFD)*

This methodology consists of four elements as shown in figure (6.2). A data flow is indicated by arrows, a process is represented by a circle or ellipse, an external source is represented by boxes, and a data store was represented by parallel lines or open-ended rectangles. DFD is used to identify functional elements of a system and information flow between elements. In addition, it shows transformations within systems without making assumptions about how they occur. DFD can efficiently show greater detail of information but they are arguably difficult to read (Chung, 1989; Ranky, 1994; Anumba et al., 1998).

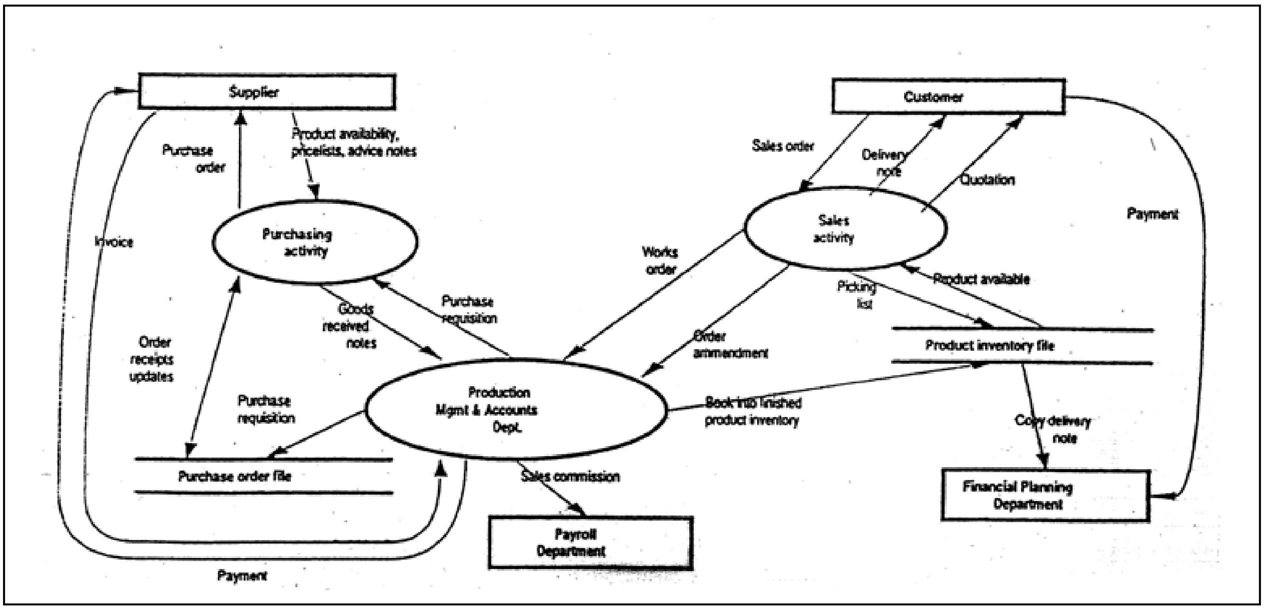


Figure 6.2 Data Flow Diagram for a Manufacturing Company

6.3.2.3 *Role Activity Diagrams (RADs)*

This methodology consists of states and events but they are not flow charts and emphasis is on roles. Figure (6.3) shows the behaviour of a class of people. In addition, a sequence of steps or activities, which can be tested, out by a person or group. RAD was originally developed for software process modelling. RAD has limited usage in construction (Abeysinghe and Phalp, 1997).

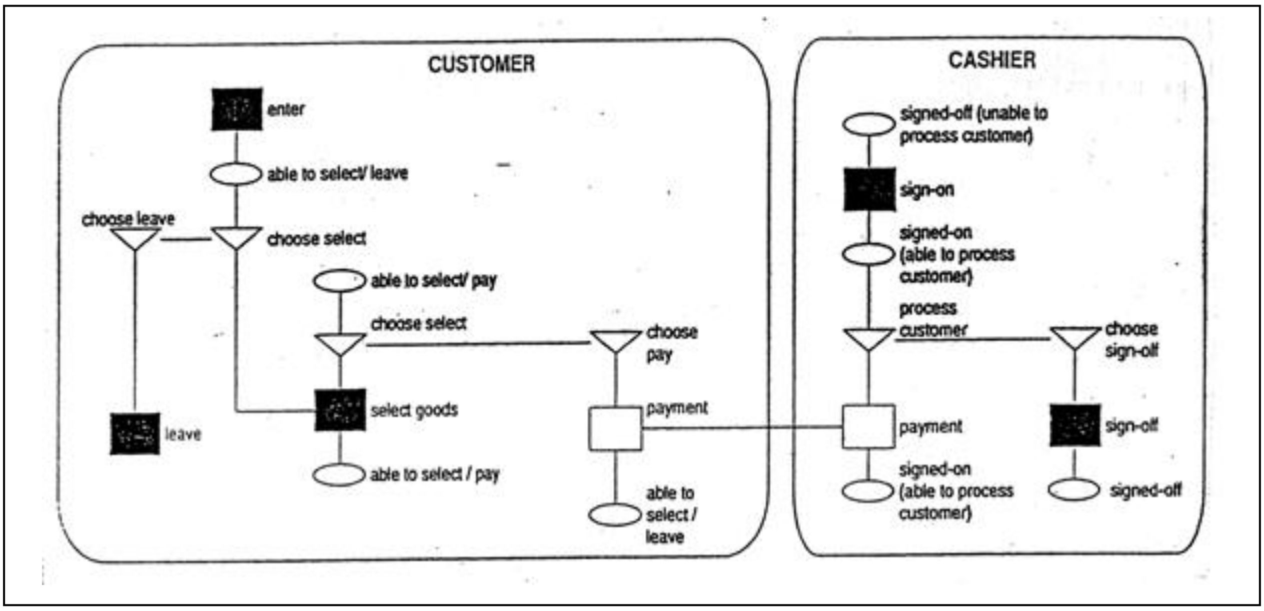


Figure 6.3 Role Activity Diagram of a Shopping Process

6.3.2.4 Unified Modelling Language (UML)

UML is a standard graphical language for visualising, specifying, constructing and documenting the artefacts of a software-intensive system. It is based on an integration of the most prominent object-oriented Languages. UML provides a standard way to write system's blue prints, focus is on software systems, and support both process and product modelling. This methodology is relatively new modelling language and is not widely used in the construction industry (Booch et al, 1998).

6.3.2.5 Structured Analysis and Design Techniques (SADT) / IDEF-0

It is a requirements specification tool based on the concept of system modelling. It uses natural and graphic languages to convey meaning about a system. Basic notion as shown in figure (6.4) are: box which represent the activity / function, arrows represent Inputs, Control, Outputs, and Mechanisms (ICOM). This methodology defines functions and their interfaces and facilitates hierarchy decomposition of detail in a system. It is used for developing system description. In addition, it is used widely in construction and is becoming a *de facto* standard for process modelling of the building process (Marca and McGowan, 1988; Chung, 1989; Laamanen, 1994). It provides for the communication of complex concepts. It does not seem to provide an integrated approach to system development and does not provide support for the entire life cycle.

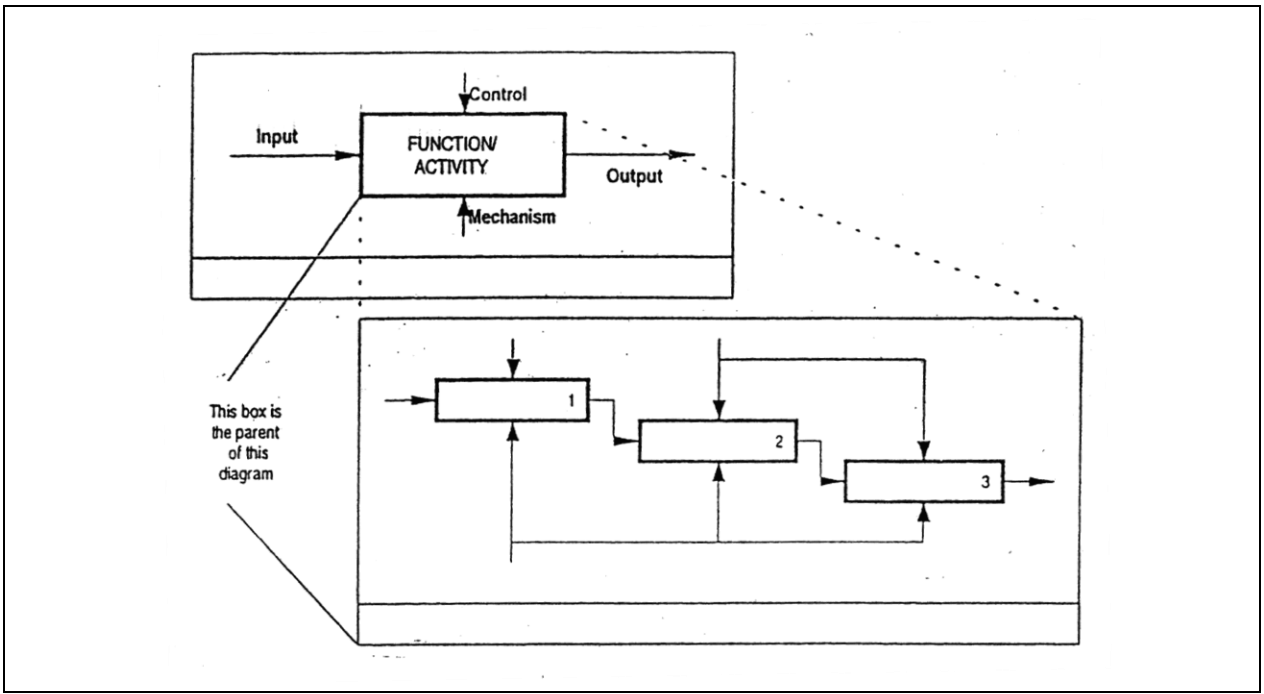


Figure 6.4 SADT / IDEF-0 Notation

The modelling methodologies described above provide a means of representing the framework for the Value and Risk Management Protocol. However, the IDEF-0 methodology was considered to be the most appropriate methodology because:

- It deals with functional / activity modelling which is appropriate since the objective was to describe the functions and activities of the proposed Value and Risk Management Protocol.
- It facilitates the development of a comprehensive model due to the elaborated information required to perform a function or activity such as (Input, Control, Output, and Mechanism).
- It is relatively easy to use and understand, and it has been proven to be suitable for use in construction since it permits a system to be described in greater level of detail (Sanvido et al., 1990; Kamara, 1999)
- It provides a mechanism for decomposing a function into a number of smaller sub-functions and verifies that the inputs and outputs of the function match those of its sub-functions. This allows many individuals to work on different aspects of the total system and yet be consistent in terms of final system integration (Wu, 1994).

6.4 The Functional Representation of The Protocol

The following section will describe the functional representation of the VRMP described preceded by a discussion of the notation of IDEF-0, the selected modelling methodology.

6.4.1 IDEF-0 Notation

IDEF-0 is a modelling technique based on the Structured Analysis and Design Technique (SADT), a graphical approach to system description (Marca and McGowan, 1988), originally developed by Douglas T. McGowan and SofTech, Inc. in the 1970. Since then SADT has been refined and used for a variety of problems by SofTech, Inc. In 1981, the US Air Force Programme for Integrated Computer-Aided Manufacturing (ICAM) standardised and made public a number of IDEF (Integrated DEFinition language) modelling techniques. These comprised: IDEF0, which used to produce a functional model; IDEF1, which used to produce information model and IDEF2, which used to produce a dynamic model. The IDEF techniques were originally developed to improve manufacturing productivity via the application of structured methods. The programme identified the need for better analysis and communication techniques for people involved in improving manufacturing productivity (Tah and Carr, 2000). Of these three, IDEF-0 is the most used, in particular in the modelling of manufacturing and services processes and in business process reengineering tools (Kimbler, 1997).

IDEF-0 models are composed of three types of information: graphic diagrams, text, and glossary, which are cross-referenced to each other (IDEF, 1993). The graphic diagrams are the major component of the IDEF-0 model, containing boxes, arrows, box/arrow interactions and associated relationships. A box represents a major function of a subject. These functions (described using verbs or verb phrase) are composed into more detailed diagrams, until the subject is described at a level necessary to support the goals of the project. The top-level diagram in the model provides the most general description of the subject and is followed by a series of child diagrams providing more detail about the subject. Arrows show the flow of products including data between functions (IDEF, 1993). The kinds of arrows used in IDEF-0, and their relationship within a box, are illustrated in figure (6.5). These include Input, Control, Output, Mechanism (ICOM), mechanism call, tunnelled, internal and boundary, and boundary arrows (Kamara et al., 2000). IDEF0 diagrams are easy to understand because they show processes in the same way that individuals naturally think about them. IDEF0 diagrams decompose processes into sub-processes and product flows, in much the same way that professionals think of tasks that have been set at workable levels, and will also think in terms of product deliverables. IDEF0 is a simple language to learn. It has been well proven over the years, and the numerous commercial products available for IDEF0 diagramming enable development and analysis to be carried out quickly and easily (Tah and Carr, 2000).

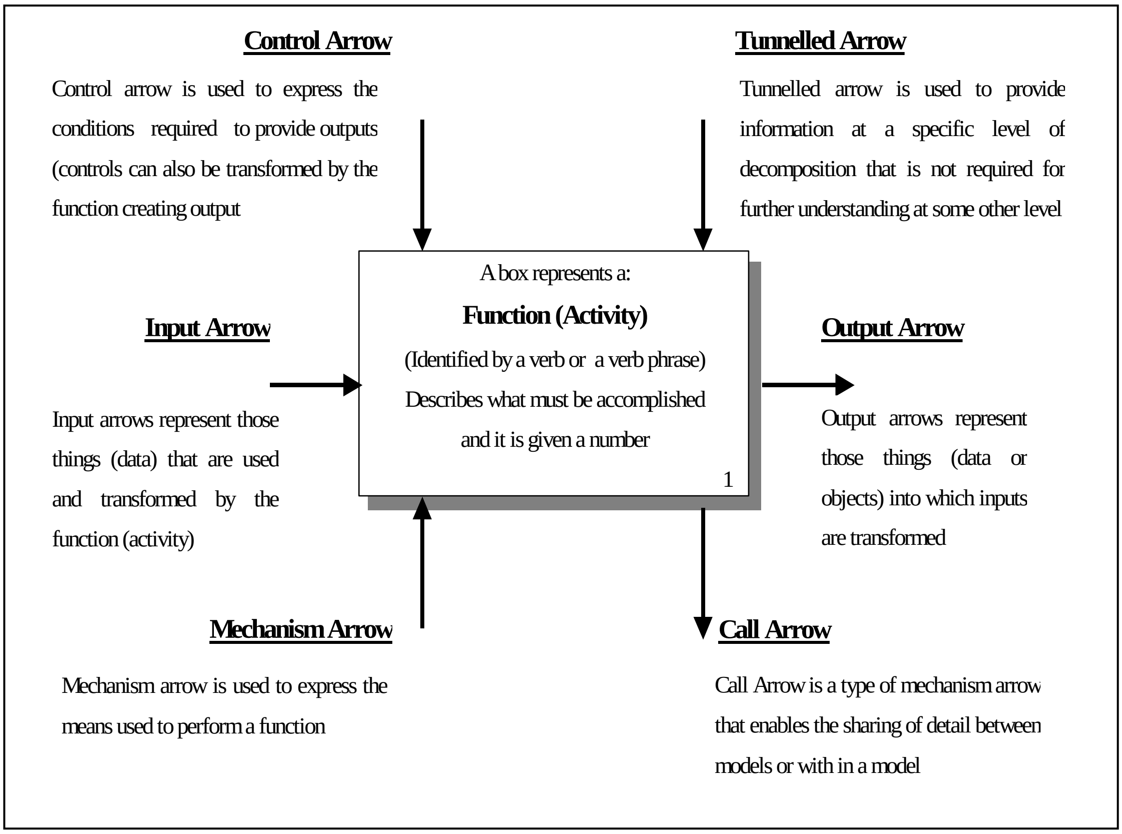


Figure 6.5 Basic Concepts of the IDEF-0 Method

6.4.2 The Contents of The Protocol

Table (6.2) represents a node index (table of contents) for the Value and Risk Management Protocol. Four diagrams are specified in the node index: the context (VRMP/A0) diagram (Managing Construction Brief Development), the Identifying Problem (VRMP/A1) diagram, the structuring objectives (VRMP/A2) diagram, the scrutinising alternative solutions (VRMP/A3) diagram, and the adopting development decision (VRMP/A4) diagram, see figure (6.7). A fifth diagram (VRMP/A-0) which represents the top-level diagram for the protocol is represented in figure (6.6). It contains a single activity "Managing Construction Brief Development" which enables client organisations and construction professionals adopt the proper decision to develop the project brief, achieve client satisfaction, manage project change orders as well as enhance the briefing process through learned lessons and feed back. This will be achieved by using the Value and Risk Management Protocol and the brief development study team. In addition, the availability of the client desire to manage brief development and enhance the project performance will represent the conditions that will help successfully achieve the function output.

Diagram Reference				Description
VRMP/A0				**Managing Construction Brief Development**
	VRMP/A1			**Identifying Problem**
		A11		Assembling and Empowering the team
			A111	Orientation Meeting
			A112	Identifying and Selecting the team members
			A113	Deciding on study date, time, duration & location
		A12		Investigating Brief Development Data
			A121	Collecting Brief Development Data
			A122	Defining Development Data Resources
			A123	Classifying Development Data
		A13		Defining Brief Development
			A131	Describing Brief Development
			A132	Defining Development Driver
			A133	Defining Development Stage
			A134	Defining Development Initiator
			A135	Defining Value & Risk Sources to Client
	VRMP/A2			**Structuring Objectives**
		A21		Defining Objectives
		A22		Developing Objectives Value Hierarchy
		A23		Allocating Importance Weights
		A24		Defining Associated Risks
	VRMP/A3			**Scrutinising Alternative Solutions**
		A31		Generating Alternatives
		A32		Evaluating Alternatives
			A321	Developing Decision Matrix
			A322	Assessing Associated Risks
			A323	Comparing Alternatives
			A324	Performing Sensitivity Analysis
			A325	Reconciling Value and Risk
	VRMP/A4			**Adopting Development Decision**

		A41	Presenting Alternatives
		A42	Selecting the Best Alternative
		A43	Implementing the Selected Alternative
		A44	Monitoring and Feeding back

Table 6.2 Node Index for The Value and Risk Management Protocol

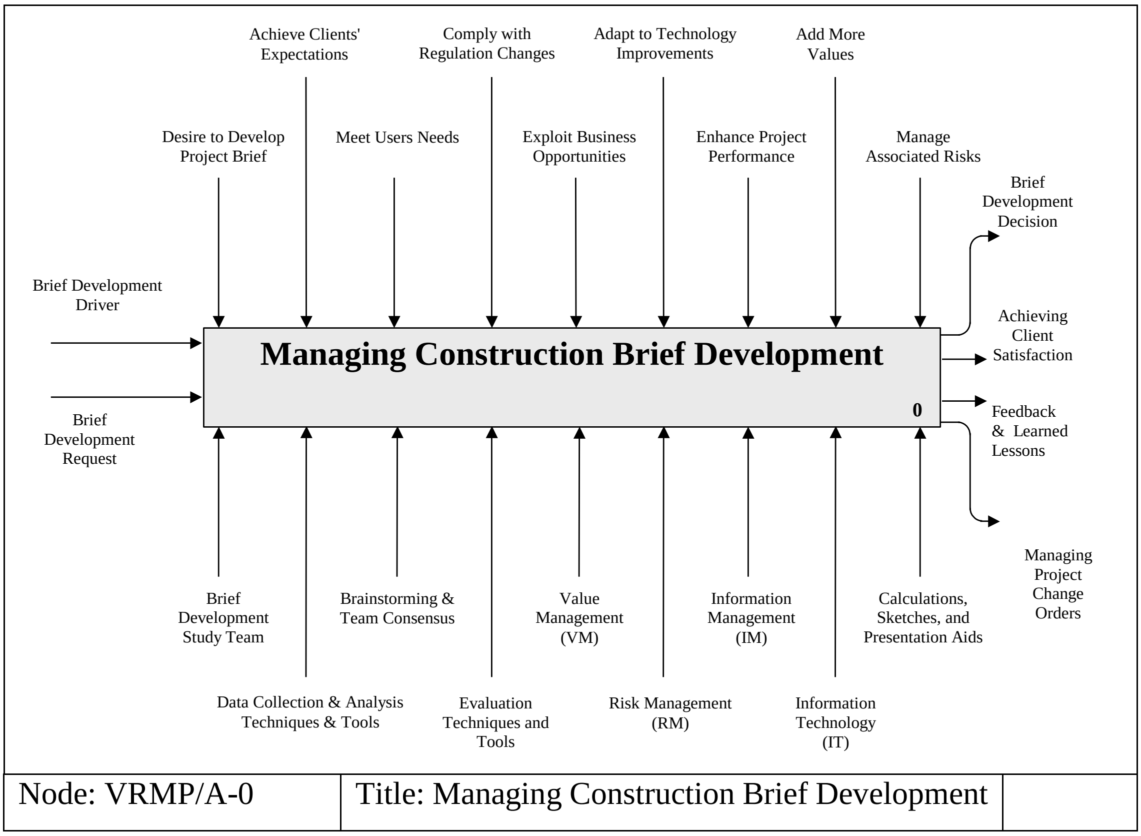
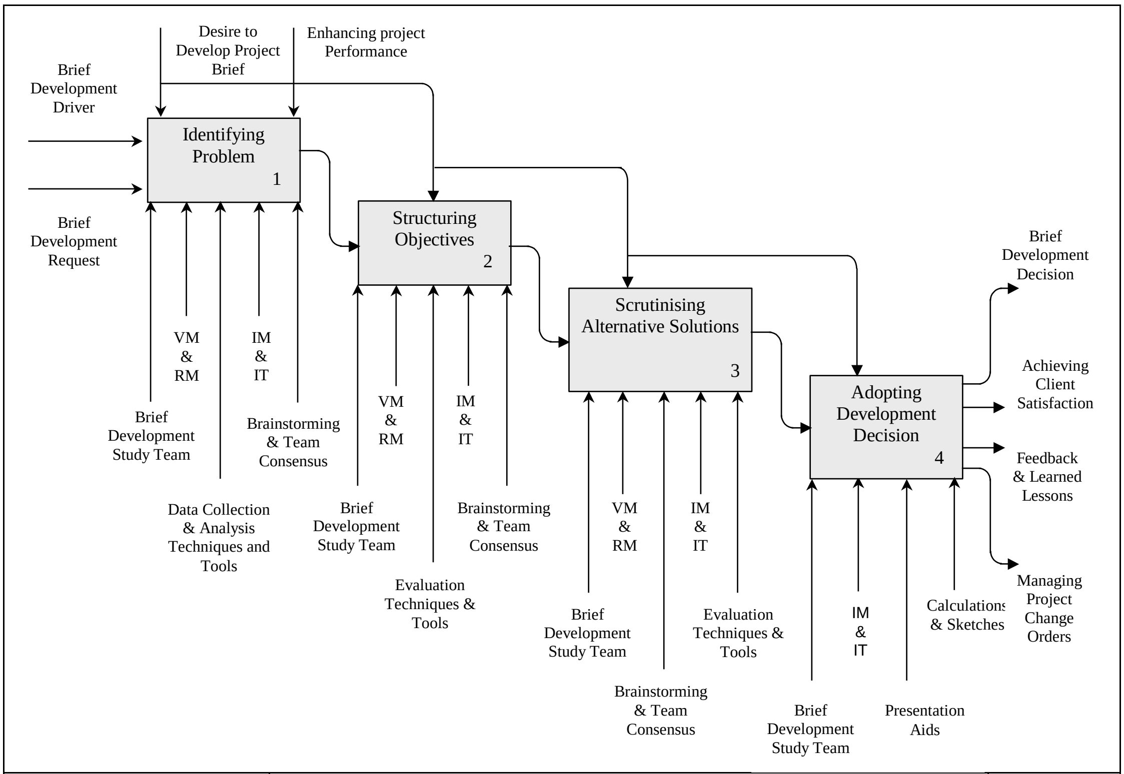


Figure 6.6 The Top-Level Diagram for the Value and Risk Management Protocol



Node: VRMP/A0	Title: Managing Construction Brief Development	

Figure 6.7 The Four Main Steps of the VRMP

6.4.2.1 Identifying Problem

The "Identifying Problem" function (figure 6.8) is a decomposition of box 1 in the VRMP/A0 diagram (figure 6.7) and it involves three activities: (1) Assembling and Empowering the Team, (2) Investigating Brief Development Data, and (3) Defining Brief Development.

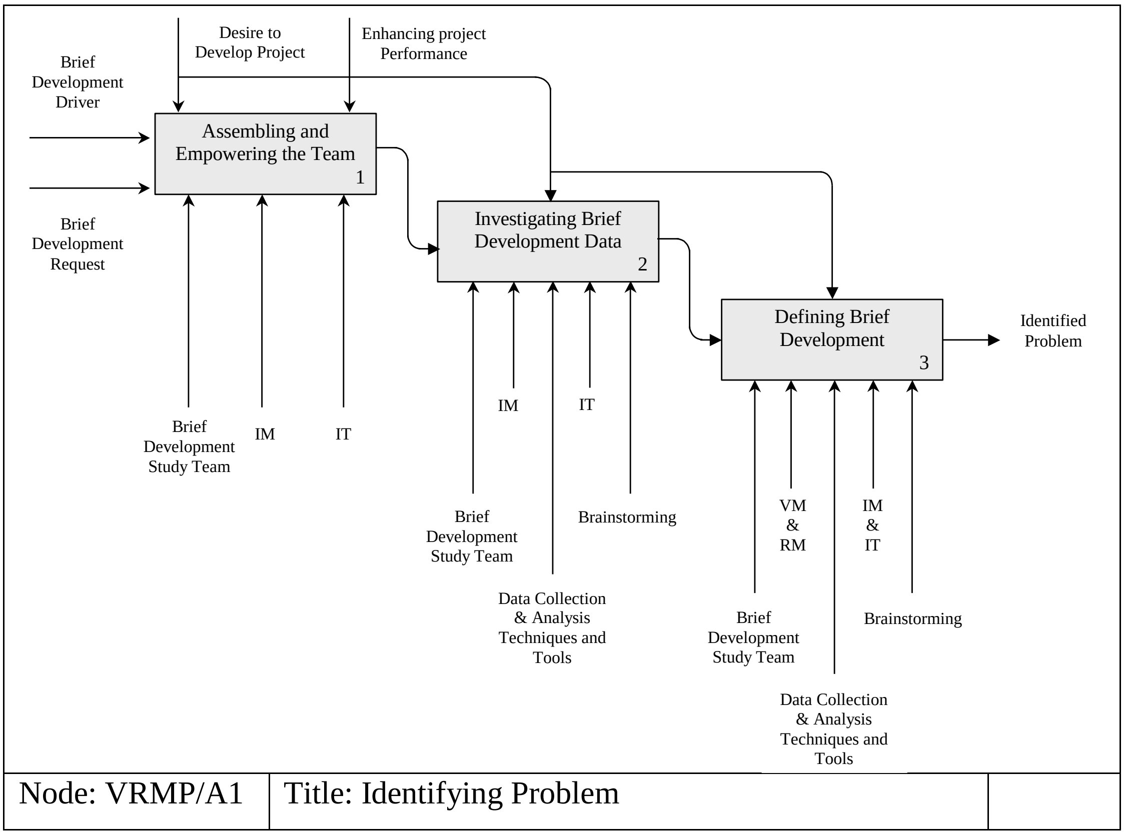


Figure 6.8 Identifying Problem

❖ *Assembling and Empowering the Team*

It is important to have an orientation meeting prior to the study in order to understand the client's objectives and identify the reasons that drive the client to develop the project brief, so that the information required for the study can be assessed and arranged. In addition, strategic matters such as selecting team members, study date, time, duration and location could be decided. The correct team selection is critical to the success of brief development study. When selecting a team, balance between the need for participants who represent various areas of expertise and interest has to be achieved. The valuable background knowledge of clients and users representatives plays a vital role in assisting team members understand the project operations and brief development. Teams should contain between six and twelve full time participants to maintain optimum productivity (Norton and McElligott, 1995). Information management and information technology were used to create, classify, store, retrieve, share, and update data, see figure (6.9).

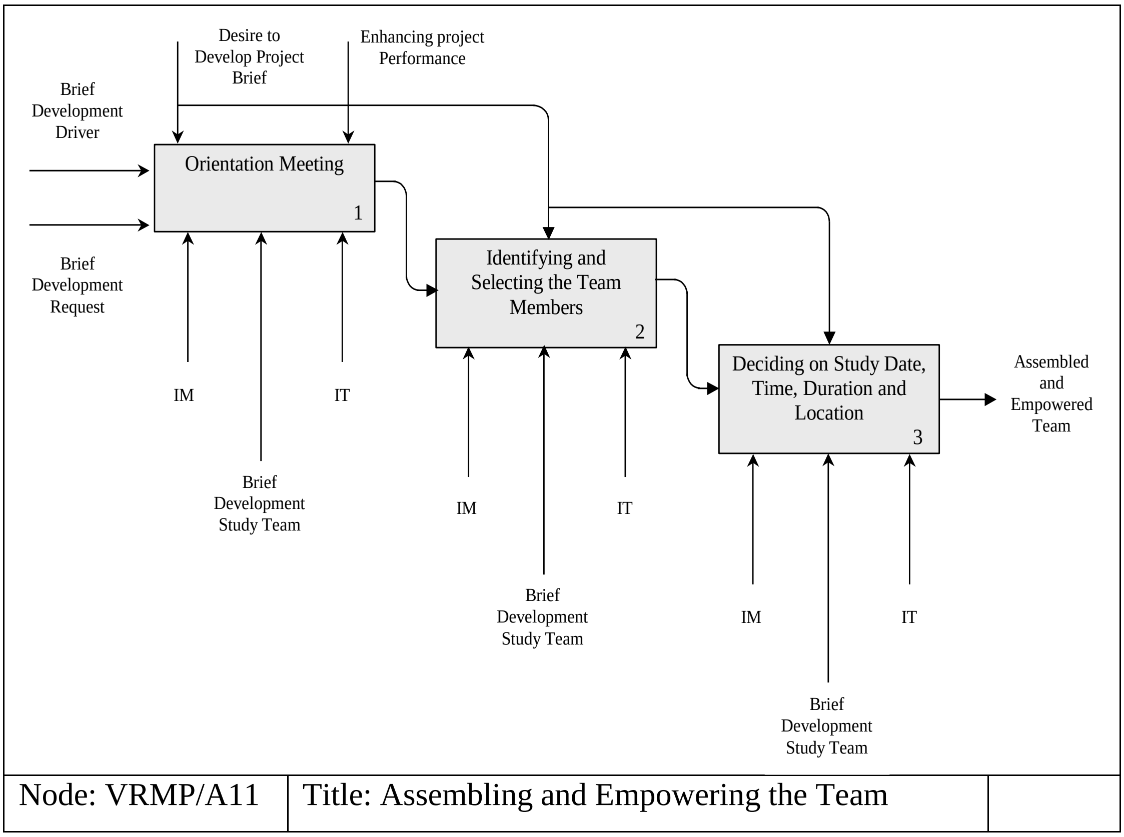


Figure 6.9 Assembling and Empowering the Team

❖ *Investigating Brief Development Data*

This activity aims to investigate brief development data. It focuses on "Collecting Brief Development Data", "Defining Development Data Resources" and "Classifying Development Data". When a brief development request is raised either by client, designer, government authority or other concerned parties, it is important to authenticate these data. This will be done through collecting data from relevant parties and reliable sources, then data resources will be defined and the collected data will be classified. Utilising information management and information technology capabilities will facilitate creating, classifying, storing, retrieving, sharing and updating data, see figure (6.10).

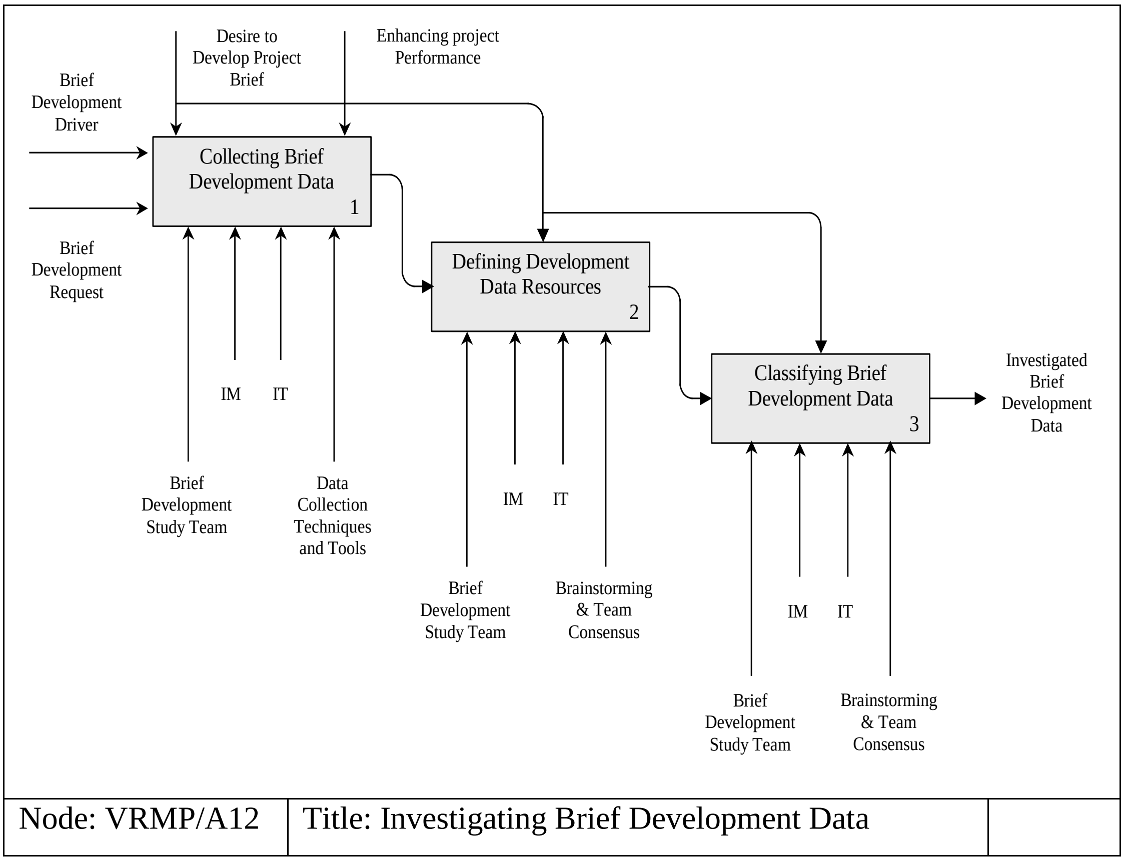


Figure 6.10 Investigating Brief Development Data

❖ *Defining Brief Development*

In order to complete the picture of brief development, this activity aims to describe brief development, define development driver, stage, initiator, value sources and risk sources to client. This information is an essential and integral part of the information collected in "Identifying Brief Development" function. It is intended to enable the study team, adequately, understands the development required to be made to the project brief and will be the basis for followed function, see figure (6.11).

6.4.2.2 Structuring Objectives

The "Structuring Objectives" function (figure 6.12) is a decomposition of box 2 in the VRMP/A0 diagram (Figure 6.7) and it involves four activities: "Defining Objectives", "Developing Objectives Value Hierarchy", "Allocating Importance Weight" and "Defining Associated Risks".

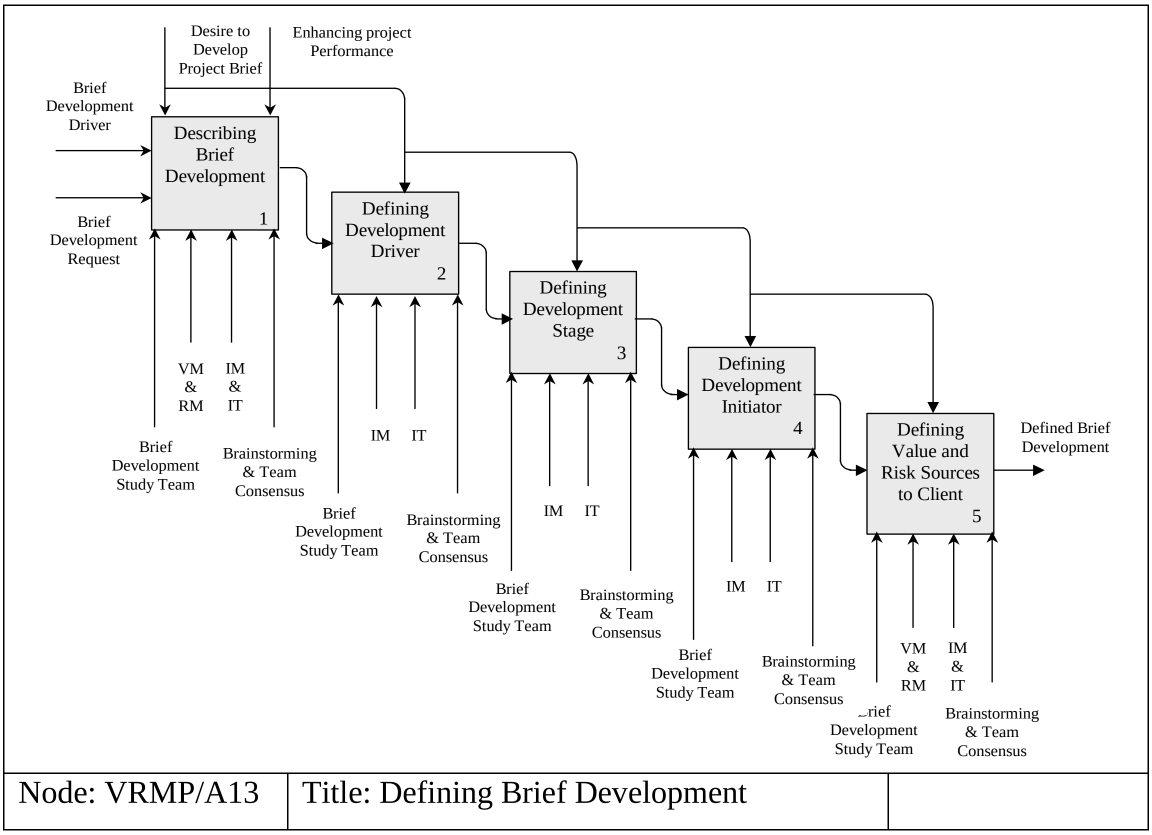


Figure 6.11 Defining Brief Development

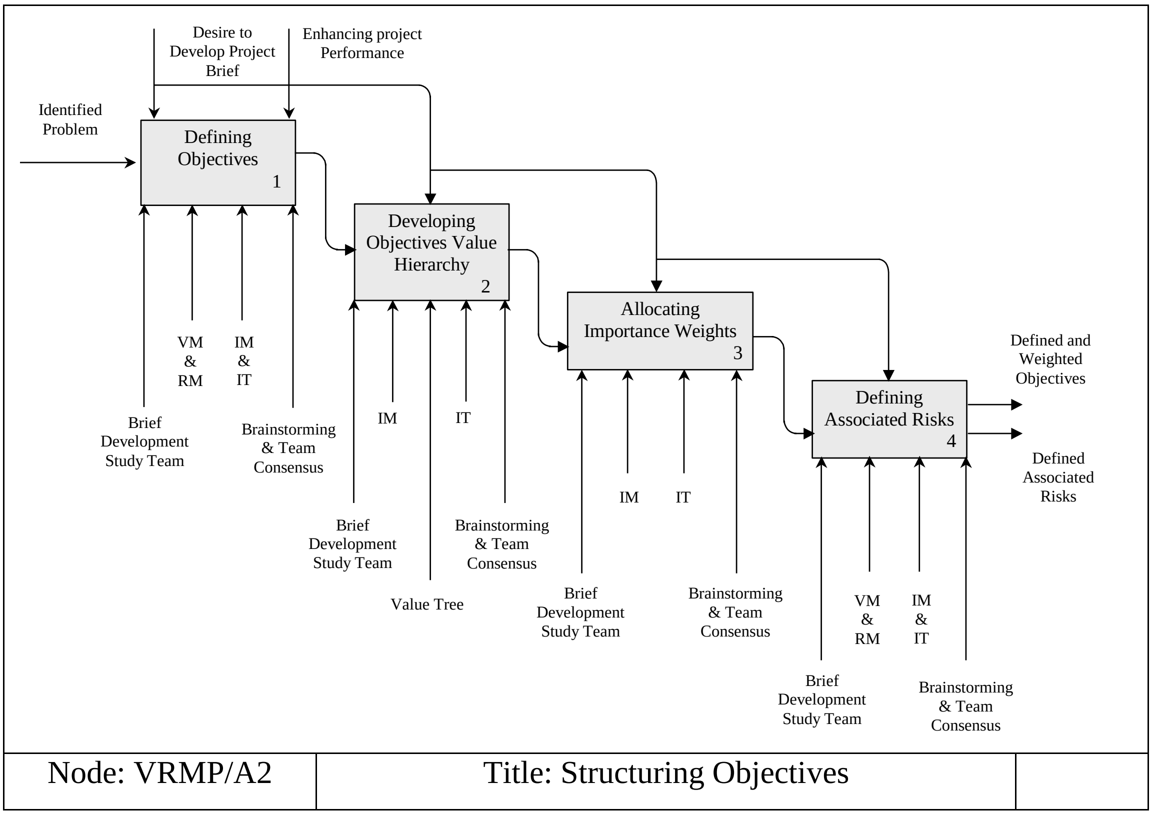


Figure 6.12 Structuring Objectives

❖ *Defining Objectives*

In an endeavor to enable client organisations and construction professionals adopt the appropriate decision, the objectives of brief development have to be adequately defined. These objectives could be emerging clients' requirements, meeting user needs, coping with regulation changes, exploiting business opportunities and adapting to technology improvement for instance. Clear definition of objectives leads to the achievement of client and user satisfaction. The objective of this function was adequately achieved through collecting data from the concerned parties and the use of brainstorming and team consensus.

❖ *Developing Objectives Value Hierarchy*

The brief development objectives defined at the previous function have to be structured in a value tree in order to help allocating importance weights in subsequent stage. The top of the tree is characterised by the overriding raison d'être of the entire objectives. This is then progressively broken down into sub-objectives. Whilst the higher order objective represents an end in itself, the lower order objectives are considered to be 'means-to-an-end'. It is important that the value tree is produced by brainstorming and group consensus and that each participant feels involved.

❖ *Allocating Importance Weights*

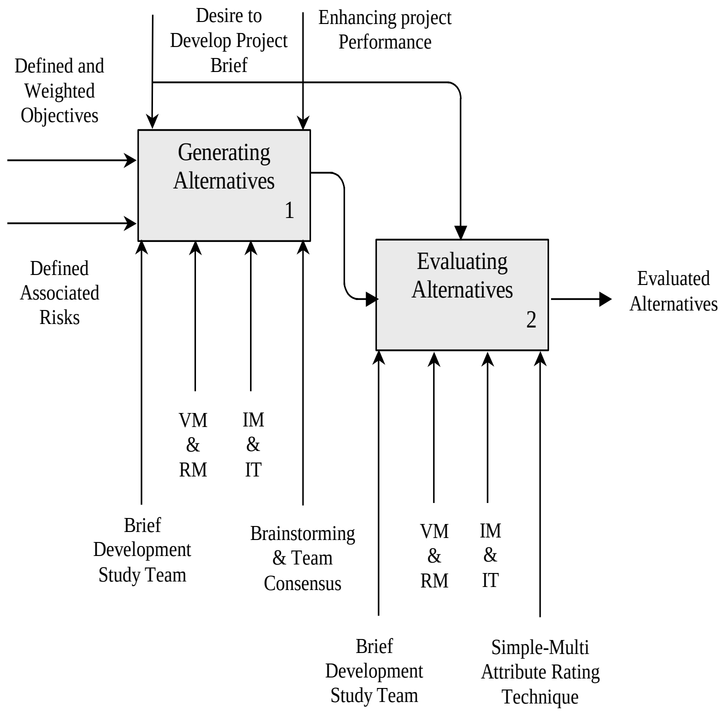
It is essential after the objectives value hierarchy is developed to allocate importance weights to each attribute according to its perceived importance. Attributes are initially listed in order to perceived importance and the least importance is awarded an arbitrary weight of 10. It is then necessary to allocate weights to the other attributes on the basis of their relative importance. The weights are then summed and each attribute is normalised so that the total weight for the group adds up to 1.

❖ *Defining Associated Risks*

Since better value could not be achieved unless associated risk are identified, this function aimed to define the different risks that lead to brief development or affect the achievement of development objectives.

6.4.2.3 Scrutinising Alternative Solutions

The "Scrutinising Alternative Solutions" function (figure 6.13) is a decomposition of box 3 in the VRMP/A0 diagram (Figure 6.7) and it involves two activities: "Generating Alternatives" and "Evaluating Alternatives".



Node: VRMP/A3	Title: Scrutinising Alternative Solutions	

Figure 6.13 Scrutinising Alternative Solutions

❖ *Generating Alternatives*

The aim of the "Generating Alternatives" function is to create new ideas that achieve the various brief development objectives defined at previous functions. Brainstorming technique will be used to generate and record as large number of ideas without evaluation. The rules for brainstorming are as follows:

(1) The problem under study should be described to the team in advance.

(2) A positive environment should be established by the team leader prior to embarking on idea generation.

(3) The group should be relatively small and should consist of members from diverse backgrounds.

(4) Illogical ideas and freewheeling are encouraged.

(5) Quantity and not quality ideas are encouraged.

(6) Judgement of ideas is prohibited.

(5) The combination and improvement of ideas is encouraged (Norton and McElligott, 1995).

❖ *Evaluation Alternatives*

During this function the desire for the judgement of ideas, which was suppressed during the "Alternatives Generation" function, is released. The allocation of importance weights to the objectives value hierarchy forms the basis of the evaluation process. Alternatives evaluation screens the ideas created during "Alternatives Generation", so that only the best ideas will be selected for development. Evaluation involves the following processes, see figure (6.14).

(1) Developing Decision Matrix

(2) Assessing Associated Risks

(3) Comparing Alternatives

(4) Performing Sensitivity Analysis

(5) Reconciling Value and Risk

Firstly, each option is assessed against each of the identified attributes (i.e. objectives and sub-objectives), this is best done in the form of a decision matrix. Each brief development option is scored against each attribute on a scale from 0-100. Following the allocation of scores, these are then weighted (i.e. multiplied) by the appropriate importance weighting identified during the allocating importance weight function. The weighted scores for each attribute in brief development alternatives (i.e. alternative A) can then be added together to provide the aggregate score for brief development alternatives. By comparing the total scores of the various alternatives, the most suitable options can be arrived at which has highest score (CIRIA, 1996). Secondly, every alternative is assessed against the associated risks by assessing risk likelihood and severity. The assessed risk = Likelihood * Severity. Thirdly, all development alternatives are compared to each other on the basis of expected value and associated risks. The best alternative is the one which has more net expected value which (= expected value-associated risk). Fourthly, sensitivity analysis has to be carried out. The purpose of this analysis is to test how sensitive the outcome of the rating process is to marginal changes in the key variables. Particular attention should be given to any importance weights which members of the team had expressed discomfort. It may be necessary to adjust the structure of the value and risk tree (Green, 1992). Finally, It may be essential that the study team revisits the selected alternatives in particular when the associated risk (i.e. cost) is higher than the estimated cost. Minor modifications to the selected alternative will overcome this problem without affecting the overall performance.

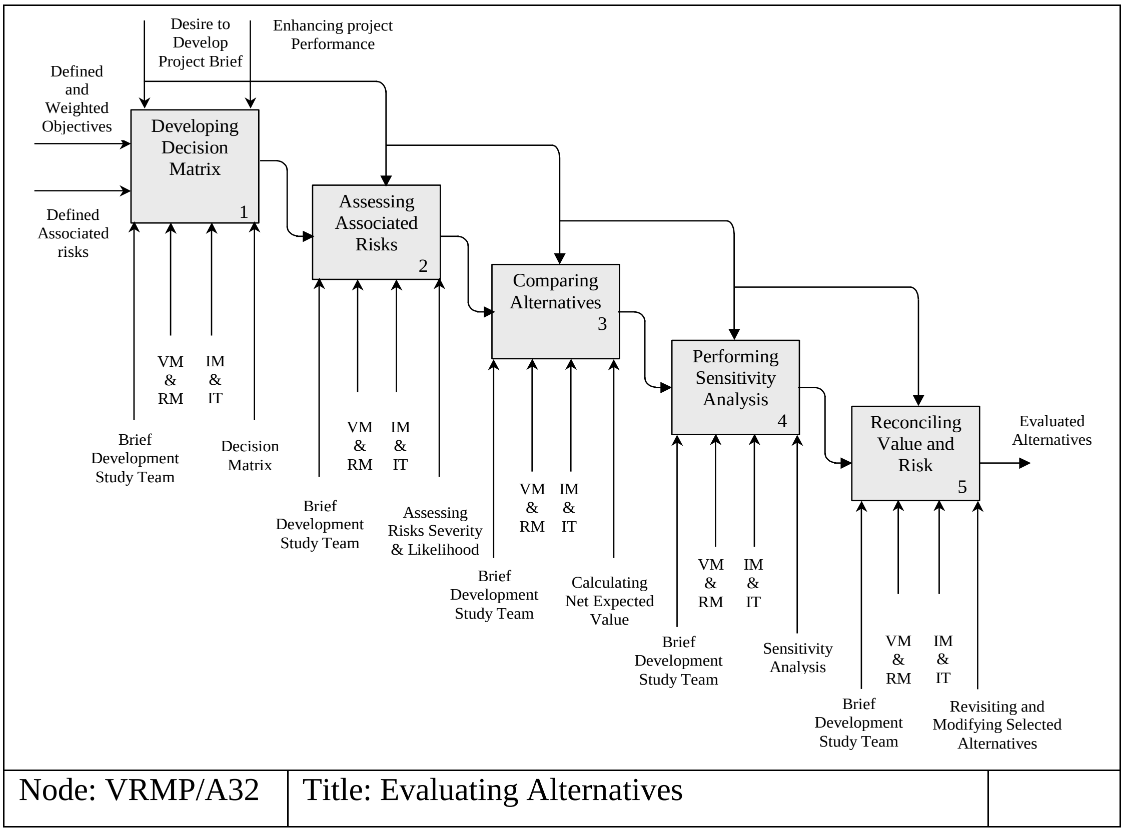


Figure 6.14 Evaluating Alternatives

6.4.2.4 Adopting Development Decision

The "Adopting Development Decision" function (figure 6.15) is a decomposition of box 4 in the VRMP/A0 diagram (Figure 6.7) and it involves four activities: "Presenting Alternatives", "Selecting Best Alternative", " Implementing Selected Alternatives" and "Monitoring and feeding back".

- *Presenting Alternatives*
- *Selecting the Best Alternative*

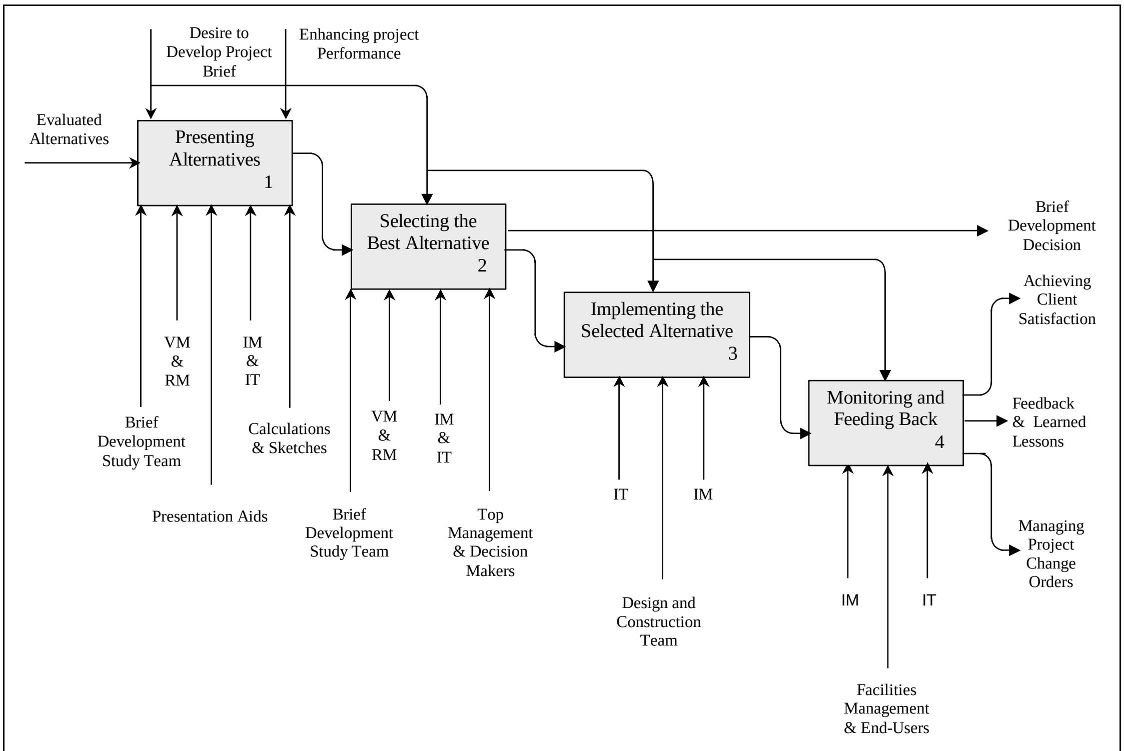
The objective of the "Presenting Alternatives" function is to assist in the communication of the results of the brief development study to the decision-makers. Since miscommunication of the proposals may result in their rejection, it is essential that every effort is made to ensure full perception of the brief development team's recommendation by all interested parties. The presentation function enables the study team to orally present their major recommendations so that the subsequent review of the written proposals is not hindered by a lack of understanding. During the “Selecting Best alternative” function the decision-makers should select the most appropriate alternative that achieves the client objectives and guarantees his/her satisfaction at the most cost-effective manner (Norton and McElligott, 1995).

❖ *Implementing the Selected Alternative*

If the decision-makers adopted the decision to proceed with brief development either by modification, omission, or addition to the brief document contents, the project manager with the collaboration of design and construction team has to establish the plans and procedures to implement this decision. If the decision was not to develop the project brief, the project manager has to complete the work as it was decided in the approved brief contents before the development request.

❖ *Monitoring and Feedback*

The "Monitoring" function plays an important role in following up and observing the implementation of the adopted decision of brief development. It aims to ensure that the implementation of the selected decision proceeds as planned and tries to take any corrective actions if any problems face the implementation of brief development. In addition, it is necessary to make sure that the final product of brief development satisfies and achieves the client requirements. "Feeding back" function aims to improve the briefing process for future projects by feeding back the client organisation and design and construction teams with learned lessons and comments that have to be utilised and pitfalls that need to be avoided in new projects.



Node: VRMP/A4	Title: Adopting Development Decision	

Figure 6.15 Adopting Development Decision

6.5 Application of the Value and Risk Management Protocol

In order to investigate how the VRMP will be implemented in managing dynamic brief development in construction, the protocol was applied on a real case study. Details of the study are described below.

6.5.1 Brief Description of the Project

The project was designed as a commercial building consists of:

- Ground floor comprised of shops and services rooms.
- Four typical floors comprised of 16 flats (two bed rooms)
- Roof floor comprised of services rooms and watchman room

The project cost was expected to be DHS (Dirhams) 6.000.000 and the construction periods expected to be 12 months. At the tender action stage, the project client decided to change the design of the project to be an office building. A development request was submitted to the design firm and the Department of Social Services and Commercial Buildings (DSSCB) as the funding body and the authority that will approve the design and supervise the construction of the project. It was made clear to the client that any modifications or changes to the project brief should be within the limit of the government loan to construct the building, otherwise the client is responsible for providing additional fund to cover any extra expenses. The client stated that he does not have the ability to provide additional fund and the modifications should not exceed the government loan. For this reason reducing project cost, in terms of using substitute materials and reducing maintenance cost, was one of the main objectives of brief development. The client agreed to compensate the design firm for the effort and expenses paid for re-designing the project as an office building.

6.5.2 Identifying Problem

6.5.2.1 Assembling and Empowering the Team

An orientation meeting was held at the design firm on 8/3/2003. This meeting was attended by the client representative, projects manager, chief architect and the researcher. The aim of this meeting was to discuss the client’s request to modify the design of the project and understand the client's objectives and the reasons that derived him to modify the project design and how his objectives could be achieved. A brief development study team was formed. It contained the researcher as a facilitator, client representative, projects manager, architect, quantity surveyor, structural engineer, civil engineer, and electro-mechanical engineer. The study date was decided to be on 15/3/2003 from 8:30 AM. to 4:30 PM. for the period of 5 days at the design firm. One week was given to the design firm to collect adequate information from related authorities regarding design changes and its requirements and approvals.

6.5.2.2 Investigating Brief Development Data

Data were collected from many sources such as the client organisation, end user, Municipality and Town Planning Department, Civil Defence Directorate, Water and Electricity Department for example. The first two sources (i.e. client and end user) are the two parties that will benefit from the project, so the data collected from them was focused on how the new design will meet their expectations and satisfy their needs, where the data collected from other sources was about the requirements and procedures for design change as well as how the new design will comply and conform with government authorities regulations.

Data Resource	:	Client Organisation, End User, and Gov. Authorities.
Data Classification	:	Client Requirements &Economic

6.5.2.3 Defining Brief Development

Development Description

Modifying the design of the project from commercial building consisting of:

Ground floor: shops and services rooms

Typical floors: 16 flats (two bed rooms)

Roof: Services rooms and watchman room

To an office building consisting of :

Ground floor: showroom and services rooms

Typical floors: offices

Roof: Services rooms and watchman room

Development Driver	:	Responding to market demand
Development Stage	:	Tender Action
Development Initiator	:	Client Organisation & End User
Value Source to Client	:	End User
Risk Source to Client	:	End User

6.5.3 Structuring Objectives

6.5.3.1 Defining Objectives

The client objectives were defined as modifying the project design from a commercial building to an office building in order to get better value for money and utilise the benefits of the project location. A set of sub objectives were generated to achieve the client objectives:

1 - increase income.

2 - respond to market demand.

3 - reduce project cost.

4 - reduce maintenance cost.

5 - attract customers.

6 - use substitute materials.

6.5.3.2 & 6.5.3.3 Developing Objectives Value Hierarchy & Allocating Importance Weights

After the brief development objectives were defined, the brainstorming technique was used to develop objectives value hierarchy and allocate importance weight for each objective based on the importance of the objective to the client organisation, see figure (6.16) and table (6.3).

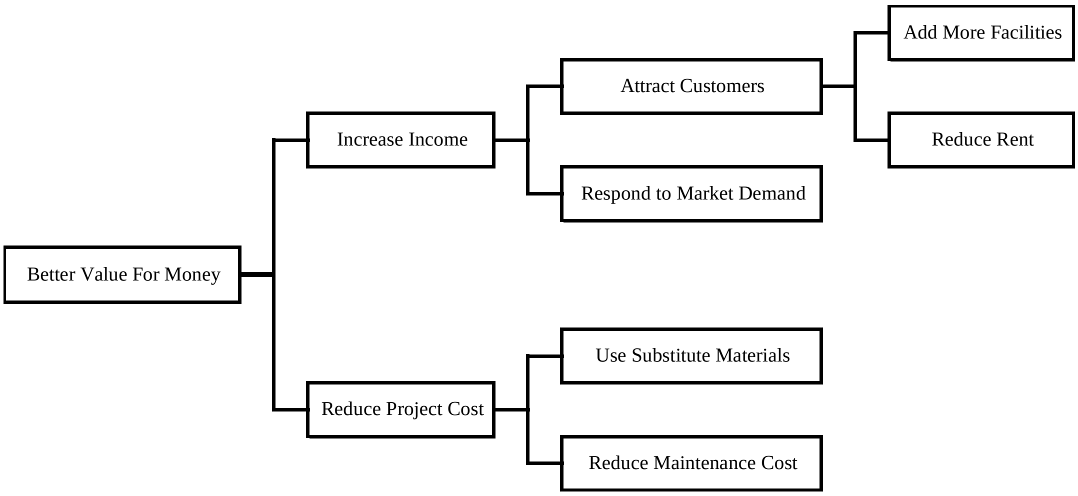


Figure 6.16 Brief Development Objectives Value Hierarchy

Development Objectives	Weights	Normalised Importance Weight
Add More Facilities	10.00	0.24
Reduce Rent	15.00	0.36
Respond to Market Demand	10.00	0.20
Use Substitute Materials	40.00	0.16
Reduce Maintenance Cost	10.00	0.04

Table 6.3 Importance Weights of the Brief Development Objectives

6.5.3.4 Defining Associated Risks

After the objectives value hierarchy was developed and the importance weights were allocated and calculated, the associated risks that may threat the achievement of the required objectives were defined. These risks were defined as:

(1) Delay due to re-design time required as well as getting authorities approvals.

(2) Delay due to importing materials.

(3) Losing customers.

6.5.4 Scrutinising Alternative Solutions

6.5.4.1 Generating Alternatives

The multi-disciplinary study team used brainstorming technique to generate creative alternatives to achieve the above objectives. Table (6.4) summarises the generated alternatives.

Alternative A	Leave the design of the typical floors as it is, move the services rooms in the ground floor to basement in order to increase the showroom area, and use substitute cheaper materials
Alternative B	Increase the number of flats from 16 (two bed room) to 24 (one bed room), move the services rooms to basement to increase showroom area, construct car parking at basement, raise the building specification, and reduce rent.
Alternative C	Re-design two floors to be offices, leave the other floors to be 8 flats (two bed room), move the services rooms to basement, construct car parking at basement, and use substitute cheaper materials.
Alternative D	Re-design two floors to be offices, re-design the other two floors to be 12 flats (one bed room) instead of 8 flats (two bed room), move the services rooms to basement, construct car parking at basement, and use substitute cheaper materials.
Alternative E	Modify the design of the whole project to be office building, move the services room in ground floor to basement, add car parking, and raise building specification to attract customers.
Alternative F	Modify the design of the whole project to be office building, move the services rooms in ground floor to basement, add car parking, and use substitute cheaper materials.
Alternative G	Invest the client resources in another type of projects

Table 6.4 Brief Development Generated Alternative

6.5.4.2 Evaluating Alternatives

After the previous stage was completed, the different generated alternatives were evaluated. Alternative "G" was rejected on the basis that the government loan given to the client was intended to be spent on constructing his building and not for another purpose. Other alternatives were raised for evaluation. Decision Matrix was created to evaluate each alternative against the pre-defined objectives, see table (6.5). Assessing associated risks plays an important role in identifying the risks that most threat the achievement of the development objectives. This was done by assessing risk likelihood and severity, where assessed risk = likelihood (L) * Severity (S), see table (6.6).

Assessment Attributes	Add More Facilities	Reduce Rent	Respond to Market Demand	Use Substitute Materials	Reduce Maintenance Cost	Total
Weights of Importance	**0.24**	**0.36**	**0.20**	**0.16**	**0.04**	
Alternative A	0.00	0.00	20.00	100.00	0.00	
	0.00	0.00	4.00	16.00	0.00	20.00
Alternative B	75.00	25.00	30.00	0.00	0.00	
	18.00	9.00	6.00	0.00	0.00	33.00
Alternative C	50.00	0.00	40.00	100.00	42.00	
	12.00	0.00	8.00	16.00	1.68	37.68
Alternative D	50.00	0.00	50.00	100.00	40.00	
	12.00	0.00	10.00	16.00	1.60	39.60
Alternative E	75.00	0.00	80.00	0.00	85.00	
	18.00	0.00	16.00	0.00	3.40	37.40
Alternative F	50.00	0.00	80.00	100.00	85.00	
	12.00	0.00	16.00	16.00	3.40	47.40

Table 6.5 Decision Matrix Used to Evaluate Alternatives

Assessment Attributes	Re-Design Delay		Importing Materials		Losing Customers		Total
	L	S	L	S	L	S	
Alternative A	5.00	1.00	1.00	1.00	2.00	2.00	10.00
	5.00		1.00		4.00		
Alternative B	5.00	3.00	3.00	3.00	1.00	1.00	25.00
	15.00		9.00		1.00		
Alternative C	5.00	2.00	1.00	1.00	1.00	1.00	12.00
	10.00		1.00		1.00		
Alternative D	5.00	2.00	1.00	1.00	1.00	1.00	12.00
	10.00		1.00		1.00		
Alternative E	5.00	2.00	4.00	3.00	1.00	1.00	23.00
	10.00		12.00		1.00		
Alternative F	5.00	2.00	1.00	1.00	1.00	1.00	12.00
	10.00		1.00		1.00		

Table 6.6 Assessing Associated Risks

After the decision matrix was developed and the associated risks were assessed. Alternative were compared on the bases of expected value and associated risks, where net expected value = expected value – associated risk, see table (6.7).

	Expected Value	Associated Risk	Net Expected Value
Alternative A	20.00	10.00	10.00
Alternative B	33.00	25.00	8.00
Alternative C	37.68	12.00	25.68
Alternative D	39.60	12.00	27.60
Alternative E	37.40	23.00	14.40
Alternative F	47.40	12.00	35.40

Table 6.7 Comparing Alternatives

Results of comparing alternatives showed that alternative “F” has the highest net expected value of 35.40. Sensitivity analysis was carried out by fixing all evaluation criteria and changing one criterion and then observes its effect on evaluated alternatives. Results showed that alternative “F” still the favored option.

6.5.5 Adopting Development Decision

6.5.5.1 Presenting Alternatives

A presentation meeting was held at the design firm office where brief description of the study was introduced to the client. It included presentation of the VRMP, identification of the problem in hand, structured objectives, generated and evaluated alternatives. In addition, a brief development study report was submitted to the client organisation in order to facilitate reviewing the systematic steps followed and helping adopt the proper brief development decision.

6.5.5.2 Selecting the Best Alternative

Alternative “F” was selected as the best alternatives with net expected value of 35.40. The cost of the selected alternative was expected to be DHS 5.660.270, which is within the budget of the government loan.

6.5.5.3 Implementing the Selected Alternative

After the client organisation selected to change the design of the project from commercial building to an office building with moving the service rooms in ground floor to basement, add car parking and use substitute cheaper materials, official letter was issued by the client organisation and the DSSCB to the design firm stated the acceptance of the changes of the project design and brief development and that the design firm will be compensated for the re-design and production of tender documents as an office building .

6.5.5.4 Monitoring and Feeding Back

Based on the above step, the design firm re-designed the project according to the developed brief. The feed back of the case study is summarised as:

(1) Carrying out adequate study of the client business case, client requirements, future projects and market demand will avoid later changes where its cost is expensive and it disrupts the scheduled works.

(2) The designer should bear in mind that many client organisations do not have in depth construction knowledge or can not describe what do they need, so the designer should have the art of questioning and suggest more options until the client requirements are met and his / her satisfaction is achieved.

(3) Client organisation should provide the design firm with all information and open communication channels to reflect their requirements as early as possible.

(4) The project client was satisfied with the results of the study.

6.6 Discussion

It is essential at this point to analyse the case study mentioned above and show how well the VRMP helped achieve the objective of the dynamic brief development concept.

(1) The VRMP enabled client organisations achieve their expectations and obtain their satisfaction through increasing income, responding to market demand, reducing project cost, reducing maintenance cost, attracting customers, and using substitute materials.

(2) The VRMP facilitated responding to the market demand in an innovative way by developing creative solutions at the most cost effective manner.

(3) The VRMP reduced the number of change orders that could take place if the project was constructed as commercial building and the client decided to change it to office building later on.

(4) Improving the briefing process through learned lessons and feedback.

6.7 Benefits of the Value and Risk Management Protocol

The main benefit of the Value and Risk Management Protocol is enabling client organisation and construction professionals adopt the proper decision to develop the project brief. Other benefits of the protocol are summarised as:

(1) Overcoming the limitations of the previous approaches to manage change orders and integrate value and risk management. Beside the establishment of the theoretical basis of integrating value and risk management, the research moved a step ahead and applied the protocol in solving real engineering and construction problems such as managing brief development and managing project change orders. The research tried to manipulate the lack of attention paid to the subject of integrating value management and risk management by emphasising the need for their integration since both disciplines are complementary techniques and there is a need and possibility for their integration. This is because best value could not be achieved unless associated risks have been managed taking in account the cost of their management. Overcoming the limitations of the previous developed approaches is summarised as:

- The protocol answered the question raised by Randall (1996) about evaluating value management under uncertainty, and therefore conducting risk identification before or after value brainstorming?. The answer of this question was based on the argument that value identification leads to identifying associated risks. In addition, identifying the risks that could threat the achievement of brief development objectives firstly, may hinder the team members from identifying and exploring the values that could be gained as risk identification is a pessimistic process. It was encouraging and logical to stimulate the study team by identifying the values that could be gained firstly and then identify the associated risks. This view was supported by Randall who considered value is the lead technique, which is used to launch risk activities. The developed protocol creates firstly the objectives value hierarchy and then identifies associated risks to these values. Continuous revision and auditing of values and risks was carried out in order to reach to an appropriate identification of value and risk. During the evaluation stage, alternatives were evaluated and compared on the basis of the best values that could be achieved at the lowest associated risks.

- The protocol employed quantitative risk assessment in the form of numerical values for risk probability and risk severity. This was built from the practical experience of the study team members. In addition, the protocol avoided the use of the new term of uncertainty instead of value and risk as suggested by Green (1996b), so the confusion that could arise from introducing new terminology was minimised. Furthermore, the protocol utilised the benefits of information management and information technology in terms of creating, classifying, storing, retrieving, sharing and updating data.

(2) Helping clarifying and eliminating misunderstanding of client aims and objectives through the participation of project stakeholders and ensuring that client requirements are clearly defined.

(3) Identifying the brief development required in detail including the nature, driver, stage, initiator, value sources and risk sources to the project from the client point of view.

(4) Helping meeting client's expectations at the most cost effective manner.

(5) Creating collaborative work environment through building a common understanding of the client's requirements amongst the design and construction teams.

(6) Achieving better solutions through the application of structured steps and the use of diverse team experience.

(7) Add more values to the project through the generation of creative solutions that achieve the expected function at lowest cost.

(8) Minimising uncertainties through identification, analysis and responding to associated risks.

(9) Responding in an innovative manner to the different influences of the brief development drivers and hence better management of change orders.

(10) Enhancing the briefing process through comments and feedback from end-users and facilities management team.

It is clear that the Value and Risk Management Protocol represents a distinct approach to achieve client satisfaction, responding to brief development drivers throughout the project life cycle, managing project change orders effectively, and improving the existing briefing process. However, there are a few limitations of the protocol, which need to be mentioned.

6.8 Limitations of the Value and Risk Management Protocol

The effective application of the Value and Risk Management Protocol depends to a large extent on the client organisations and construction professionals. If the top management of a client organisation, design and construction firms as well as other related parties such as funding bodies and suppliers do not have the desire and tended not to use the protocol, then its adoption will be limited. In addition, the application of the protocol is time consuming, and within the current culture in the construction industry where insufficient time is spent on managing brief development, this protocol might not be welcomed by some sectors of the industry. Moreover, the large amount of information used to manage brief development necessitated the importance to be well managed.

The benefits of the protocol should be clearly presented to top management of client organisations and construction professionals in order to get them convinced with the role, which the protocol could play in managing brief development. This will increase the opportunities for adopting the protocol. In addition, the limitations of time consuming and the large amount of date used could be overcome by encapsulating the protocol in a computerised format. This will enhance the usefulness of the protocol and provide a basis for its integration with other project management software packages and other construction activities, which are computer-based. In addition, it will facilitate input, organising, retrieving, sharing and updating brief development information.

6.9 Conclusions

The Value and Risk Management Protocol (VRMP) is a decision making tool designed within this research to manage and control brief development throughout the project life cycle. Its need emerged from the necessity of dynamic brief development. The aim of the protocol was to enable client organisation and construction professionals adopt the proper decision to develop the project brief on the basis of value addition and risk management. In addition, it aimed to achieve client satisfaction, respond to the different influences of the brief development drivers, manage project change orders effectively, and improve the performance of the briefing process through feedback and learned lessons.

These aims were achieved through a set of interrelated objectives of: adequate identification of brief development problems, better understanding of the client objectives, generating, evaluating and selecting the best alternative that will achieve these objectives at the most cost - effective manner, and implementing the selected alternative, monitoring its execution and feeding back the client organisation, design and construction teams with comments and learned lessons.

Seven items were identified as key principles of the protocol. They were: whole project view, dynamism and flexibility, stakeholders involvement, co-ordination and communication, feedback, rational, and creativity.

The protocol based on systematic steps of decision-making consists of: (1) intelligent phase, (2) design phase, and (3) choice phase. In order to select the proper way to represent the protocol activities, a revision of models, modelling process, and modelling tools were undertaken. IDEF-0 methodology was considered the most appropriate tool to represent the protocol. The rational behind its selection and description of its notation were illustrated.

The protocol consisted of four steps: Identifying problem, structuring objectives, scrutinising alternative solutions, and adopting development decision. The activities carried out during the first step were, assembling and empowering the team, investigating brief development data, and defining brief development. The activities undertaken during the second step were, defining objectives, developing objectives value hierarchy, allocating importance weight, and defining associated risks. The activities performed during the third step were: generating and evaluating alternatives. Finally, the activities carried out during the last step were: presenting alternatives, selecting best alternatives, implementing selected alternative, and monitoring and feeding back. The end of this chapter applied the protocol to a real case study and listed the benefits and limitations of the protocol. In order to overcome the limitations of the protocol and facilitate its use and utilise the benefits of information technology, the next chapter will describe the developed version of the protocol in a computer software format.

Chapter 7

The Brief Development Manager (BDManager) Prototype Software

7.1 Introduction

In order to overcome the limitations of the Value and Risk Management Protocol (VRMP), facilitate its use and escalate its efficiency as an innovative tool for managing dynamic brief development, this chapter presents a computerised version of the VRMP called the Brief Development Manager (BDManager) prototype software. Because of the importance of information management and information technology in supporting the proposed prototype, the role of both disciplines in managing brief development were illustrated. Detailed description of the prototype software is presented. This included defining the objectives and features of the BDManager, different types of developing prototypes, development of BDManager using Microsoft Access, system architecture for the prototype, development of database objects such as tables, forms, queries and reports. In addition, a particular section was devoted to illustrate the use of the BDManager in managing dynamic brief development. It comprises running of the BDManager and detailed description of the different prototype screens.

7.2 The Role of Information Management and Information Technology in Managing Brief Development

Information plays a key role in construction project management. Construction projects depend on the reliable and quick exchange of information. How data is recorded, refined, and organised affects its usefulness to the project. For a construction project to be well managed, data from past projects, as well as from current ones, must be readily available. Data and the accumulation and documentation of data are essential for project planning, controlling, and decision making to ensure not only that shared meaning and mutual understanding are constructed in the organisation but also that solutions have considered all angles of the problem. In each of these areas, effective information management is an integral part of any successful project management system whose primary objective is completed on time (Yates and Elnagar, 1997; Azam et. al, 1998; Zhan, 1998).

It is essential to put in place a clearly defined information management framework. This should establish the pattern of information flow through the life of the project, and identify the manner in which information will be managed, preferably through a single point of responsibility. In addition, because of the changes that take place in the design and construction documentation throughout the design and construction process, an information strategy to manage project information must be established as early as possible. This strategy must take into account the diversity of participants and work place. If this is achieved the benefits to clients are undisputed: better information flow saves time and money, disputes are avoided, a better product is obtained in a short time, and the client's aim of value for money is achieved. Information should be regarded as the property of the project, not the individual who created it. It is a shared resource. Each participant should be able to access accurate information, in a useful format and in timely fashion. Quality of information and information management could be escalated if the information is created in a way that makes its reuse easy and routine, if information can be transferred completely and accurately between parties, and if information can be tailored to the need of particular participants (Mitchell and Miller, 1999).

Information management has a crucial role in managing dynamic brief development in construction projects. Firstly, in the highly competitive construction market, information management enables construction professionals respond swiftly and efficiently to client's requirements, brief development drivers and provide a building that meets agreed standards and satisfies its clients, cost and time constraints. Interference in the construction process resulting from design changes or the late supply of information to the design and construction teams. The construction industry has come increasingly to recognise the need for more effective information transfer between participating organisations, and internally among the personnel within the organisation (Baldwin et al., 1999). Secondly, information management helps improve the briefing process through documentation and continuous improvement from learned lessons and feed back. Documentation systems should adequately track the information flow through the system and should contain a method to follow up on the overall impact of the changes. It could minimise the possibility of disputes, which may occur between design consultancies and their clients' concerning changes to the client brief. This could be achieved by documenting and insisting on all changes being requested and responded to in writing indicating whether these changes will or will not cause alternation to other things which have previously been agreed (Jebb, 1992). Documentation systems can be simple but should provide adequate insight into the change and its total impact. Frequent status updates will provide better knowledge and control of changes. Field reports during implementation are also helpful if changes are being evaluated in that area. In addition, systems are needed within the industry to generate and take advantage of lessons learned database (CII, 1994). Finally, managing project information helps manage project change orders through providing information for studying their impacts on different project aspects, generating, evaluating, selecting best solutions, monitoring and feeding back as well as reviewing the effects of similar change orders in similar projects.

Managing project information and documents is a powerful approach for communicating and controlling product development. Using information technology to manage documents becomes one of the most important challenges facing organisations. The use of information technology to support the creation, approving, sustaining, applying, sharing, and reviewing information can increase flexibility, fast-cycling capabilities (Amami and Beghini, 2000). Information is not a static resource. As projects progress change to the stored information base that has been built up during the project are inevitable. The manual process for updating information could be very time consuming, costly, and ineffective particularly in a project with a large store of knowledge. In some cases, the designer who initiated the change may forget to propagate the change or even incorrectly assume that some other disciplines are not affected. The result is a set of poorly coordinated documents with conflicts, inconsistencies, and mismatch. In addition, most design firms do not adequately organise the design knowledge, which often causes parts of the knowledge to be lost and makes the management of changes difficult. Technology escalates and facilitates the process of information management. It helps identify changed information, the reason for changes, and any related information that may be affected by a change. As an aid to the manual process, information technology may help to ensure consideration of all related information. Information once created and stored must be managed. It must be possible for personnel to access any information they need, and for authorised personnel to modify the information (Bouchlaghem et al., 2000b; Hegazy et al., 2001).

Computers and electronic communication networks are destined to play an ever-bigger role in the handling of information for three reasons:

(1) Processing: computers are more accurate, and cheaper than people.

(2) Communication: electronic messaging is faster, and cheaper than paper.

(3) Storage: electronic files are more accessible, and cheaper than paper (Wilson, 1997).

Besides acting as a means for general management and processing of project and company information, there are other ways in which information technology has been taken on by construction. These developments affects the construction process itself and can be categorised into four areas: They are standardisation (examples include the use of Electronic Data Integration and bar coding), visualisation (comprising Computer Aided Design, Virtual Reality, and Augmented Reality), communication (including video/data conferencing, Intranets), and integration (employing InfoBase and project specific data bases) (Ward, 1995; Harris and McCaffer, 2001).

Information technology has an important role in managing dynamic brief development in construction projects. This could be concluded as building live project brief development database, facilitating entering, organising, retrieving, sharing and updating information, enhancing, and facilitating calculations for instance. Complete list of the use of information technology in managing brief development is described in the features of the Brief Development Manager, section (7.4).

7.3 The Objectives of Brief Development Manager

The Brief Development Manager (BDManager) is a prototype software for the Value and Risk Management Protocol (VRMP) described in chapter 6. Copy of the BDManager is attached on a compact disk (CD) at the end of this thesis. This prototype is intended to demonstrate the implementation of the protocol in a computer-based environment, and how the BDManager could facilitate the effective management of brief development. The objectives of the Brief Development Manager are summarised as:

(1) Facilitate constructing general project information including project code, brief development code, project type, client name, project location, contract type, project cost, project duration, design firm, constructor, suppliers, funding body, and remarks.

(2) Facilitate the precise identification of brief development problem and save the time through the use of pre-designed pull down menus that contain wide variety of options about data classification, development drivers, stages, initiators, value and risk sources.

(3) Facilitate the structuring of brief development objectives and scrutinising alternative solutions through using Microsoft Excel in developing objectives value hierarchy, accelerating the calculations of allocating importance weights, developing decision matrix, assessing associated risks, comparing alternatives and performing sensitivity analysis.

(4) Facilitate building a live project database through collecting, verifying, organising, storing, retrieving, sharing and updating information.

(5) Facilitate the communication between concerned parties through using Electronic mail to exchanging information and following up work progress.

(6) Facilitate the adoption of development decision through using presentation packages for adequate presentation of development alternatives supported with reports, calculations and CAD generated documents. In addition it facilitates the planning for implementation, monitoring and feeding back using project planning packages.

7.4 The Features of the Brief Development Manager

In order to achieve the objectives of the brief development manager, the following features were considered during the design and development of the prototype software:

(1) Allowing all users to view the stored data and examine projects information. Authorised users only are permitted to enter, modify, and store the information required for identifying problem, structuring objectives, scrutinising alternative solutions and adopting development decision.

(2) Allowing more than one user to use the prototype simultaneously.

(3) Stimulating the user through the design of friendly and attractive data entry forms and the provision of adequate instruction on how to carry out the different steps of brief development.

(4) Facilitating the retrieving and reuse of stored information at later stages of brief development.

(5) Facilitating the inquiry of different projects information or brief development data by using different categories such as inquiry by project code, inquiry by driver or initiator for example.

(6) Facilitating the generation, viewing, and printing of reports on various aspects of the protocol.

(7) Allowing the future extension of the protocol and integration with other computer-based construction activities and software.

The above listed features of the Brief Development Manager are not exhaustive, but it represents the basic capabilities for demonstrating the computer implementation of the protocol. In addition, as a prototype, BDManager represents a working model of a complete system for managing brief development in construction whose development requires resources such as financial support and software development team that are beyond the scope of this research.

7.5 Development of the Brief Development Manager Prototype Software

There are two major approaches to developing prototype software. They are rapid (disposable or throwaway) prototyping and evolutionary prototyping. Rapid (disposable) prototyping involves the creation of a working model of various parts of the system at a very early stage of its development. The model then becomes the starting point from which users can re-examine their expectations and clarify their requirements. When this has been achieved, the prototype is thrown away and the system is formally developed based on the identified requirements. Evolutionary prototyping takes place after a more careful investigation and the methods used in building the prototype are more structured. Evolutionary prototypes form the heart of the new system being developed and are not therefore thrown away (Crinnion, 1991; Davis, 1995; Britton and Doake, 1996).

The development of the Brief Development Manager involves elements of both rapid and evolutionary prototyping concepts. As it is intended to demonstrate the proposed methodology for managing brief development, it could be considered as a rapid prototype. On the other hand, the functional representation of the protocol as described in chapter 6 represents detailed and structured system analysis, which is a feature of the evolutionary prototyping.

7.5.1 Development of Brief Development Manager Using Microsoft Access

The Brief Development Manager prototype software was developed in an iterative process. Firstly, the objectives of the prototype were defined and the outlines of interface and data entry / view screens were designed. Then, consultation with software programmers resulted in selecting the Microsoft Access as the package to be used in developing the prototype. The choice of Microsoft Access as the database system was based on the following rationale (McLaren, 1996; Brydon, 1997; Kamara, 1999):

(1) Microsoft Access is a well-known PC- based relational Data Base Management System that facilitate the storage and retrieval of structured information.

(2) Microsoft Access supports two industry standard query languages: Standard Query Language (SQL) and Query By Example (QBE).

(3) Microsoft Access contains a full-featured procedural programming language - essentially a subset of Visual Basic.

(4) Microsoft Access has a rapid application development environment and its built-in design tools facilitates the development of forms and the generation of reports and queries to meet different requirements.

(5) Microsoft Access has a sprinkling of object-oriented extensions and various wizards and builders to make development easier.

(6) Microsoft Access is a general-purpose package, which would be relatively inexpensive and quicker to develop the prototype

(7) Microsoft Access suits programming and compatible with other Windows based packages such as Microsoft Word, Microsoft Excel, and Microsoft Power Point.

(8) Microsoft Access enables the automatic embedding of MS word documents and MS excel spreadsheet, which facilitates including any required information. In addition, it does have options that update any modifications to these files.

(9) Microsoft Access capacity is sufficient to facilitate future extension and integration of the prototype with other computer based construction activities, see table (7.1).

(10) Microsoft Access facilitates the automation of many tasks without the need for programming.

(11) Microsoft Access has been used successfully in many similar research projects dealing with collecting and managing of information.

Item	Capacity
Maximum size of database	1 Gigabyte (1,000 Megabyte)
Tables per database	32,768
Fields per Table	255
Characters in object names	64
Characters per memo field	64,000
Characters per text field	255
Characters per record	2,048
Open tables	2,54
Maximum report size	22 inches wide, 22 inches high

Table 7.1 Capacity Constraints of Microsoft Access

The development of an Access application is normally based on the following procedures, which formed the basis for developing the Brief Development Manager prototype, see figure (7.1):

(1) Evaluation of the information needs of the system with particular reference to the flow of data and information.

(2) Design of tables, forms, reports, and queries, which will use the identified information to run the prototype to achieve its objectives (Kalian, 1998).

7.5.2 System Architecture for the Brief Development Manager

The system architecture for the Brief Development Manager as shown in figure (7.2) consists of four components: (1) General Project Information, (2) value and risk management protocol, (3) inquiries centre, and (4) reports centre. These components facilitate collecting, verifying, organising, storing, retrieving, sharing and updating information from the Access data repository. The user interface interacts with the interconnected system components through a set of screens. The linking arrows indicate that entering, storing, viewing and editing of information could be done at any stage of the brief development process.

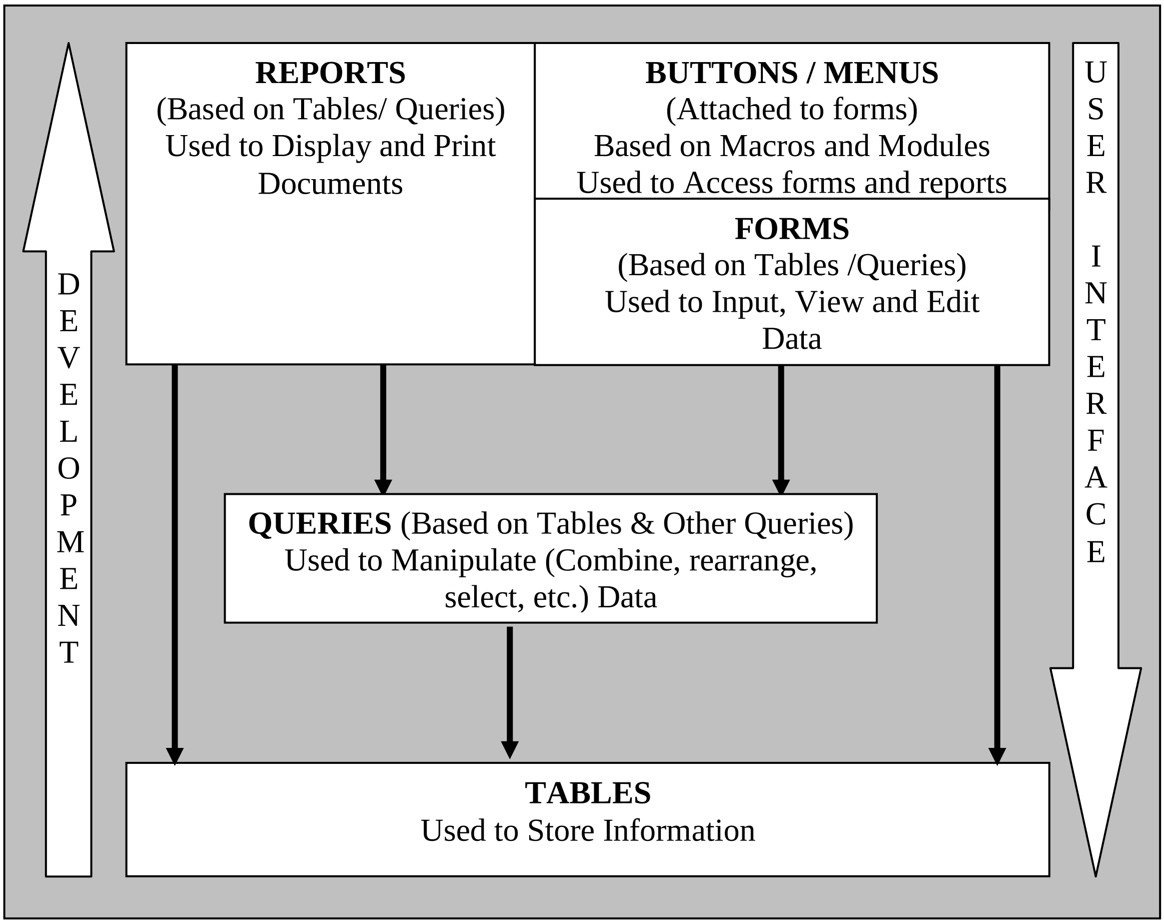


Figure 7.1 Access Application Objects and Usage

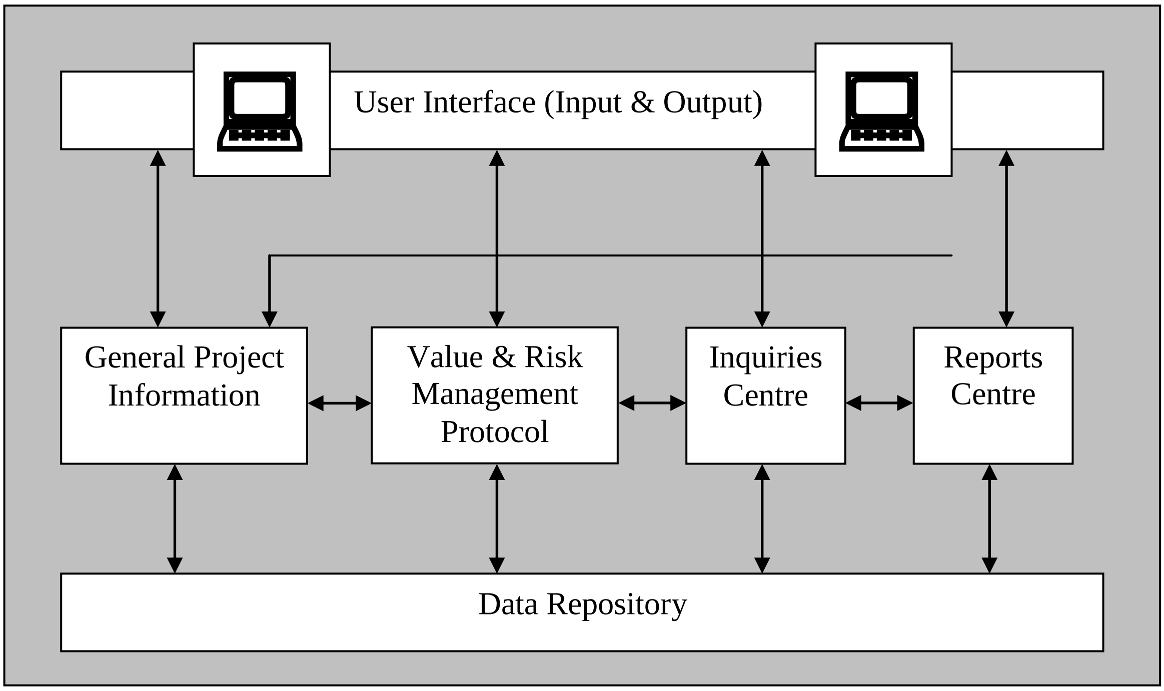


Figure 7.2 System Architecture for the Brief Development Manager

7.5.3 Development of Database Objects for the Brief Development Manager

The following section will explain the design of tables, forms, queries and reports used in the Brief Development Manager prototype software.

7.5.3.1 Design of Tables

A database table is the basic structure that holds the data values for database (McLaren, 1996). Each table is designed to store information corresponding to an entity of the defined entities for the Value and Risk Management Protocol as described in chapter 6. List of designed tables is mentioned in figure (7.3).

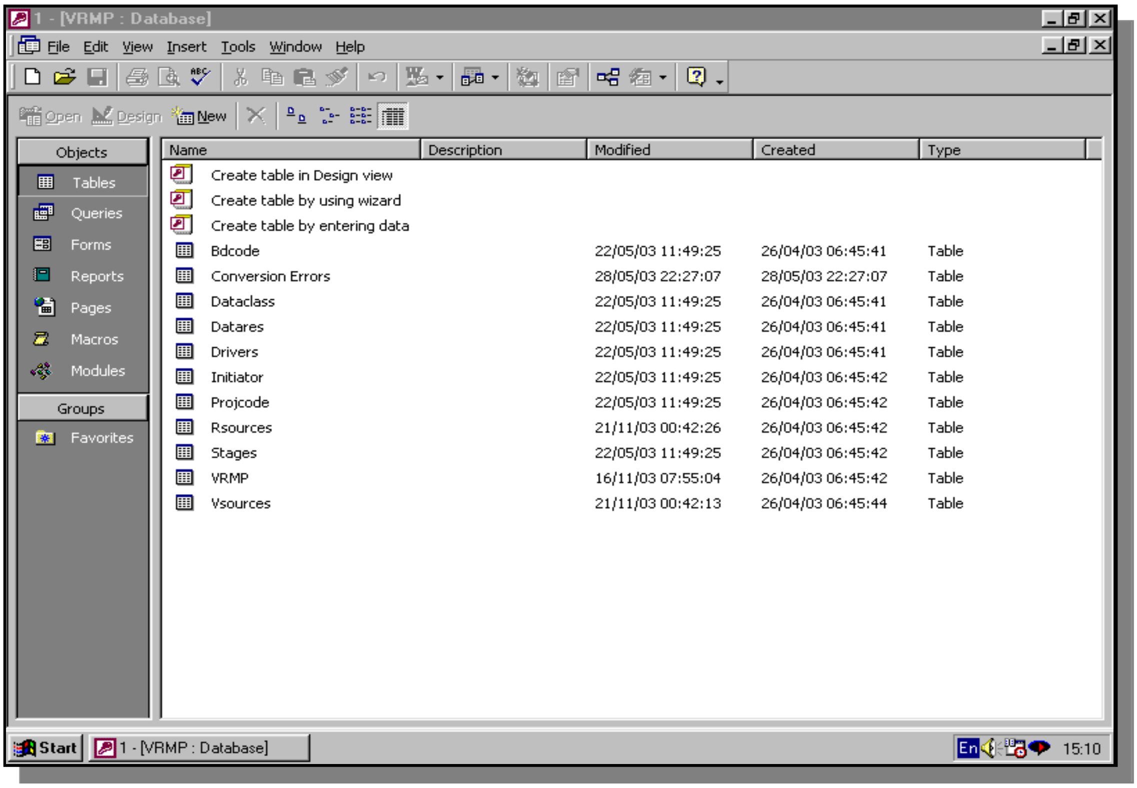


Figure 7.3 List of Tables for the BDManager Prototype Software

The design of tables in Microsoft Access is facilitated by using table design view. Figure (7.4) shows the design view of the VRMP table. Building a new table begins with clicking on "New" button of the database window when the "Table" objective is in focus. This displays a "New Table" dialogue that has various options for the kind of table to be created, see figure (7.5). The "Datasheet View" creates tables in datasheet view. "Table Wizard" creates tables based on pre-defined tables designed by Access. "Import Tables" imports tables and objects from an external file into the current database. "Link Table" creates tables in the current database that are linked to tables in an external file. "Design View", which was adopted in building the prototype tables because of its suitability to achieve the prototype objectives, creates tables in the design view. Every table consists of three columns: (1) field name, (2) data type, and (3) description. Although, a primary key is not required in the field name, it is recommended. A table must have a primary key to define a relationship between this table and other tables in the database. "Bdcode" was selected as a primary key, which ensured that each record had a unique brief development code. The second column describes the characteristics of each field. Access provides a pull down menu, which could be used to select the data type required. The available types of data are: Text, Memo, Number, Date/Time, Currency, AutoNumber, Yes/No, OLE Object, Hyperlink, or lookup Wizard. The third column was provided for the description of each field.

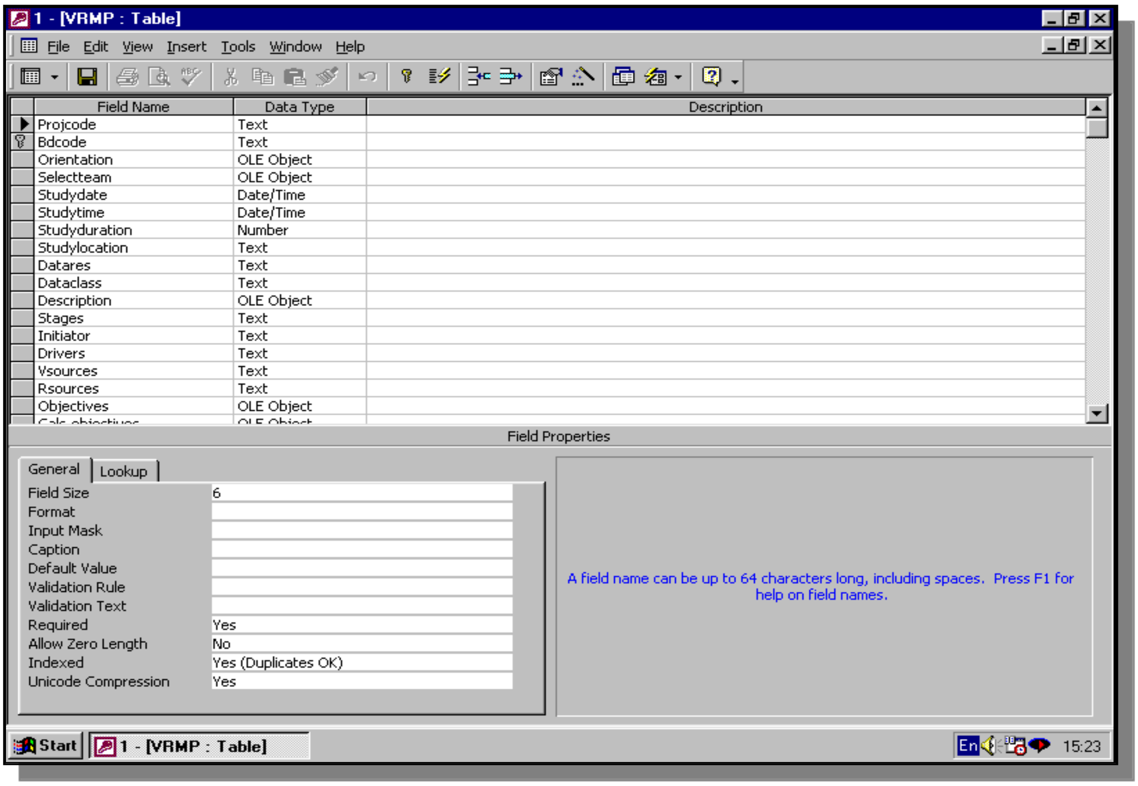


Figure 7.4 Design View for the VRMP Table

❖ Relationship between Tables

Microsoft Access is a relational database, which allows the establishment of relationships between tables. This facilitates the combination or comparison of data between tables. Establishing relationship is created by selecting "Relationships" from the "Tools" menu. Figure (7.6) shows the relationship between the prototype tables. The lines indicate the relationship between fields in different tables.

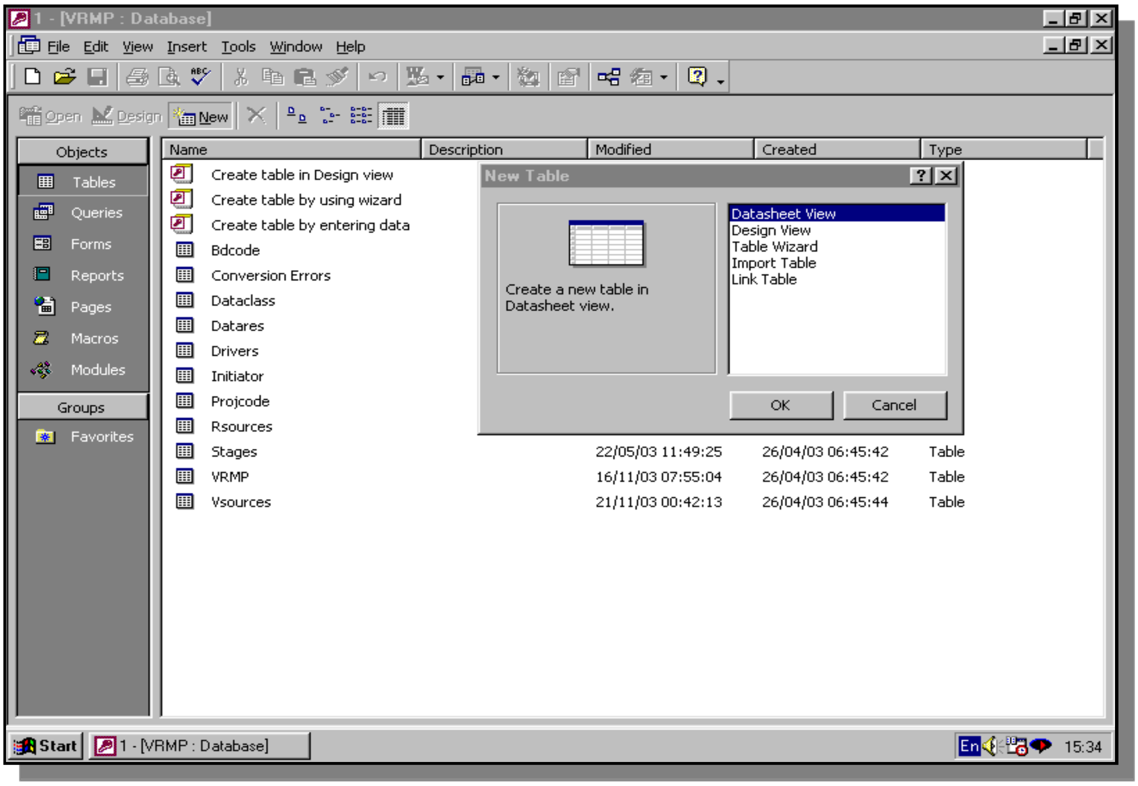


Figure 7.5 View of the "New Table" Dialogue Box

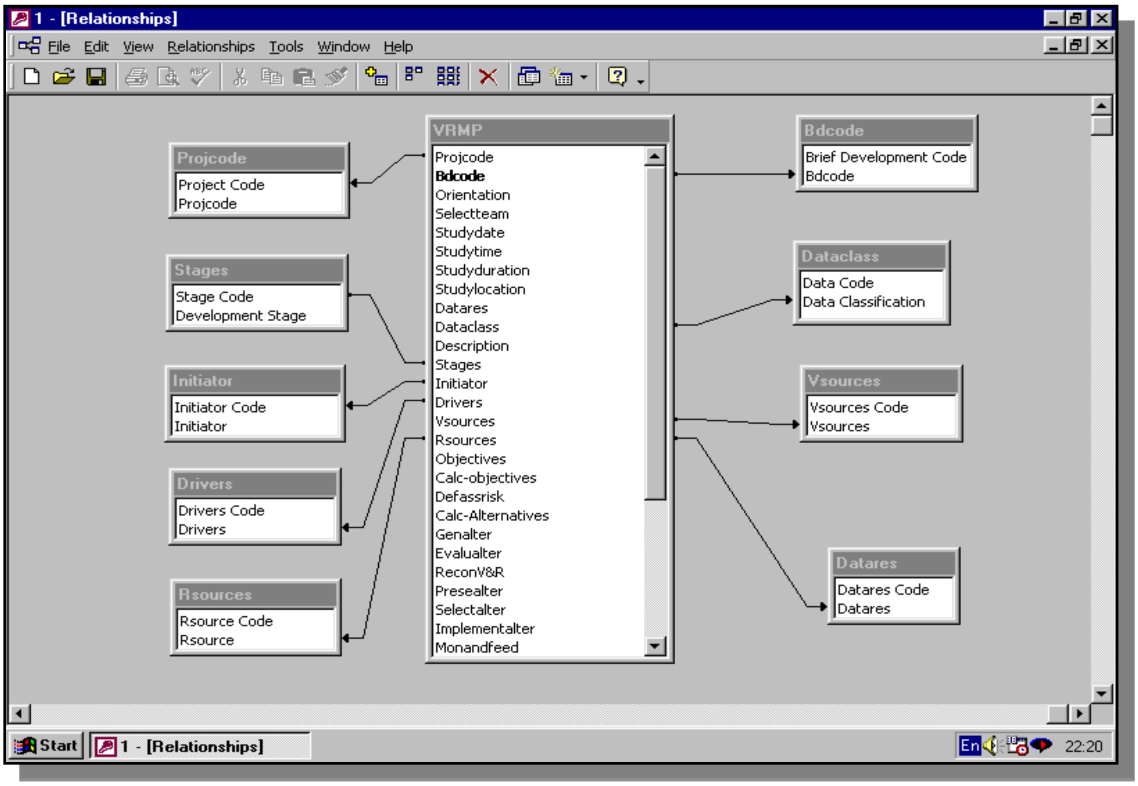


Figure 7.6 Relationships between the BDManager Prototype Software Tables

7.5.3.2 Design of Forms

Tables are the basis for designing forms. Forms are used for entering, displaying and editing the data stored in tables. Forms could be built on tables or queries. List of designed forms is shown in figure (7.7). The design of a new form starts by clicking on the "New" button of the database window when the "Forms" objective is in focus. This displays a "New Form" dialogue that has various options for the kind of form to be developed, see figure (7.8). The "Design View" option displays a blank form, which is not based on any table. "Form Wizard" allows the selection of a specific field from one table or group of tables. Selection of any of the "Auto Form" option automatically generates a form based on a specific table. The "Chart Wizard" facilitates the development of charts, and the "Pivot Table Wizard" allows embedding on an excel spreadsheet. The Brief Development Manager forms used the "Form Wizard" option because it allowed selecting the fields to be used in forms design. Figure (7.9) shows the design view of the "VRMP" form and its properties sheet that was used to modify the properties of the forms (i.e. font name, font size, font weight).

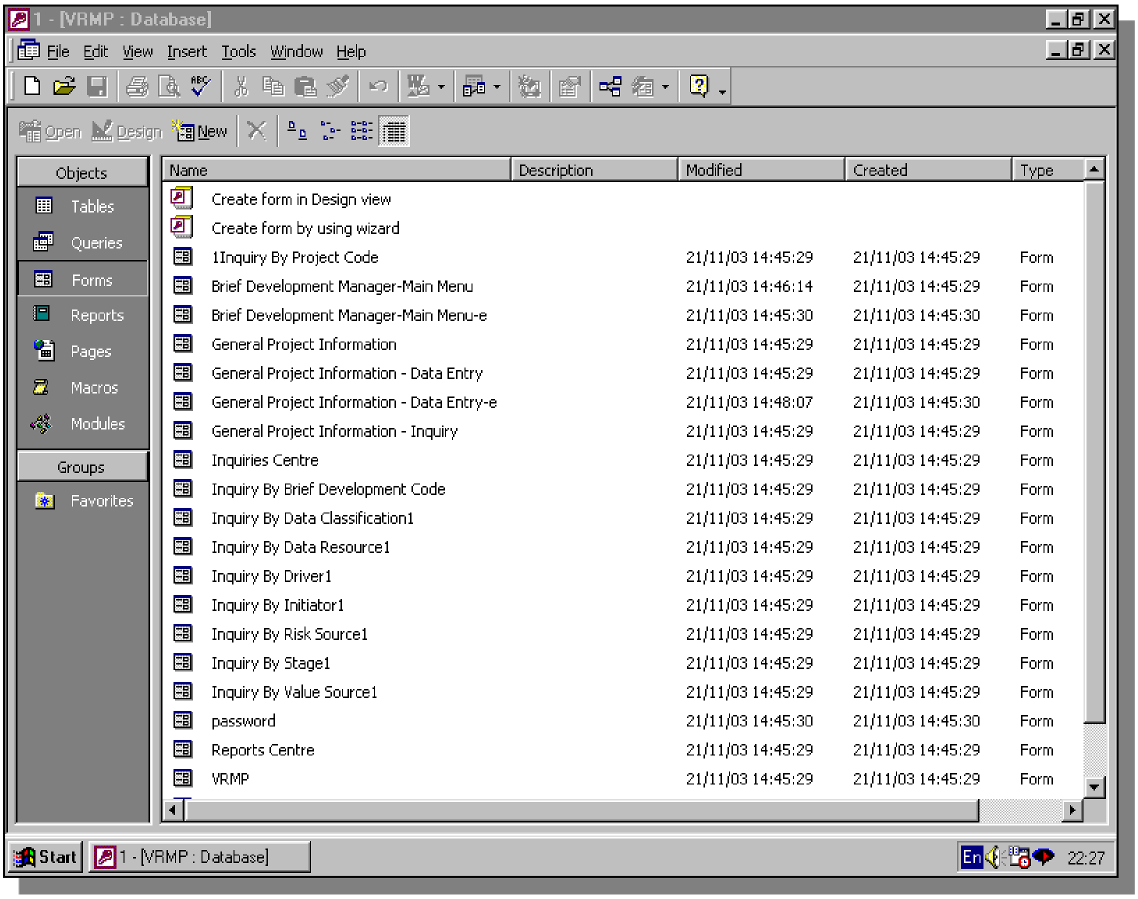


Figure 7.7 List of Forms for the BDManager Prototype Software

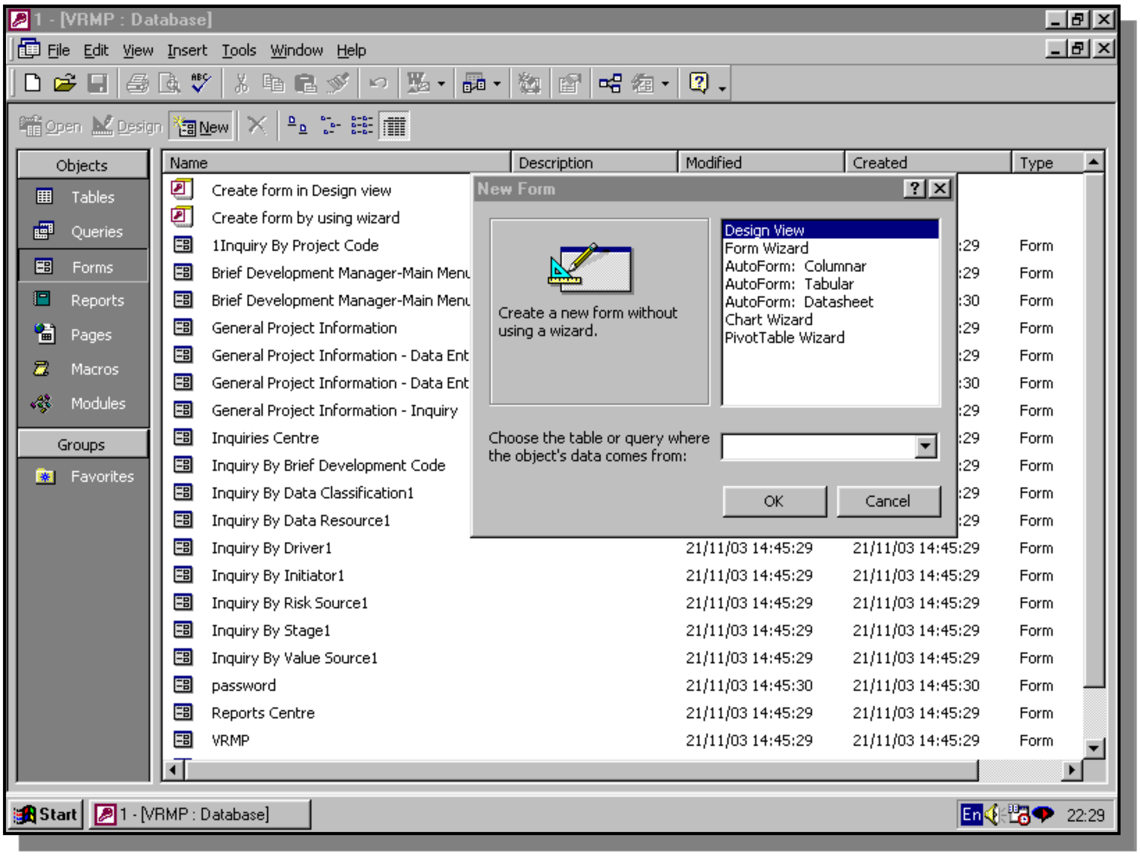


Figure 7.8 View of "New Form" Dialogue Box

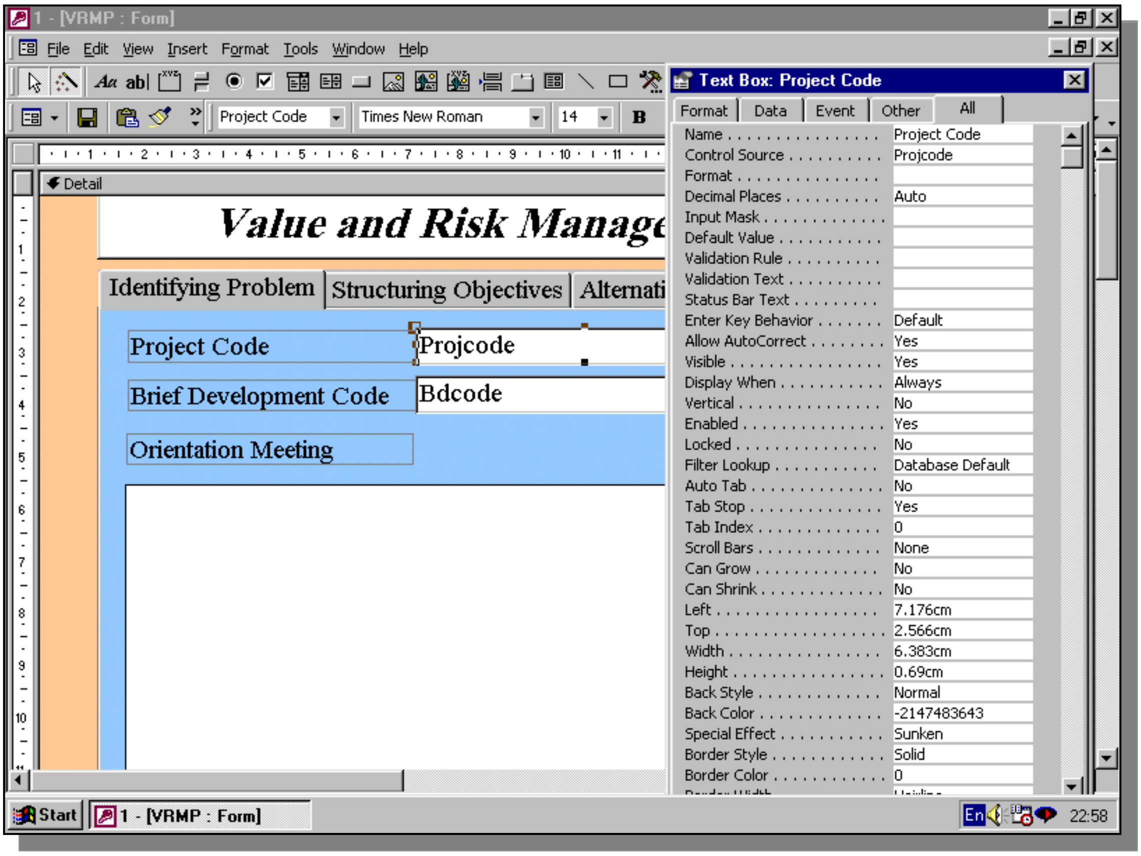


Figure 7.9 Design View of the VRMP Form with its Properties Sheet

7.5.3.3 Design of Queries

Queries are designed to help the user of the prototype search for some project information using different categories such as inquire by brief development driver. List of queries designed for the Brief Development Manager is shown in figure (7.10). The design of queries depends on table information and it begins with clicking on "New" button of the database window when the "Queries" objective is in focus. This displays a "New Query" dialogue that has various options for the kind of query to be developed, see figure (7.11). "Design View", which was used for building the prototype queries, creates a new query without using a wizard. It allows the selection of table fields. "Simple Query Wizard" creates a select query from the picked fields. "Cross Query Format" this wizard creates a cross tab query that displays data in a compact, spreadsheet-like format. "Find Duplicate Query Wizard" creates a query that finds records with duplicate field values in a single table or query. Finally, "Find Unmatched Query Wizard" creates a query that finds records (rows) in one table that have no related records in another table.

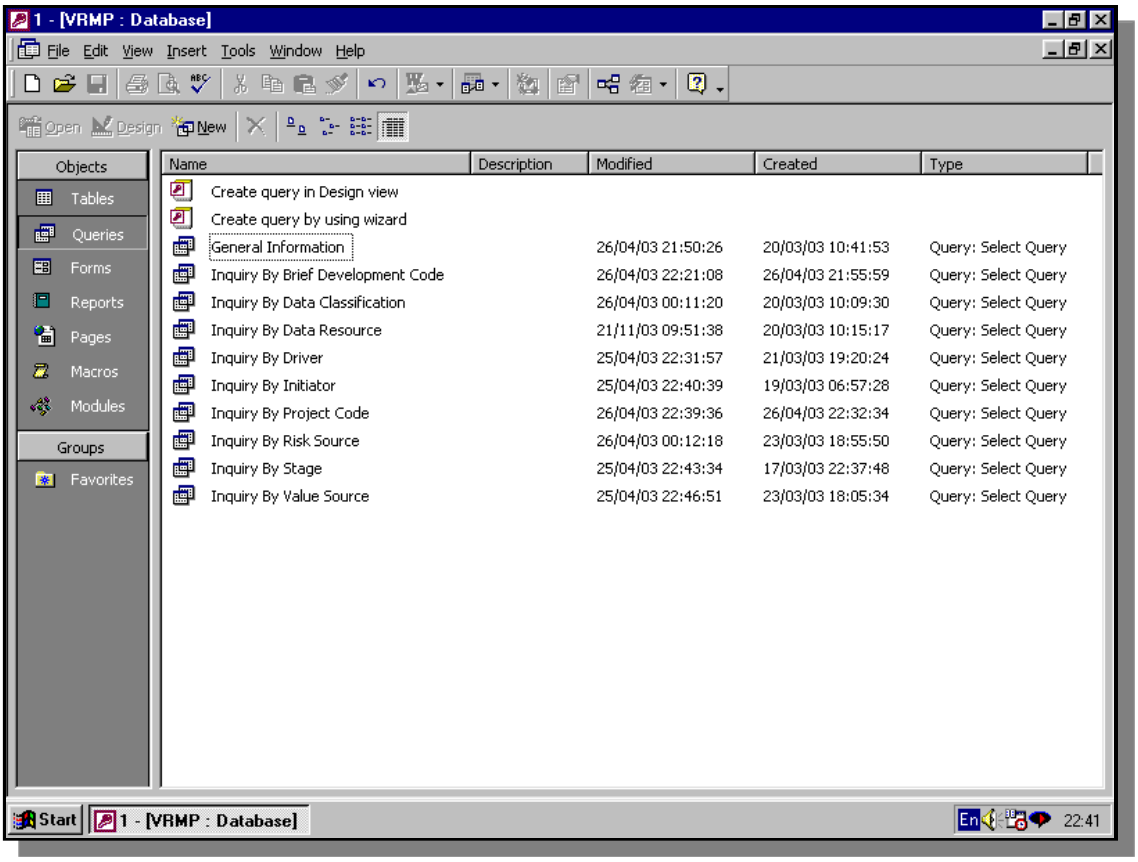


Figure 7.10 List of Queries for the BDManager Prototype Software

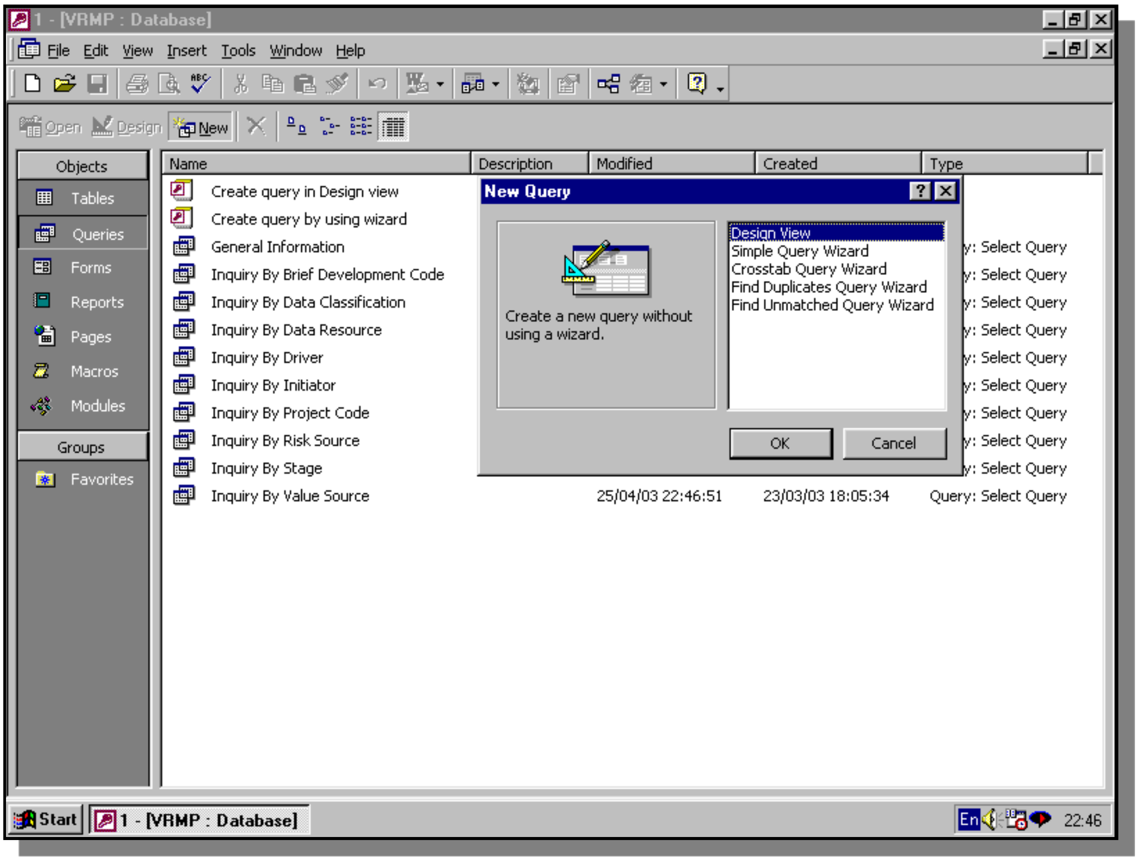


Figure 7.11 View of "New Query" Dialogue Box

7.5.3.4 Design of Report

Reports are designed to allow the user of the Brief Development Manager prototype software view and print reports for project information using different categories. Reports could be built on tables or queries. List of designed reports is shown in figure (7.12). The design of a new report begins by clicking on the "New" button of the database window when the "Reports" objective is in focus. This displays a "New Report" dialogue that has various options for the kind of report to be developed, see figure (7.13). "Design View", which was used to design the prototype reports, creates reports without using wizard. It allows the selection of table or query fields. "Report Wizard" automatically creates the report based on the selected fields. The "Auto Report" options either create columnar or tabular reports. "Chart Report" creates reports with charts. "Label Wizard" creates a report formatted for printing on labels.

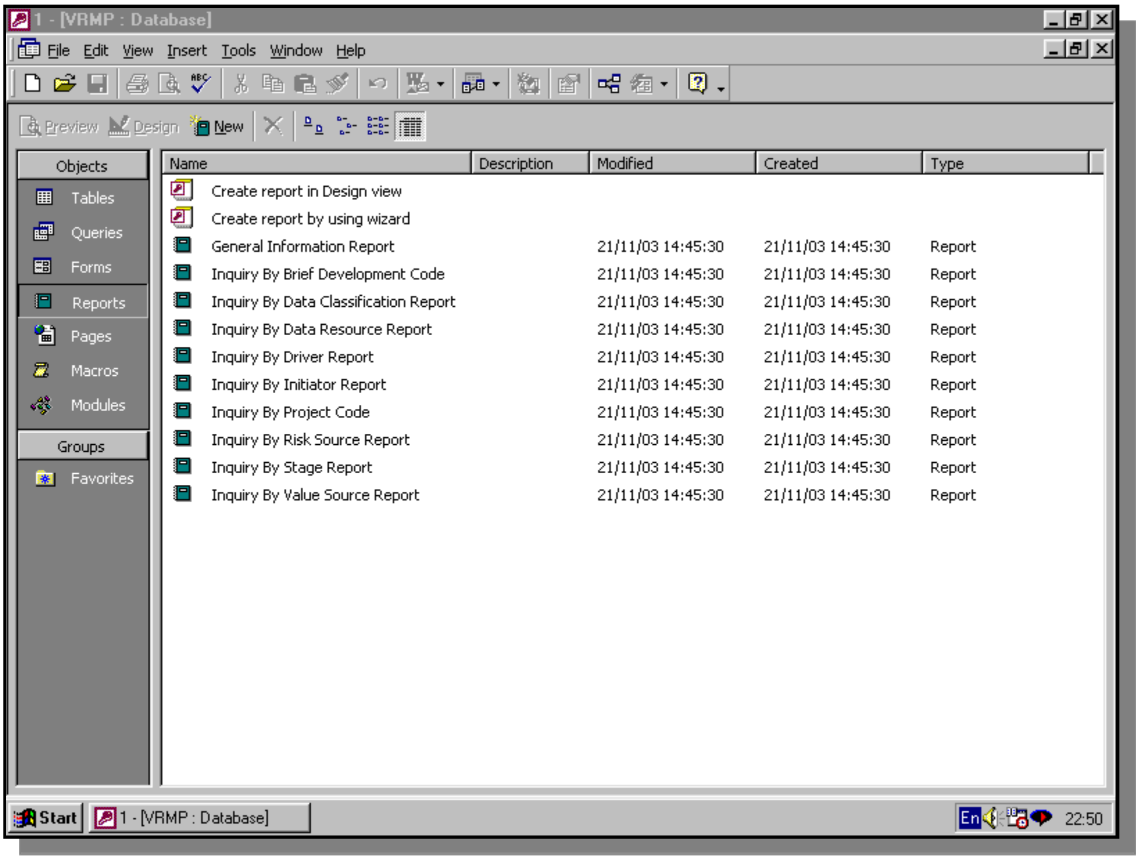


Figure 7.12 List of Reports for the BDManager Prototype Software

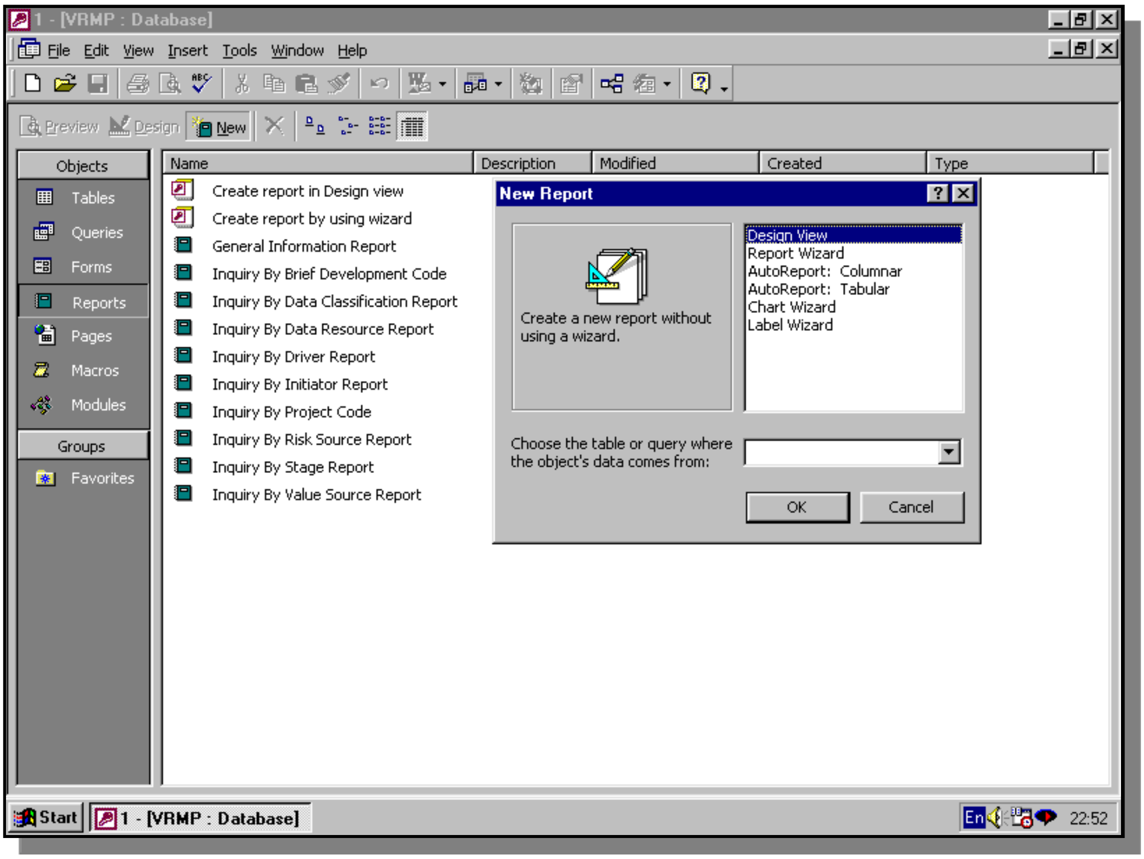


Figure 7.13 View of "New Report" Dialogue Box

7.6 Managing Dynamic Brief Development with the Brief Development Manager Prototype Software

The design of the Brief Development Manager was built on the four steps of the value and Risk Management Protocol, as described in chapter 6. These steps are (1) Identifying Problem, (2) Structuring Objectives, (3) Scrutinising Alternative Solutions, and (4) Adopting Development Decision. All the techniques used in the paper-based application of the protocol were facilitated and expedited by using a computerised version.

7.6.1 Running the Brief Development Manager

The Brief Development Manager is stored as a Microsoft Access file named "Value and Risk Management Protocol.mbd". Running the protocol requires the installation of Microsoft Access 2000, although it is possible to convert it to prior Access database versions by selecting the "Database Utilities" option from "Tools" menu. By double clicking on the above-mentioned file, the user is prompted to enter the database password. Correct password allows the mentioned file to be opened. Trial password of "123456" was set. When the file is opened, the welcome screen for the Brief Development Manager prototype software is displayed. The following section will illustrate the contents of the Brief Development Manager.

7.6.2 Contents of the Brief Development Manager

7.6.2.1 The Welcome Screen

Figure (7.14) shows the Welcome screen, which introduces the prototype to its users. It contains a brief statement about what the application is and what it is intended to do. In addition, the screen gives the user three options: (1) to continue as a data entry, (2) to continue as data viewer, or (3) to exit.

7.6.2.2 Continue as Data Entry

Clicking on the "Continue as Data Entry" button open an authentication screen, which prompt the user to enter his or her user number and password. Permitted users only will be allowed to enter the "Brief Development Manager - Data entry" screen and they will be able to enter new brief development data and update existing information, see figures (7.15) and (7.16). For the purpose of this research, a user trial number and password of (123) and (456) was selected respectively.

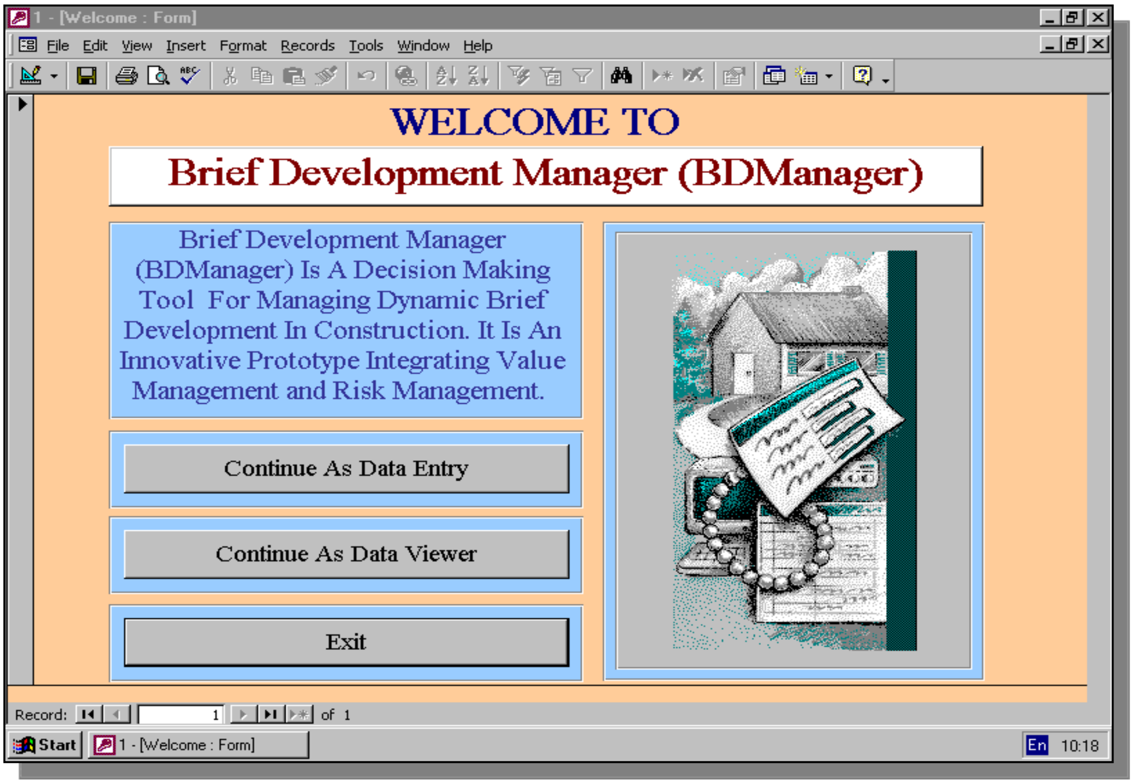


Figure 7.14 The Welcome Screen for the Brief Development Manager

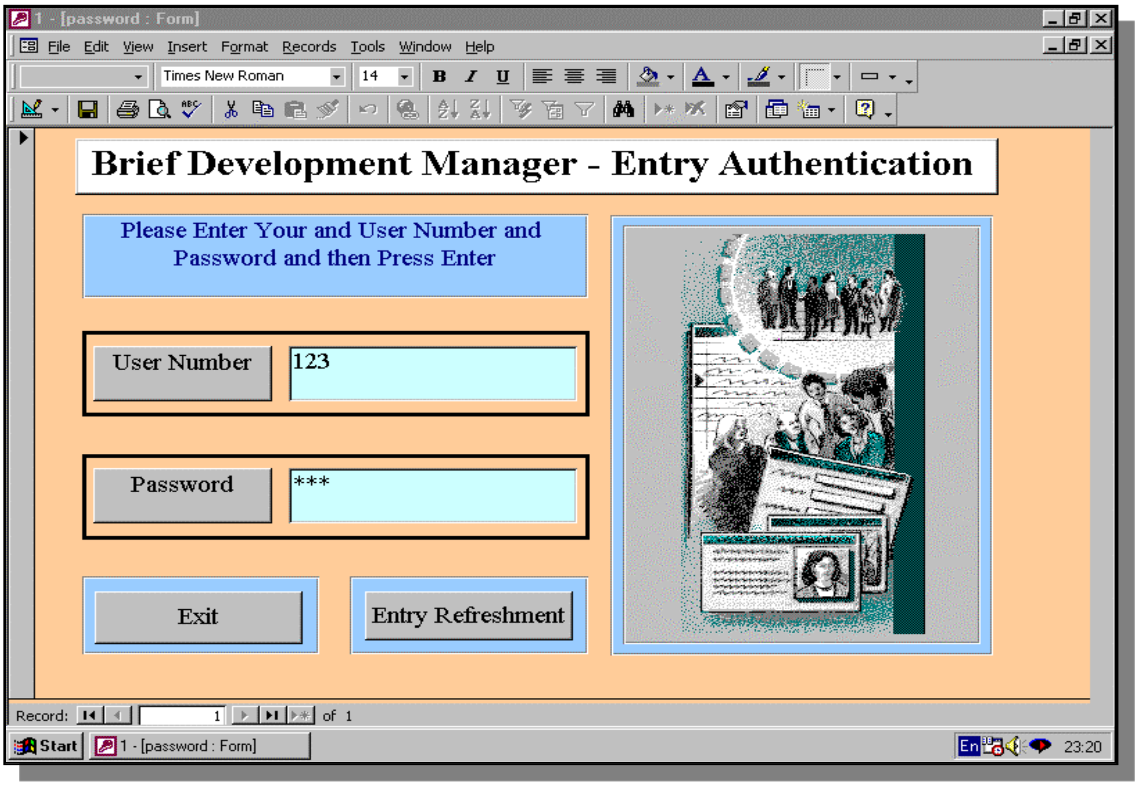


Figure 7.15 The "Brief Development Manager - Entry Authentication" Screen

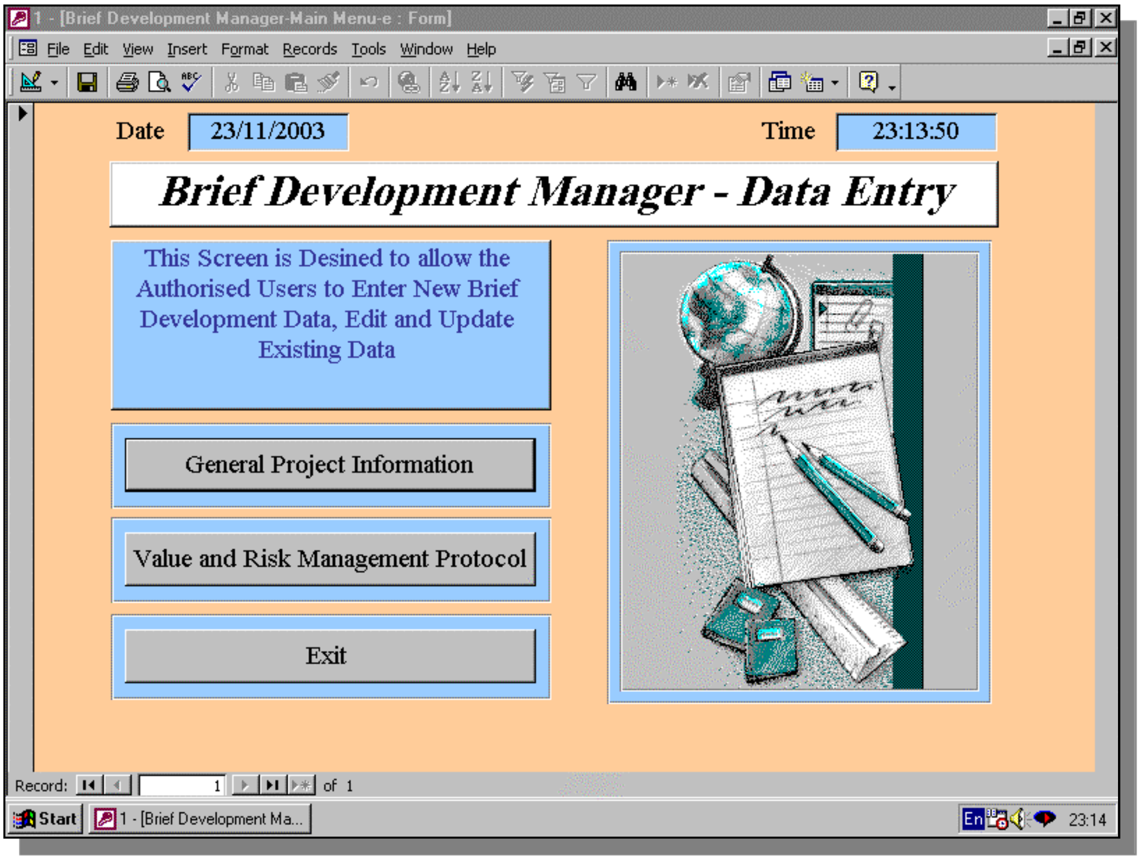


Figure 7.16 View of the "Brief Development Manager - Data Entry" Screen

❖ **General Project Information**

The General Project Information item aims to allow the user to get information of pre-entered projects as well as adding new information for new projects. This will be the first step in managing brief development. By clicking on the "General Project Information" button, a "General Project Information" screen will be displayed, see figure (7.17). The record at the end of the screen shows the available projects' records. From there the information of each project could be investigated and when all records were navigated, for example (4 of 4), the fifth record will be displayed as a blank view where the information for new projects could be entered. A quit icon was added at the end of the screen to allow the user to return to the "Brief Development Manager - Data Entry" screen.

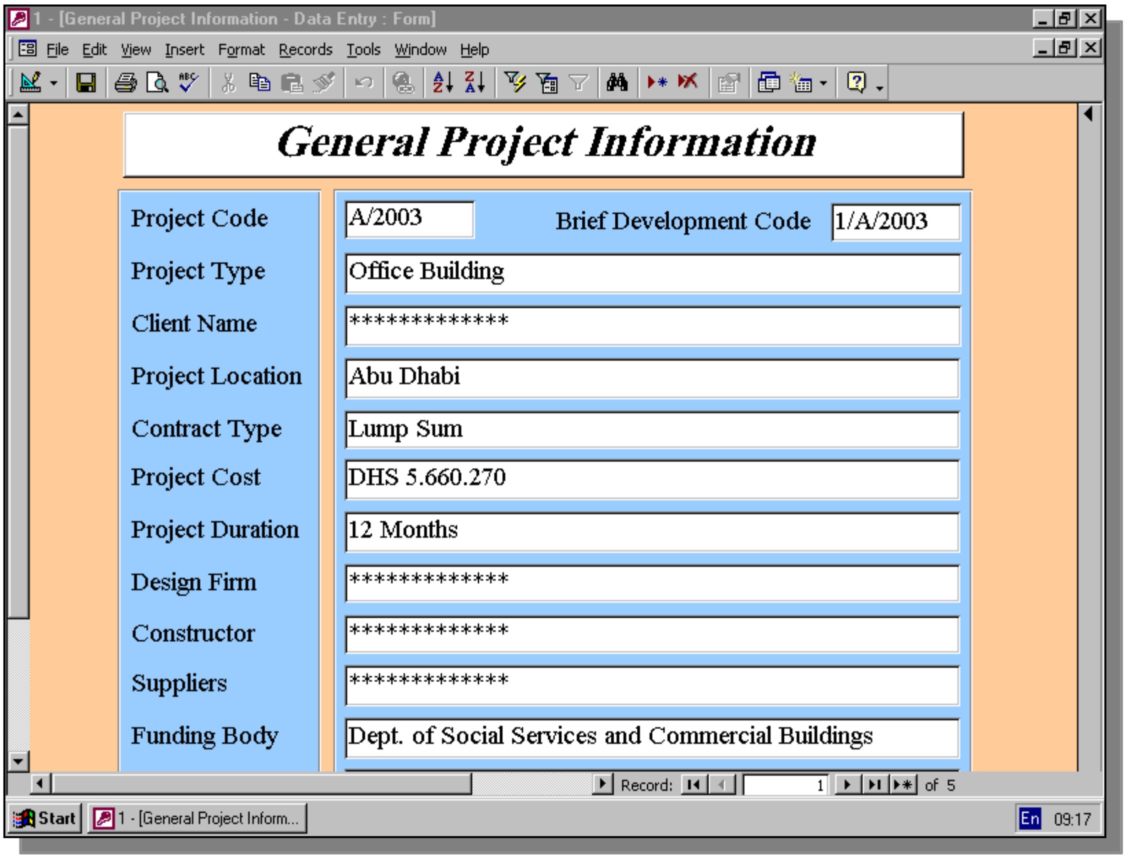


Figure 7.17 View of the "General Project Information" Screen

❖ **Value and Risk Management Protocol**

The value and risk management protocol is the second item in the "Brief Development Manager - Data Entry" screen. By clicking on the "Value and Risk Management Protocol" button the authorised users will be allowed to proceed and apply the designed protocol by following its four steps as follows.

(1) Identifying Problem

This involves the input of certain information in order to clearly identify the brief development problem. All information is stored in the main table "VRMP". Entering the information was done by three different ways. Firstly, the user is prompted to enter the information in defined boxes on the screen. This included entering project code, brief development code, study date, study time, study duration in days, and study location. In the second way the information was generated as Microsoft Word files. This included orientation meeting, the team members, and development description. These files are inserted to the VRMP table as objects and will be activated by the application, which created these files. In addition the option "Link" shows the file contents as a picture and this picture will be linked to the file that it was created from, so that any changes to the file contents will be reflected in the database, see figure (7.18). Finally, the third way stimulated the user to select information from a wide range of options from a pull down menu. This included data resources, data classification, development drivers, development stage, development initiator, value sources to client, and risk source to client, see figure (7.19). A quit icon was added at the end of the screen to allow the user to return to the "Brief Development Manager - Data Entry" screen.

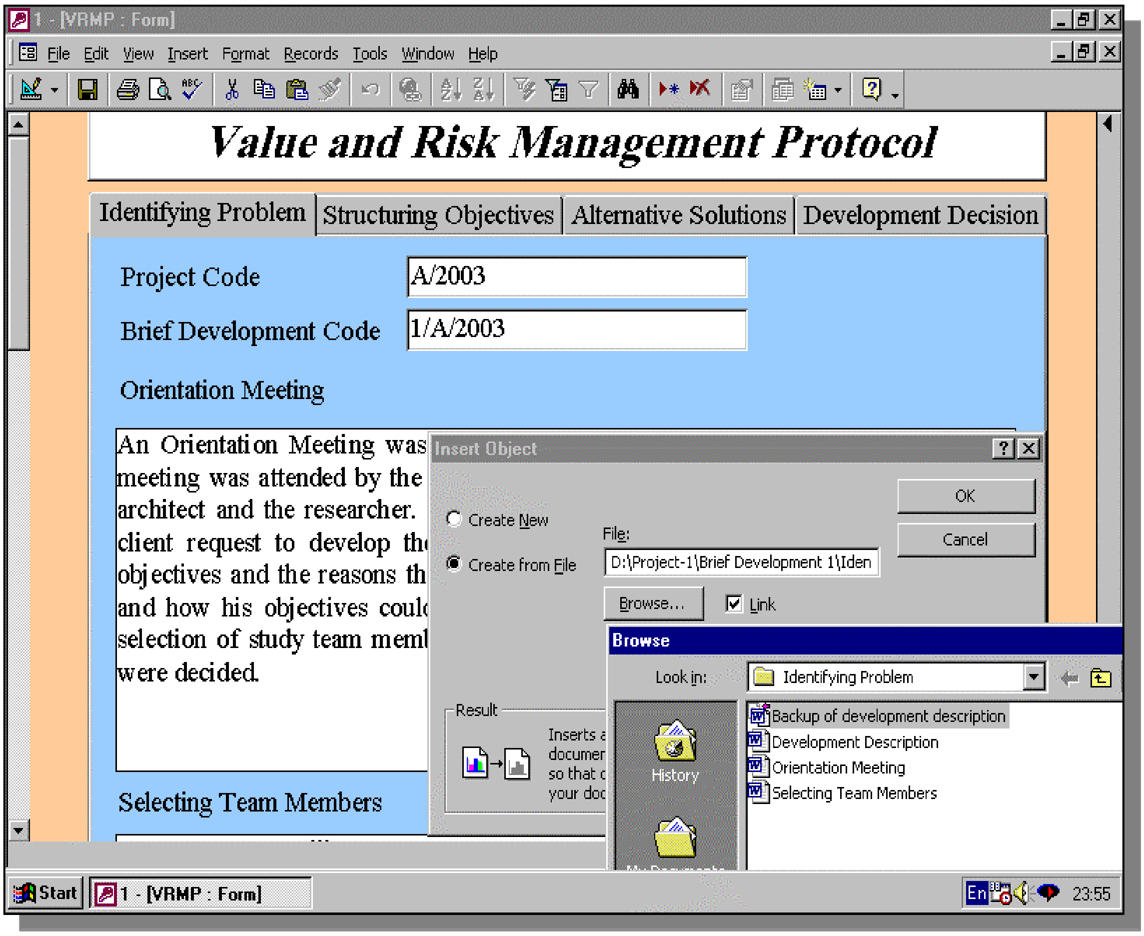


Figure 7.18 View of Entering Data Using Pre-defined Boxes and Inserting Files as Linked Object in the Database

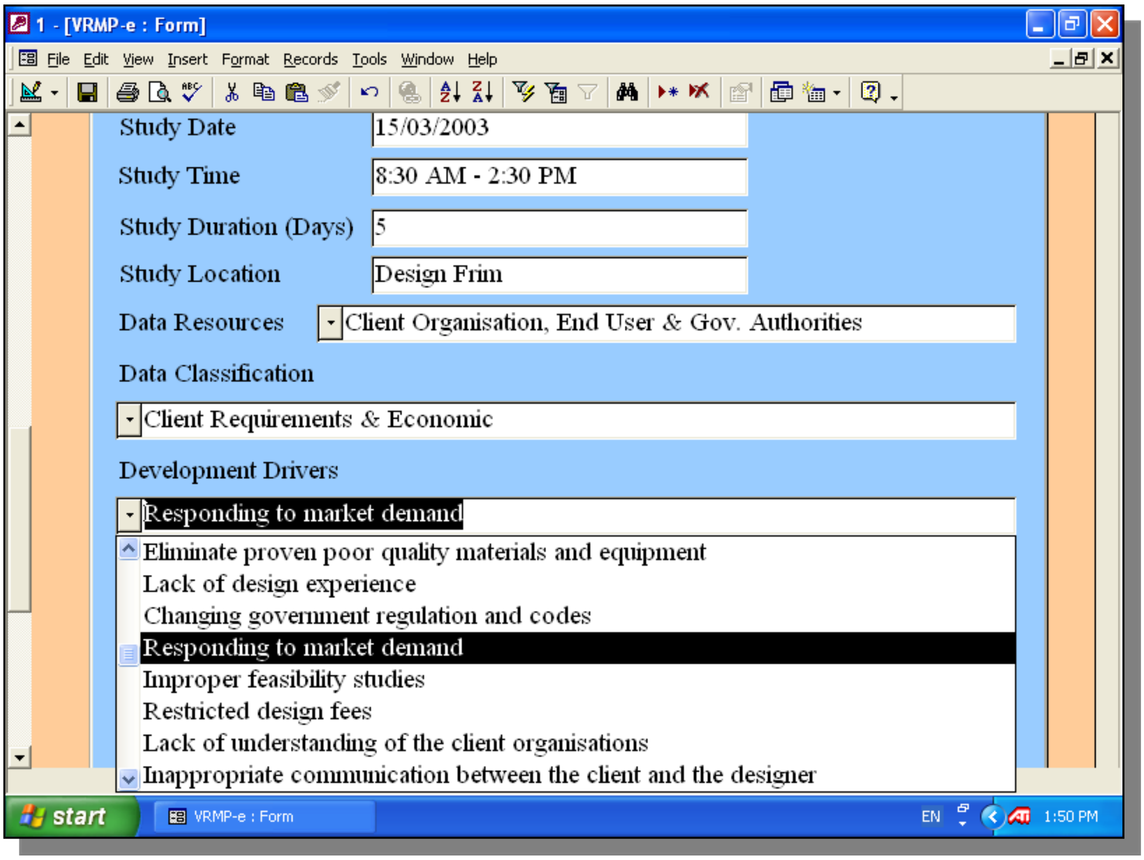


Figure 7.19 View of Entering Information Using Pull Down Menus

(2) Structuring Objectives

Structuring objectives is the second step in managing brief development. It involves the input of information, which is intended to help the users understand and structure brief development objectives. These information included defining objectives, developing objectives value hierarchy, allocating importance weight, and defining associated risks. Defining objectives and associated risks was created in Microsoft Word files where developing objectives value hierarchy and allocating importance weight were generated in Microsoft Excel files. As done in the "Identifying Problem" step these files were inserted as objects, viewed as pictures and linked to the files that they were created from in order to allow the reflection of any modifications to their contents, see figure (7.20) and (7.21). A quit icon was added at the end of the screen to allow the user to return to the "Brief Development Manager - Data Entry" screen.

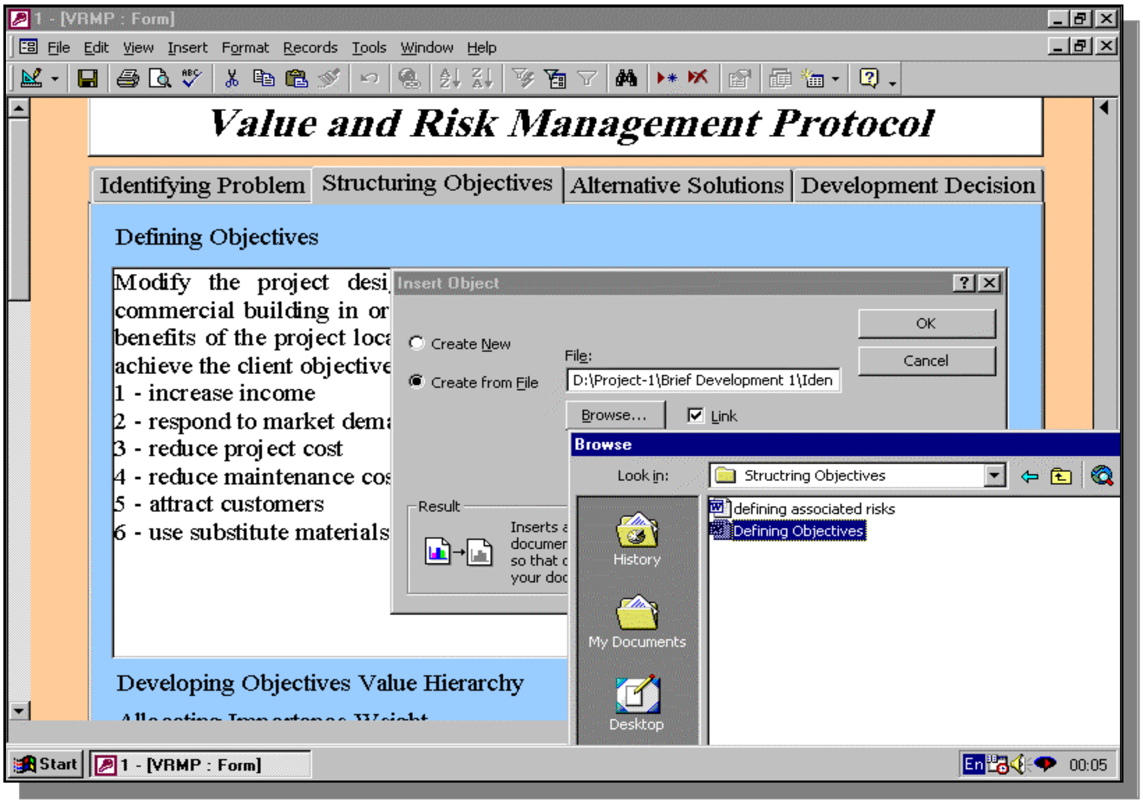


Figure 7.20 Defining Objectives and Inserting the Microsoft Word File as Linked Object in the Database File

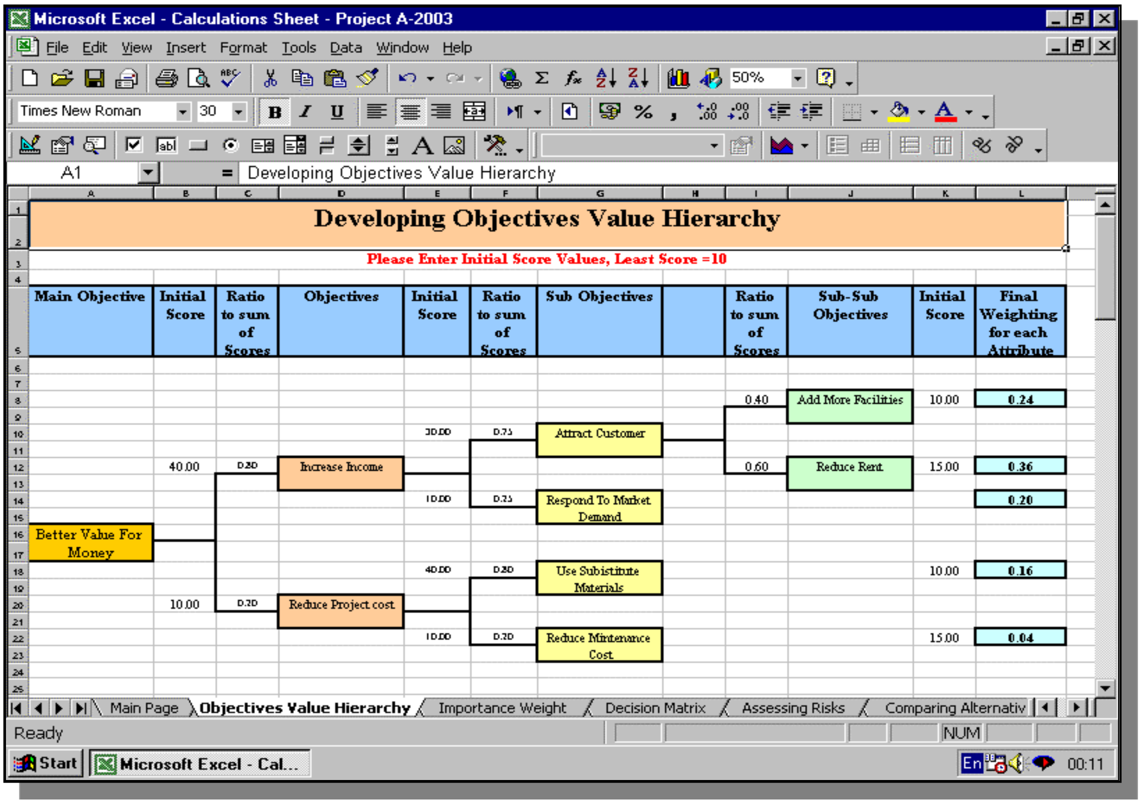


Figure 7.21 Developing Objectives Value Hierarchy and Allocating Importance Weight Using Microsoft Excel

(3) Scrutinising Alternative Solutions

After the brief development problem was identified and the objectives were structured, the following step is to scrutinise alternative solution that achieve the defined objectives at the most cost-effective manner. The information to be entered in the prototype screen includes: generating and evaluating alternatives. Evaluating alternatives includes: developing decision matrix, assessing associated risks, comparing alternatives, performing sensitivity analysis, and reconciling value and risk. Some of these information were Microsoft Word based files. They are: Generating Alternatives.doc, Evaluating Alternatives.doc., and Reconciling Value and Risk.doc. The remaining files are Microsoft Excel based files. It is interesting to note that the information cells in Excel files were linked together, so that once the information entered in one position it will be presented in other places to serve certain objectives. This facilitated the creation of different calculations as well as helped manage and control any changes happen to the information, see figure (7.22) and (7.23). A quit icon was added at the end of the screen to allow the user to return to the "Brief Development Manager - Data Entry" screen.

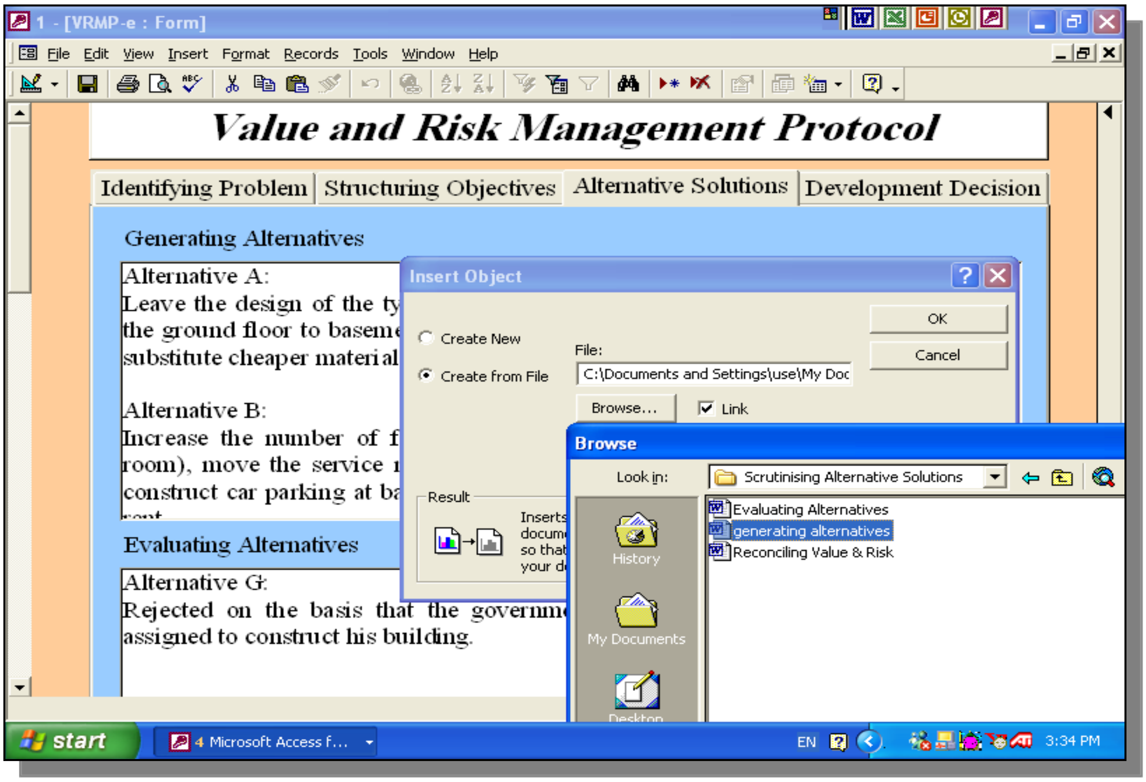


Figure 7.22 Inserting "Generating Alternatives" Microsoft Word File as an Linked Object in the Database File

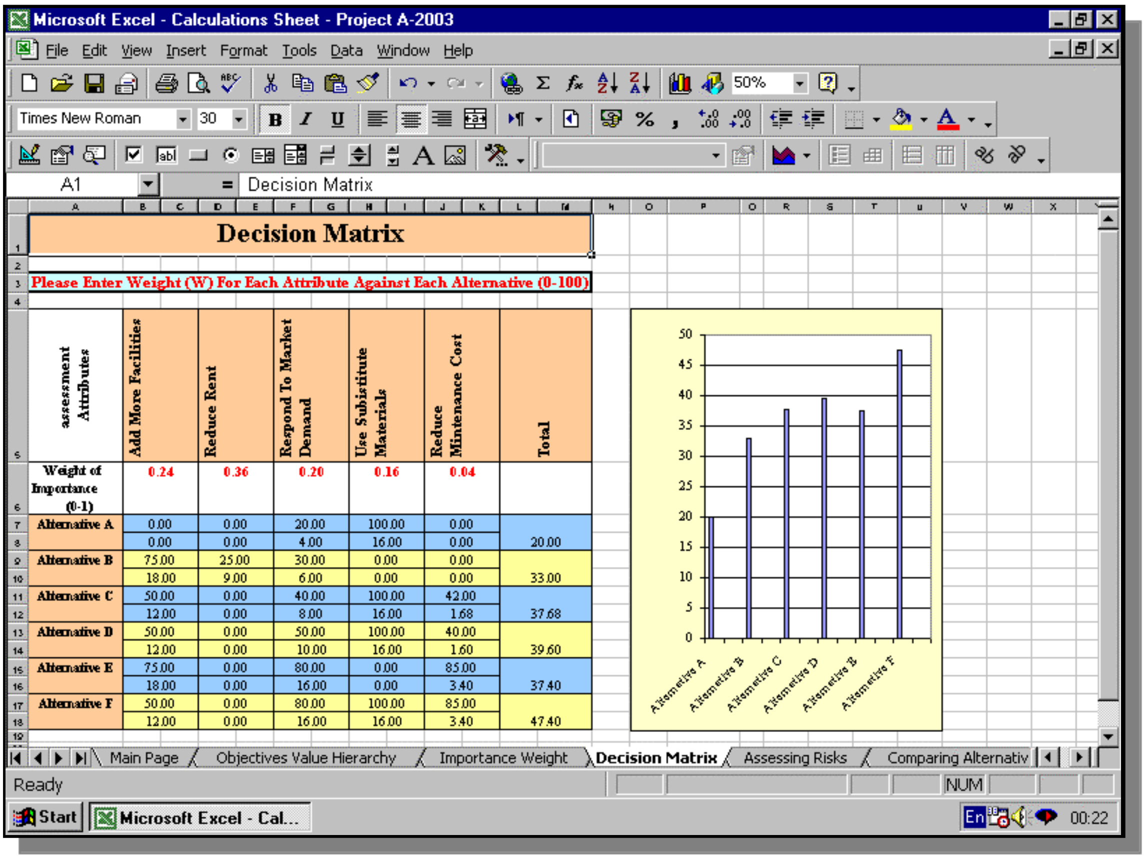


Figure 7.23 Developing Decision Matrix Using Microsoft Excel

(4) Adopting Development Decision.

Adopting the proper decision to brief development represents the last step of the Value and Risk Management Protocol. It involves entering information about presenting alternatives, selecting best alternatives, implementing selected alternative, monitoring and feeding back. All these files are Microsoft Word Files and they were prepared separately and then inserted and linked to the database. An example of attaching files is shown in figure (7.24). A quit icon was added at the end of the screen to allow the user to return to the "Brief Development Manager - Data Entry" screen.

❖ **Exit**

Clicking on the "Exit" button allows the user to quit the "Brief Development Manager-Data Entry" screen and return to the "Brief Development Manager-Entry Authentication" screen either to "Exit" to the "Welcome" screen or to refresh entry and allow other users to log in.

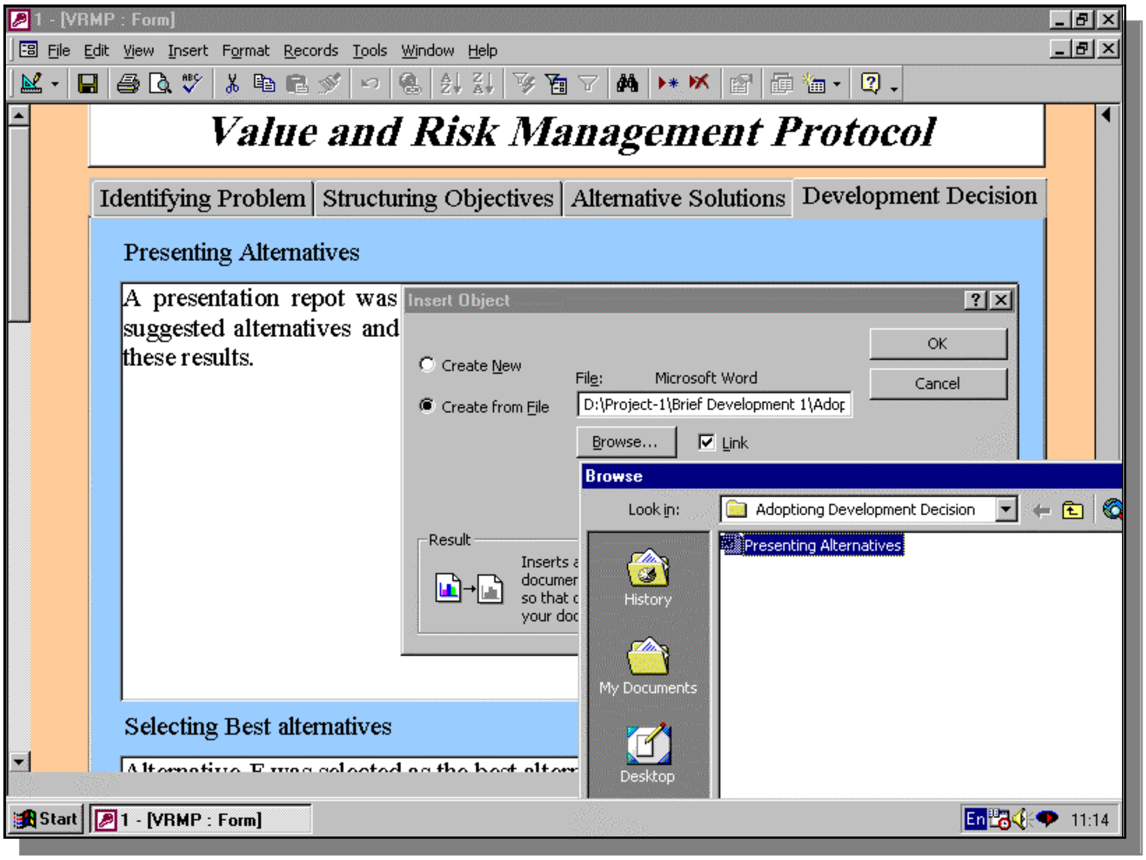


Figure 7.24 Inserting "Presenting Alternative" Microsoft Word File as an Linked Object in the Database File

7.6.2.3 Continue as Data Viewer

Clicking the "Continue as Data Viewer" button in the “Welcome” screen opens the "Brief Development Manager - Data Viewer" screen, which allows all users to view stored data without the permission to modify existing information, see figure (7.25).

❖ **General Project Information**

By clicking on the "General Project Information" button, the "General Project Information" screen is displayed and the user is allowed to view information of pre-entered projects without the ability to modify stored information. The number of total projects records is shown at the end of the screen. From there the information of each project could be displayed. A blank information sheet will be viewed when all records were navigated.

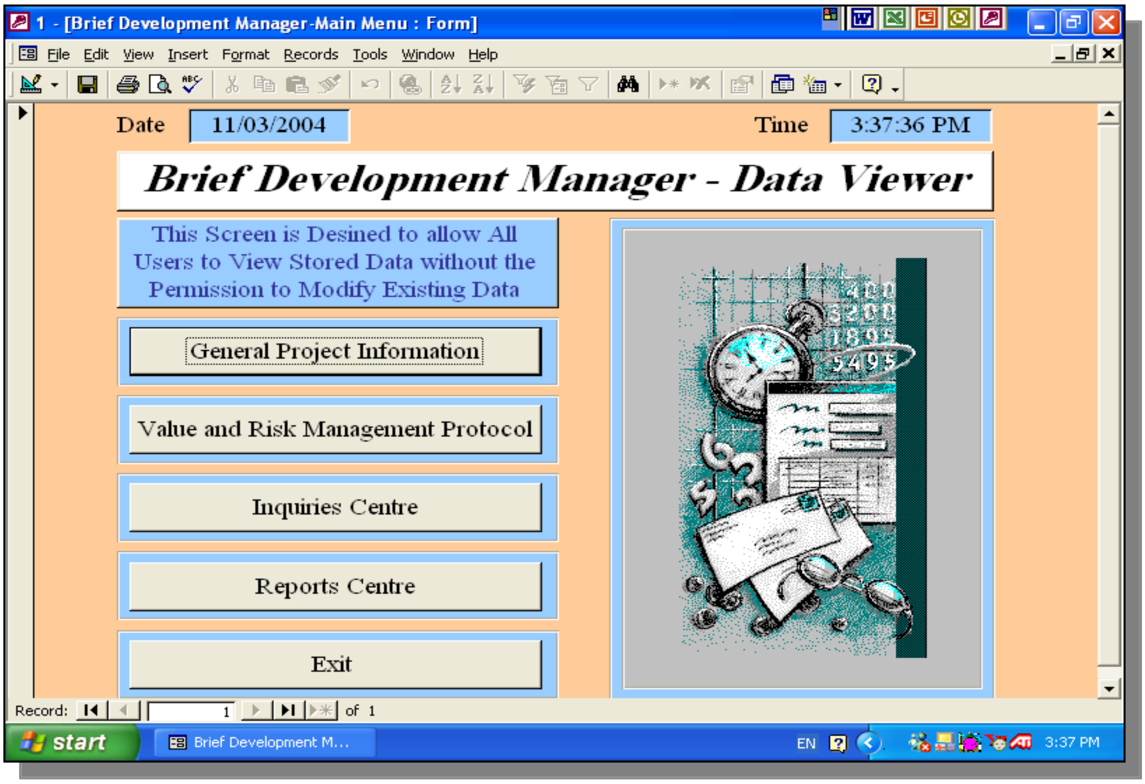


Figure 7.25 View of the Brief Development Manager - Data Viewer" Screen

❖ Value and Risk Management Protocol

The value and risk management protocol is the second item in the "Brief Development Manager - Data Viewer" screen. It allows the user to view the four steps of the Value and Risk Management Protocol without the possibility to modify or update.

❖ Inquires Centre

Clicking the third button in the " Brief Development Manager-Data Viewer" opens the inquires centre. It allows the user of the prototype to inquire project information using different categories. The inquiries centre consisted of 10 categories as shown in figure (7.26). By clicking on any of these categories' buttons an inquiry screen will be opened where the user is prompted to select from a pull down menu. For example if the "Inquiry by Driver" button is clicked, the "Inquiry By Driver" screen will be opened. From a pull down menu consists of 30 brief development driver, the user can select the driver which led to brief development. If the selected driver is stored in the database such as " Respond to Market Demand" Driver, full information of the project will be shown, see figure (7.27), otherwise the information sheet will remain blank. It is interesting to mention that by typing the initials of the required driver the full name will be displayed, see figure (7.28). This feature will facilitate the inquiry process if the category initials are known in advance and could be applied to inquiry categories.

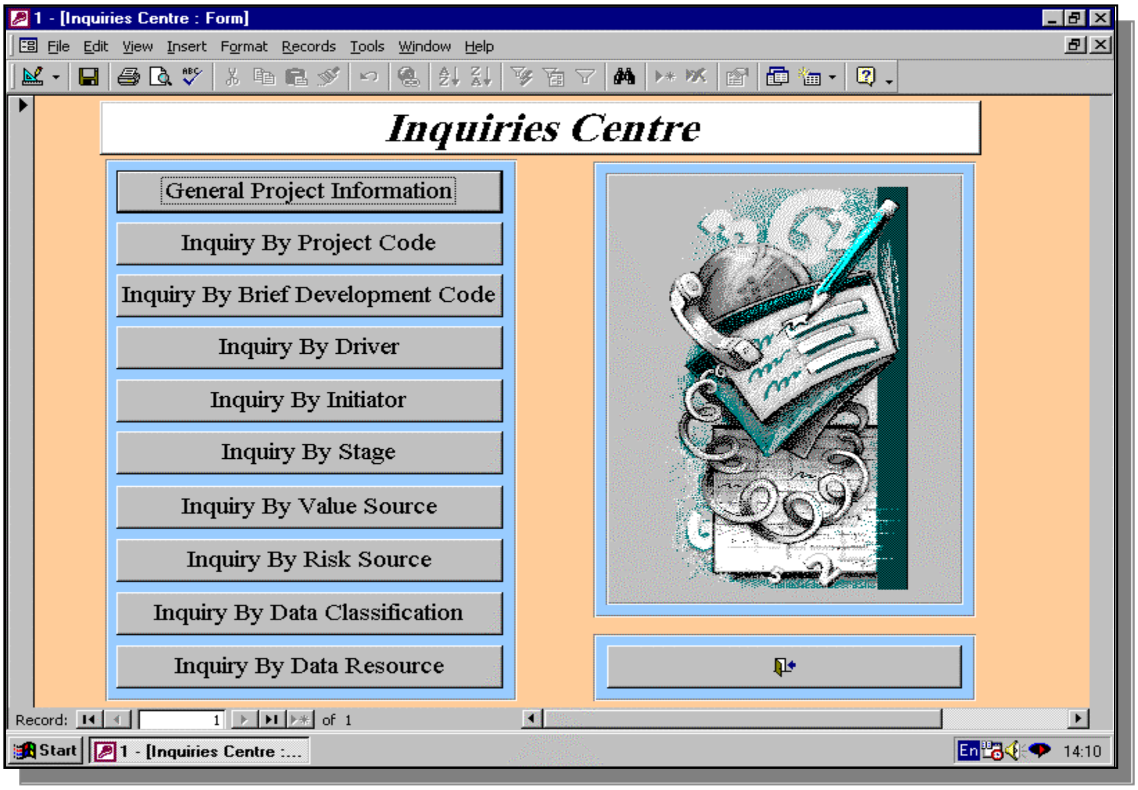


Figure 7.26 The "Inquires Centre" for the BDManager Prototype Software

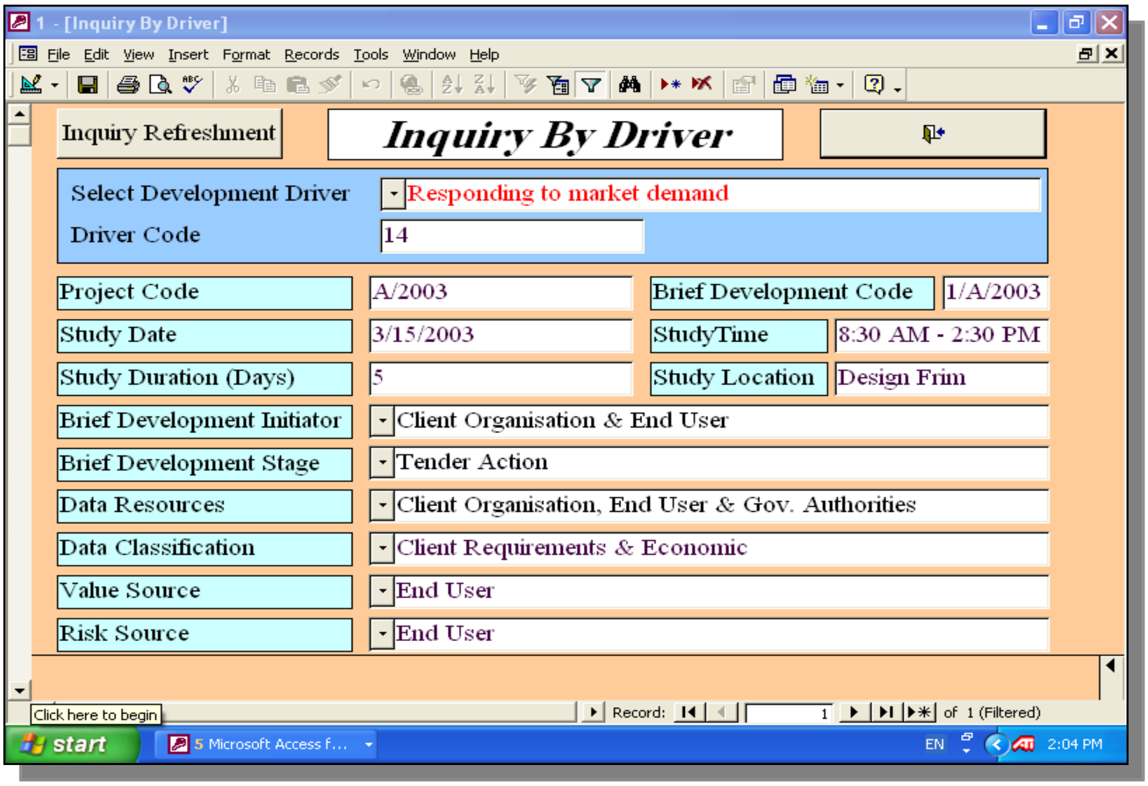


Figure 7.27 View of the "Inquiry By Driver" Screen

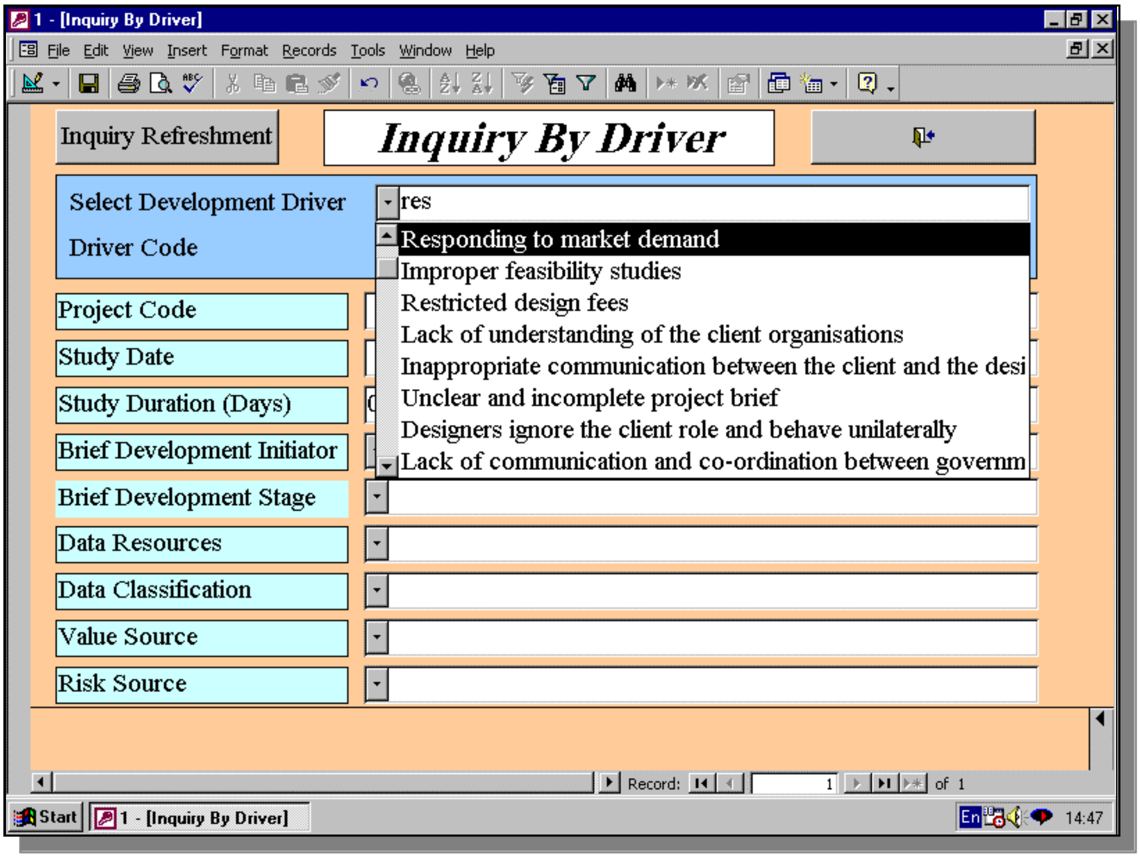


Figure 7.28 Inquiry by Typing Driver Initials and Selecting from a Pull Down Menu

All inquires screens are provided with "Inquiry Refreshment" button which allows the inquiry by another driver, and a quit icon to allow the user to return to "Brief Development Manager-Data Viewer" screen.

❖ Reports Centre

Reports centre is the fourth content of the "Brief Development Manager-Data Viewer" screen. By clicking on the "Reports Centre" button, the "Reports Centre" screen will be displayed and the user is prompted to inquire a report based on different categories such as: "Inquiry By Project Code Report", "Inquiry By Driver Report" for instance. As mentioned in Inquires centre, by typing the initials of the required inquiry report the full name will be displayed. Every report was provided with two buttons using icons for "Report Preview" and "Report Print", see figure (7.29) and (7.30). In addition, the reports centre screen was provided by "Inquiry Refreshment" button to allow inquire other reports based on different categories. A report preview of "Inquiry By Driver Report" is shown in figure (7.31). The “Reports Centre” screen is provided with a quit icon to allow the user return to "Brief Development Manager-Data Viewer" screen.

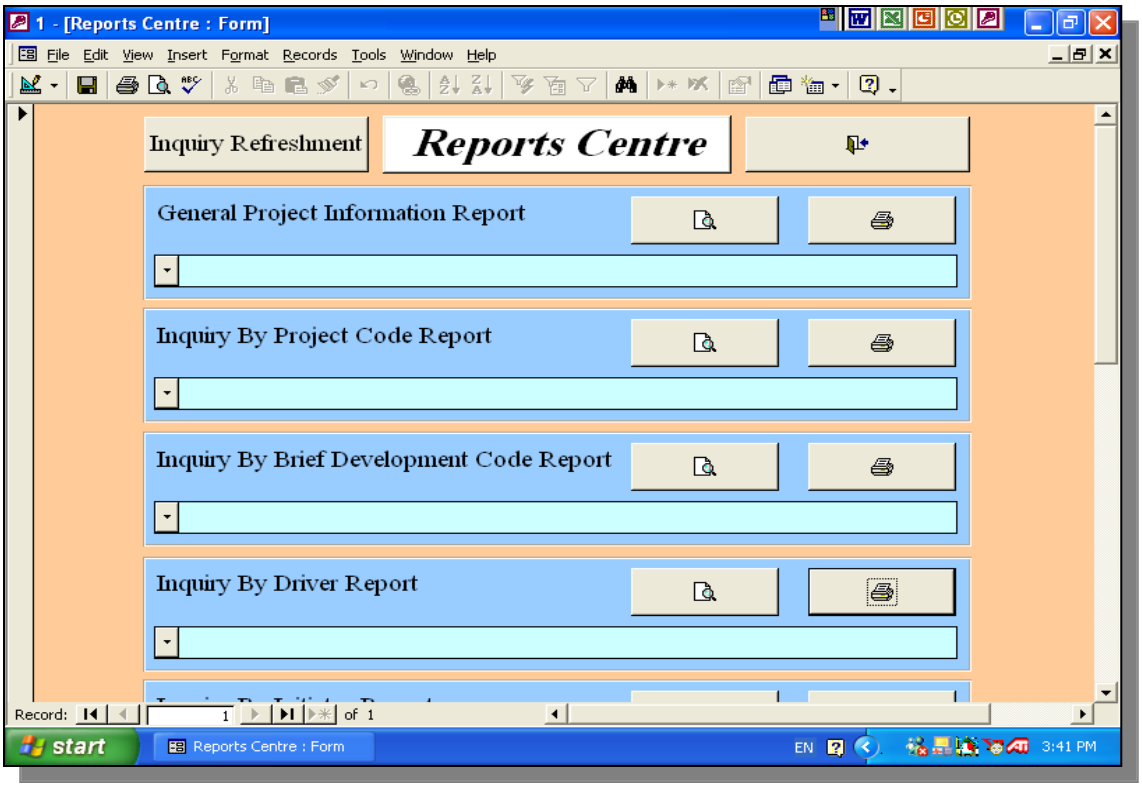


Figure 7.29 View of the "Reports Centre" Form Screen

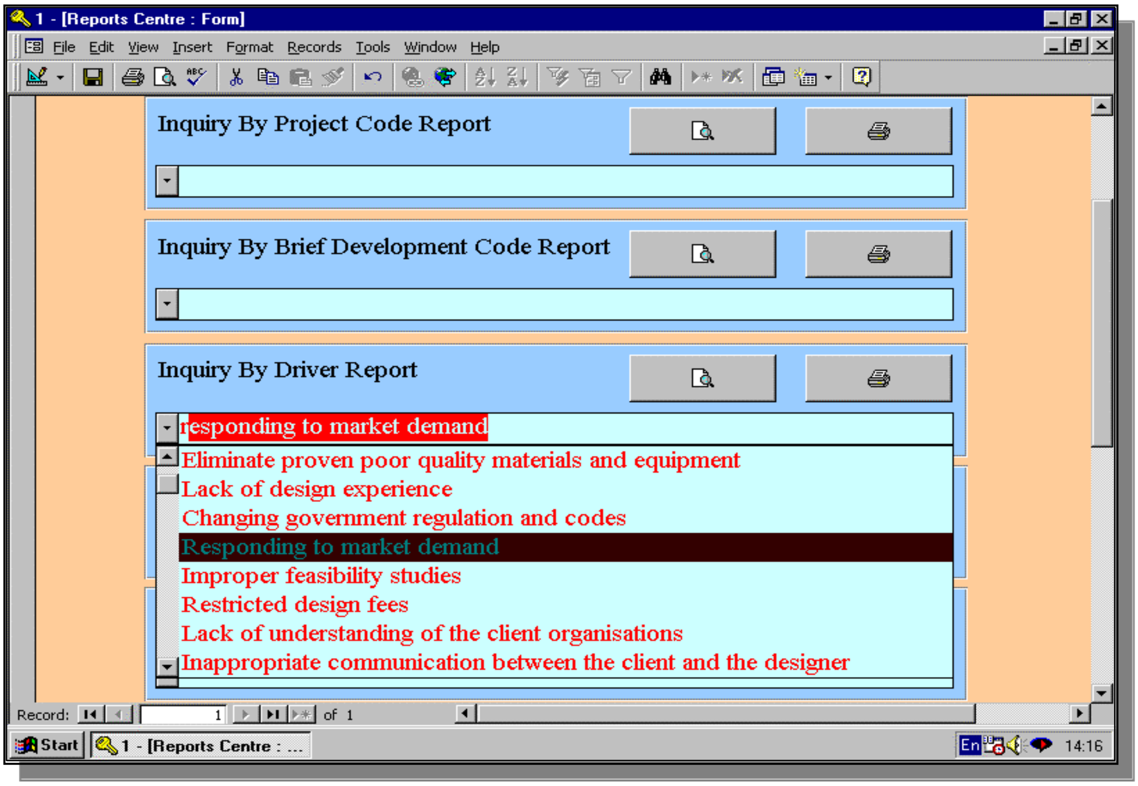


Figure 7.30 Using Pull Down Menu to Select "Inquiry By Driver Report"

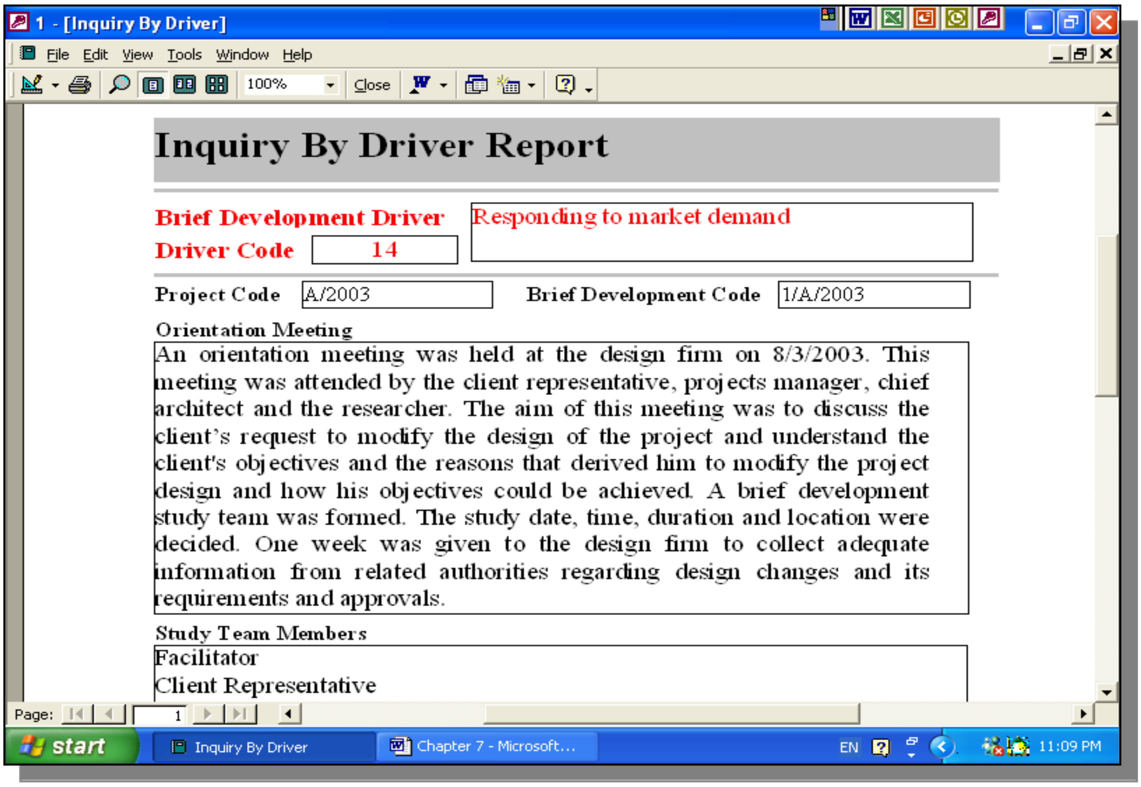


Figure 7.31 Print Preview of "Inquiry By Driver Report"

❖ **Exit**

By clicking on the "Exit" button, the user is allowed to return to the "welcome" screen.

7.6.2.4 Exit

Clicking on the last button in the "Welcome" screen allows the user to exit the Brief Development Manager prototype and exit the Microsoft Access.

7.7 Conclusions

Effective information management and information technology increase the value of a project in terms of time, cost and quality. This is because accurate and timely information in a form that can be easily shared by project participants is essential for enhancing project performance and achieve its objectives. In addition, correct, reliable, updated and well-managed information helps everyone to do the job better. Information management and information technology play an important role in managing dynamic brief development. This was achieved by (1) enabling construction professionals respond swiftly and efficiently to client's requirements, brief development drivers and provide a building that meets agreed standards and satisfies its client, cost and time constraints, (2) managing project change orders through providing information for adequate study of their impacts on time, cost and quality, as well as providing information of similar change orders in similar projects, (3) improving the briefing process through learned lessons and feed back, (4) building a live brief development database, facilitating entering, organising, retrieving, sharing and updating information as well as facilitating required calculations. The Brief Development Manager (BDManager) is the name given to the prototype system for the Value and Risk Management Protocol. The prototype is designed to implement the structured steps of the Value and Risk Management Protocol in a computer based environment. The prototype has many features such as allowing all users view stored data and examine projects information, where authorised users only are permitted to enter, modify, and store information in a friendly-designed screens. In addition, it facilitates inquiring different projects information, previewing and printing reports based on different search categories. Furthermore it allows the extension and integration with other computer based construction activities and software. According to the two prototyping approaches described above, the Brief Development Manager is a rapid prototype as it is intended to demonstrate the proposed methodology for managing brief development. In addition it is an evolutionary prototype because of its detailed and structured system as described in chapter 6. The Brief Development Manager was developed in an iterative process. It began with defining the objectives of the prototype, outlines of the interface as well as designing the data entry / view screens. Then consultation with software programmers resulted in selecting Microsoft Access as the package to be used in developing the Brief Development Manager. This was based on the advantages and features of Microsoft Access. The design of database objectives such as tables, forms, queries, and reports was illustrated. The prototype consists of a number of attractive and user-friendly screens. When the prototype is activated, the user is asked to enter the database password. When the correct password is provided, a welcome screen is displayed which give the user three option either to continue as data entry, to continue as data viewer, or to exit. When the user selected to continue as data entry, an authentication screen will be displayed which asks the user to enter his or her user number and password. Authorised users will be permitted to enter, modify and update project data. When the user selects to continue as a data viewer, a data viewer screen is displayed and the user is permitted to view the stored information without the ability to modify or update it. In addition, the data viewer screen contains a number of buttons, which allow the user to inquire project information, preview and print reports based on different search categories. The third option, allows the user to exit the application. Because of the importance of evaluating the designed prototype, the next chapter will be devoted to evaluate the Brief Development Manager and investigate its role in facilitating managing brief development. In addition, the prototype advantages and evaluators' suggestions to improve and enhance the designed prototype will be presented.

Chapter 8

Evaluation of the Brief Development Manager Prototype Software

8.1 Introduction

In order to assess the effectiveness of the produced prototype and enhance its performance, this chapter focuses on evaluating the Brief Development Manager prototype software. The evaluation of the prototype is carried out by answering three questions: what to evaluate?, how to evaluate?, and when to evaluate?. In an endeavor to investigate its efficiency and capability to deal with brief development problems as well as providing substantial comments and feed back, the developed prototype is applied on real construction projects where the proper decision for brief development is selected and implemented. Because of their importance, the reliability and validity of the Brief Development Manager in terms of development methods and findings are discussed and procedures used to escalate the reliability and validity of the prototype are illustrated. Finally, the results of the evaluation questionnaire are summarised. It includes end users comments, feed back and recommendations for improvement.

8.2 Evaluation of the Brief Development Manager

System evaluation is an integral part of the prototype development. Evaluation is used to appraise the whole value of the prototype. Verification and validation are formal methods for testing a computer programme. Verification is the process of ensuring that the product does not contain any technical errors. Verification ensures that the software has been formulated correctly. Validation is the process, which determines whether or not a system meets the required specification and is suitable for its intended purpose. Validation ensures that the software has been formulated in the intended manner (Miles et al., 2000). In other words, verification determines if the system was built right and validation determines if the right system was built. Three basic questions for system verification and validation have to be asked: (1) what to evaluate?, (2) how to evaluate?, and (3) when to evaluate? (Ng and Smith, 1998).

8.2.1 What to Evaluate?

The aim of evaluating the Brief Development Manager was to determine how well the developed system facilitated managing brief development and achieved the objectives of the Value and Risk Management Protocol as well as accomplishing the prototype features. This was achieved by:

(1) Assessing how well the Brief Development Manager facilitated identifying the brief development problem

(2) Assessing how well the Brief Development Manager facilitated structuring the brief development objectives.

(3) Assessing how well the Brief Development Manager facilitated scrutinising alternative solutions.

(4) Assessing how well the Brief Development Manager facilitates adopting the proper development decision.

(5) Assessing the Features of the Brief Development Manager.

(6) Encouraging end users to write down their comments, feedback and suggestions to develop the Brief Development Manager.

8.2.2 How to Evaluate?

Different approaches have been adopted to evaluate different systems (or prototypes). Two evaluation methods for knowledge-based system, which could be extended for general evaluations. One of these methods is to provide industry users with a working version of the system under evaluation and leave them to make use of it over a prolonged time period (e.g. number of weeks). This would give project personnel an opportunity to get used to its functionality and form an opinion on whether the stated benefits are actually achieved. A diary is used to provide a record of usage by the evaluator, and includes information on any difficulties that occurred and any features that are felt to be lacking. This is not an easy task as there is many difficulties are magnified when the trial system must be integrated with existing systems. Another approach is where a relatively large number of evaluators are available for a short period of time. An evaluation session is held in a single location with all the evaluators participating simultaneously. The session consists of a hands-on usage portion, where the evaluators are guided through a usage scenario with the use of appropriate notes. This is followed by the distribution and completion of questionnaire by each evaluator (Miles et al., 2000; Ren, 2002). During the course of evaluating the Brief Development Manager, the second method was adopted. In this approach, the major characteristics of Brief Development Manager, its development process, and the use of the prototype was demonstrated to evaluation groups applied the protocol to solve brief development problems. Study session team members were asked to respond to an evaluation questionnaire where their feedback and suggestions were obtained.

8.2.3 When to Evaluate?

The development of the Brief Development Manager was done in an iterative process. Regular revision and evaluation of the developed prototype was carried out by the researcher, the supervisors and with the collaboration of software programmers and construction professionals to assess how well the prototype covered the requirements of the Value and Risk Management

Protocol. When a satisfactory version was produced, it was applied to a number of case studies. At the end of each brief development study session, the participants were asked to fill a questionnaire designed to evaluate the suggested prototype. Copy of the questionnaire is attached in Appendix (D). Evaluators, comments and suggestions were considered and applied to enhance the performance of the designed prototype.

8.3 Application of the Brief Development Manager

In order to evaluate the brief development manager and assess its performance as a decision-making tool for managing dynamic brief development in construction, the prototype software was applied on a number of real case studies. These projects varied in their client organisations, development drivers, stages, and initiator for instance. The following section will describe in detail these case studies. It worth to mention that the identities of the client organisation, study team, design firm, constructor and suppliers were suppressed for the purpose of confidentiality according to their request.

8.3.1 Case Study (1)

This is the case study, which was studied by using the Value and Risk Management Protocol systematic steps as detailed in chapter 6. Here the study was carried out by using the Brief Development Manager prototype software.

General Project Information

The BDManager prototype software was used to enter general project information. This was done through using the "General Project Information" screen. This information included:

Project Code	:	A/2003
Brief Development Code	:	1/A/2003
Project Type	:	Office Building
Client Name	:	*************
Project Location	:	Abu Dhabi
Contract Type	:	Lump Sum
Project Cost	:	DHS 5.660.270
Project Duration	:	12Months
Design firm	:	*************
Constructor	:	*************
Suppliers	:	*************

Funding Body : Department of Social Services and Commercial Buildings (DSSCB)

Remarks :

Identifying Problem

The brief development study session began with giving the participants a brief description of the project, the client desire to develop the project brief, the Value and Risk Management Protocol as the methodology to be used in achieving a proper decision and the Brief Development Manager as the translation of the VRMP into computer based environment. The Brief Development Manager prototype software was used to identify the brief development problem. This was done through using the "Value and Risk Management Protocol" screen. It included the following information:

Project Code : A/2003

Brief Development Code : 1/A/2003

Orientation Meeting

An orientation meeting was held at the design firm on 8/3/2003. This meeting was attended by the client representative, projects manager, chief architect and the researcher. The aim of this meeting was to discuss the client's request to modify the design of the project and understand the client's objectives and the reasons that derived him to modify the project design and how his objectives could be achieved. A brief development study team was formed, where the study date, time, duration and location were decided as well. One week was given to the design firm to collect adequate information from related authorities regarding design changes and its requirements and approvals.

Selecting Team Members

The researcher as a facilitator, client representative, projects manager, architect, quantity surveyor, structural engineer, civil engineer, and electro-mechanical engineer.

Study Data : 15/03/2003

Study Time : 8:30 AM – 2:30 PM

Study Duration (Days) : 5

Study Location : Design Firm

Data Resource : Client Organisation & End User

Data Classification : Client Requirements &Economic

Development Driver : Responding to market demand

Development Description

Modifying the design of the project from commercial building consists of:

Ground floor: shops and services rooms, Typical floors: 16 flats (two bed room), and
Roof: services rooms and watchman room, to an office building consists of :
Ground floor: showroom and Service room, Typical floors: offices, Roof: services rooms and watchman room.

Development Stage	:	Tender Action
Development Initiator	:	Client Organisation & End User
Value Source to Client	:	End User
Risk Source to Client	:	End User

Structuring Objectives

Defining Objectives

The client objectives were defined as modifying the project design from a commercial building to an office building in order to get better value for money and utilise the benefits of the project location. A set of sub objectives were generated to achieve the client objectives:

(1) Increase income
(2) Respond to market demand
(3) Reduce project cost
(4) Reduce maintenance cost
(5) Attract customers
(6) Use substitute materials

Developing Objectives Value Hierarchy

Allocating Importance Weights

After the brief development objectives were defined, the brainstorming technique with the support of Microsoft Excel was used to develop objectives value hierarchy, allocate and calculate importance weights of the defined objectives as shown in figure (8.1) and table (8.1).

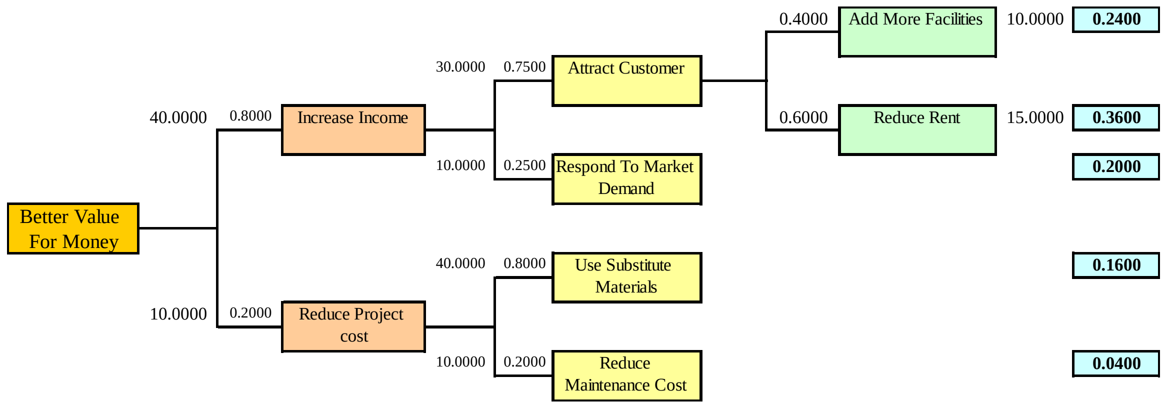


Figure 8.1 Value Hierarchy of the Brief Development Objectives of Case Study 1

Objectives	Normalised Weight
Add More Facilities	0.2400
Reduce Rent	0.3600
Respond To Market Demand	0.2000
Use Substitute Materials	0.1600
Reduce Maintenance Cost	0.0400

Table 8.1 Importance Weights of the Brief Development Objectives of Case Study 1

Defining Associated Risks

After the objectives value hierarchy was developed and the importance weights were allocated and calculated, the associated risk that may threat the achievement of the required objectives were defined. These risks were defined as:

(1) Delay due to re-design time required as well as getting authorities approvals.

(2) Delay due to importing materials

(3) Losing customers to rent the building

Scrutinising Alternative Solutions

Generating Alternatives

Brainstorming technique was used to generate creative alternatives to achieve the above aim and objectives. Table (8.2) summarises the generated alternatives.

Alternative A	Leave the design of the typical floors as it is, move the services rooms in the ground floor to basement in order to increase the showroom area, and use substitute cheaper
Alternative B	Increase the number of flats from 16 (two bed room) to 24 (one bed room), move the services rooms to basement to increase showroom area, construct car parking at basement, raise the building specification, and reduce rent.
Alternative C	Re-design two floors to be offices, leave the other floors to be 8 flats (two bed room), move the services rooms to basement, construct car parking at basement, and use substitute cheaper materials.
Alternative D	Re-design two floors to be offices, re-design the other two floors to be 12 flats (one bed room) instead of 8 flats (two bed room), move the services rooms to basement, construct car parking at basement, and use substitute cheaper materials.
Alternative E	Modify the design of the whole project to be office building, move the services rooms in ground floor to basement and add car parking, and raise building specification to attract customers.
Alternative F	Modify the design of the whole project to be office building, move the service rooms in ground floor to basement and add car parking, and use substitute cheaper materials.
Alternative G	Invest the client resources in another type of projects

Table 8.2 Brief Development Generated Alternatives of Case Study 1

Evaluating Alternatives

The next step was to evaluate generated alternatives. Alternative “G” was rejected on the basis that the government loan given to the client is assigned to construct his building and not to be used for other purposes. Other alternatives were raised for evaluation. Decision Matrix was created to evaluate each alternative against the pre-defined objectives, see table (8.3). Assessing associated risks plays an important role in identifying the risks that most threat the achievement of the development objectives. This was done by assessing risk severity and risk likelihood, where assessed risk= Likelihood (L) * Severity (S), see table (8.4).

Assessment Attributes	Add More Facilities	Reduce Rent	Respond to Market Demand	Use Substitute Materials	Reduce Maintenance Cost	Total
Weights of Importance (0-1)	**0.2400**	**0.3600**	**0.2000**	**0.1600**	**0.0400**	
Alternative A	0.00	0.00	20.00	100.00	0.00	20.00
	0.00	0.00	4.00	16.00	0.00	
Alternative B	75.00	25.00	30.00	0.00	0.00	33.00
	18.00	9.00	6.00	0.00	0.00	
Alternative C	50.00	0.00	40.00	100.00	42.00	37.68
	12.00	0.00	8.00	16.00	1.68	
Alternative D	50.00	0.00	50.00	100.00	40.00	39.60
	12.00	0.00	10.00	16.00	1.60	
Alternative E	75.00	0.00	80.00	0.00	85.00	37.40
	18.00	0.00	16.00	0.00	3.40	
Alternative F	50.00	0.00	80.00	100.00	85.00	47.40
	12.00	0.00	16.00	16.00	3.40	

Table 8.3 Using the Decision Matrix to Evaluate Alternative Solutions of Case Study 1

Assessment Attributes	Re Design Delay		Importing Materials		Losing Customer		Total
	L	S	L	S	L	S	
Alternative A	5.00	1.00	1.00	1.00	2.00	2.00	10.00
	5.00		1.00		4.00		
Alternative B	5.00	3.00	3.00	3.00	1.00	1.00	25.00
	15.00		9.00		1.00		
Alternative C	5.00	2.00	1.00	1.00	1.00	1.00	12.00
	10.00		1.00		1.00		
Alternative D	5.00	2.00	1.00	1.00	1.00	1.00	12.00
	10.00		1.00		1.00		
Alternative E	5.00	2.00	4.00	3.00	1.00	1.00	23.00
	10.00		12.00		1.00		
Alternative F	5.00	2.00	1.00	1.00	1.00	1.00	12.00
	10.00		1.00		1.00		

Table 8.4 Assessing Associated Risks of Case Study 1

After the decision matrix was developed and the associated risks were assessed, alternatives were compared on the basis of expected value and associated risks. Where net expected value = expected value – associated risk, see table (8.5).

	Expected Value	Associated Risk	Net Expected Value
Alternative A	20.00	10.00	10.00
Alternative B	33.00	25.00	8.00
Alternative C	37.68	12.00	25.68
Alternative D	39.60	12.00	27.60
Alternative E	37.40	23.00	14.40
Alternative F	47.40	12.00	35.40

Table 8.5 Comparing Alternatives of Case Study 1

Sensitivity analysis was carried out by fixing all evaluation criteria and changing one criterion and then observe its effect on evaluated alternatives. Results showed that all alternatives were not sensitive to the changes in one variable while others were fixed. This showed that alternative "F" with net expected value of 35.40 is the best alternative.

Adopting Development Decision

Presenting Alternatives

A presentation meeting was held at the design office where brief description of the study was introduced to the client organisation. It included presentation of the VRMP, identification of the problem in hand, structured objectives, generated and evaluated alternatives. In addition, a brief development study report was submitted to the client organisation in order to facilitate reviewing the systematic steps followed and helping adopt the proper brief development decision.

Selecting the Best Alternative

Alternative "F" was selected as the best alternatives with net expected value of 35.40. The cost of the selected alternative was expected to be DHS 5.660.270, which is within the budget of the government loan.

Implementing the Selected Alternative

After the client organisation selected to change the design of the project from commercial building to an office building with moving the services rooms in ground floor to basement, add car parking and use substitute cheaper materials, official letter was issued by the client organisation and the DSSCB to the design firm stated the acceptance of the changes of the project design and brief development and that the design firm will be compensated for the re-design and production of tender documents as an office building.

Monitoring and Feeding Back

Based on the above steps, the design firm re-designed the project according to the developed brief. The feed back of the case study could be summarised as:

(1) Carrying out adequate study of the client business, client requirements, future projects and market demand will avoid later changes where its cost is expensive and it disrupts the scheduled works.

(2) The designer should bear in mind that many client organisations do not have in depth construction knowledge or what do they need, so the designer should have the art of questioning and suggest more options until the client requirements are met and his / her satisfaction is achieved.

(3) Client organisation should provide the design firm with all information and open communication channels to reflect their requirements as early as possible.

8.3.2 Case Study (2)

<u>General Project Information</u>

Project Code	:	B/2003
Brief Development Code	:	1/B/2003
Project Type	:	Residential Villa
Client Name	:	*************
Project Location	:	Abu Dhabi
Contract Type	:	Lump Sum
Project Cost	:	DHS 1.200.000
Project Duration	:	12Months
Design firm	:	*************
Constructor	:	*************
Suppliers	:	*************
Funding Body	:	Department of Social Services and Commercial Buildings (DSSCB)
Remarks	:	

<u>Identifying Problem</u>

Project Code	:	B/2003
Brief Development Code	:	1/B/2003

Orientation Meeting

An Orientation Meeting was held at the Department of Social Services and Commercial Buildings (DSSCB), Abu Dhabi, UAE on 22/3/2003. This meeting was attended by the building client, head of maintenance section, architect, civil engineer, maintenance engineer, electro-mechanical engineer, and the researcher. The aim of this meeting was to understand the client's objectives and the reasons that derived him to enhance the building specification and how his objectives could be achieved. Strategic matter such as the selection of study team members, study date, time, duration and location were decided. One week was given to the design firm to collect adequate information from related authorities regarding design changes and its requirements and approvals.

Selecting Team Members

The researcher as a facilitator, client, architect, civil engineer, maintenance engineer, and electro-mechanical engineer.

Study Data : 29/03/2003

Study Time	:	from 8:30AM to 2:30PM
Study Duration (Days)	:	5
Study Location	:	DSSCB
Data Resource	:	Client Organisation & End User
Data Classification	:	Client Requirements &Economic
Development Driver	:	Upgrade project facilities

Development Description

The previous tenant cancelled his contract and left the villa on 30/6/2002. Since that time the villa was not occupied with the great demand on that area as quiet and well serviced. This was traced back to a number of reasons:

(1) Damage and failure in the ground floor flooring.

(2) Kitchen cabinets and bathrooms fittings are damaged and in bad state of repair.

(3) Ordinary windows type A/C system (very expensive electric bill).

(4) Poor building facilities (no central gas, no central Antenna, etc.).

(5) Expensive annual rent.

The building client decided to attract tenants to rent the villa, particularly after a new tenant offered to rent the villa. The modification will include:

(1) Removing all the damaged tiles in ground floor and do back filling.

(2) Fixing new ceramic tiles instead of old mosaic tiles.

(3) Removing and shifting old kitchen cabinets and bathrooms fittings and fixing new fashionable sets.

(4) Complete refurbishment and maintenance of painting, electrical and sanitary work and replacing damaged items.

(5) Adding more facilities.

(6) Reducing Rent

Development Stage	:	After Practical Completion
Development Initiator	:	Client Organisation & End User
Value Source to Client	:	End User
Risk Source to Client	:	End User

<u>Structuring Objectives</u>

Defining Objectives

The client objectives were defined as attracting new tenets to rent the villa and recover the loss of leaving the building unoccupied for approximately one year and get benefits from the villa location and size. A set of sub objectives were generated to achieve the client objectives:

(1) Enhancing Specification

(2) Adding more Facilities

(3) Reducing Rent

(4) Refurbishing and Maintaining work

Developing Objectives Value Hierarchy

Allocating Importance Weights

After the brief development objectives were identified, the brainstorming technique with the support of Microsoft Excel was used to develop objectives value hierarchy, allocate and calculate importance weights of the defined objectives as shown in figure (8.2) and table (8.6).

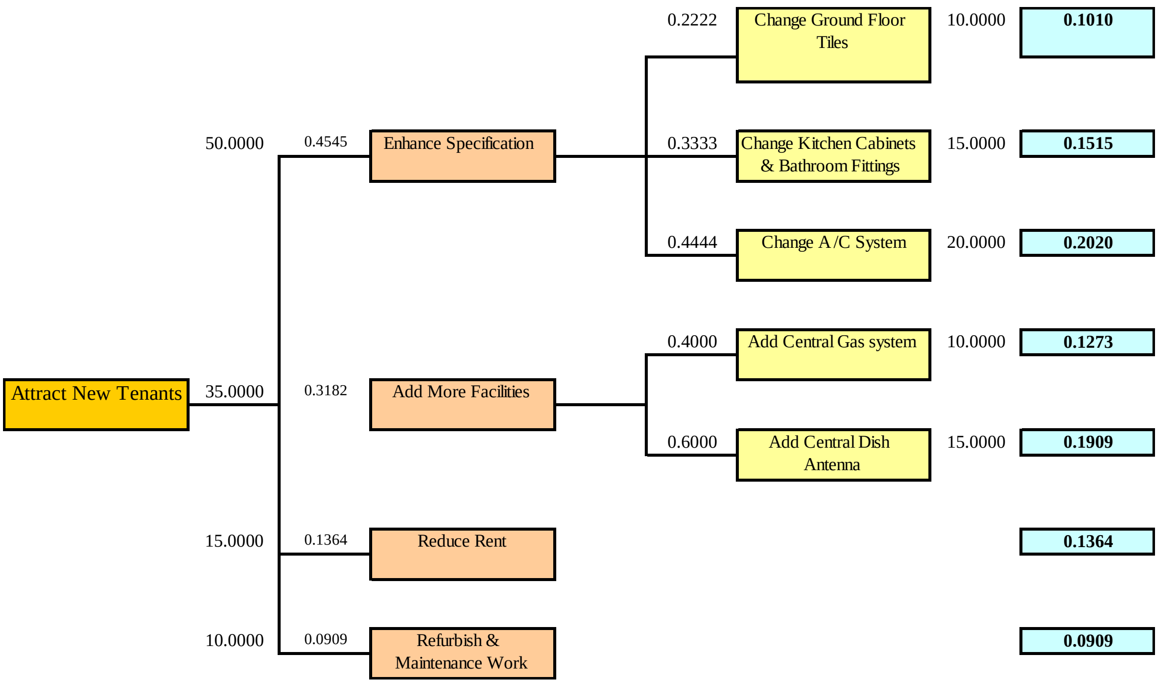


Figure 8.2 Value Hierarchy of the Brief Development Objectives of Case Study 2

Objectives	Normalised Weight
Change Ground Floor Tiles	0.1010
Change Kitchen Cabinets & Bathroom Fittings	0.1515
Change A/C System	0.2020
Add Central Gas system	0.1273
Add Central Dish Antenna	0.1909
Reduce Rent	0.1364
Refurbish & Maintenance Work	0.0909

Table 8.6 Importance Weights of the Brief Development Objectives of Case Study 2

Defining Associated Risks

After the objectives value hierarchy was developed and the importance weights were allocated and calculated, the associated risk that may threat the achievement of the required objectives were defined. These risks were defined as:

(1) Increasing the work cost than the client budget (DHS 25000).

(2) Losing current tenant

(3) Losing new tenants

Scrutinising Alternative Solutions

Generating Alternatives

Brainstorming technique was used to generate creative alternatives to achieve the above aim and objectives. Table (8.7) summarises the generated alternatives.

Alternative A	The client has to enhance the villa specification, add more facilities, complete refurbishment and maintenance work without changing the ordinary A/C system.
Alternative B	The villa annual rent is DHS 90000. A new tenant offered to rent the villa for two years with annual rent of DHS 56000 against fixing wall mounted A/C units and fixing new kitchen cabinets and the client has to complete other refurbishment and maintenance work.
Alternative C	The client has to enhance the villa specification, add more facilities and complete refurbishment and maintenance work including changing the ordinary A/C system to wall mounted units.
Alternative D	The client has to wait until he gets another tenant and does necessary maintenance work and reduces rent without changing villa specification or A/C system.
Alternative E	Re construction of the villa with high specification, new A/C system, including all facilities.

Table 8.7 Brief Development Generated Alternatives of Case Study 2

Evaluating Alternatives

The next step was to evaluate the generated alternatives. Alternative "E" was rejected on the basis that the client organisation does not have sufficient fund to demolish and re-construct the villa. Other alternatives were raised for evaluation. Decision Matrix was created to evaluate each alternative against the defined objectives, see table (8.8). Risks that threat the achievement of client objectives were assessed by assessing risk severity and risk likelihood, where assessed risk= Likelihood (L) * Severity (S), see table (8.9).

Assessment Attributes	**Change Ground Floor Tiles**	**Change Kitchen Cabinets & Bathroom Fittings**	**Change A/C System**	**Add Central Gas system**	**Add Central Dish Antenna**	**Reduce Rent**	**Refurbish & Maintenance Work**	**Total**
Weights of Importance (0-1)	**0.1010**	**0.1515**	**0.2020**	**0.1273**	**0.1909**	**0.1364**	**0.0909**	
Alternative A	100.00	100.00	0.00	100.00	100.00	0.00	100.00	66.16
	10.10	15.15	0.00	12.73	19.09	0.00	9.09	
Alternative B	100.00	0.00	0.00	100.00	100.00	38.00	100.00	56.19
	10.10	0.00	0.00	12.73	19.09	5.18	9.09	
Alternative C	100.00	100.00	100.00	100.00	100.00	0.00	100.00	86.36
	10.10	15.15	20.20	12.73	19.09	0.00	9.09	
Alternative D	100.00	0.00	0.00	0.00	0.00	60.00	100.00	27.37
	10.10	0.00	0.00	0.00	0.00	8.18	9.09	

Table 8.8 Using the Decision Matrix to Evaluate Alternative Solutions of Case Study 2

Assessment Attributes	**Increasing Work Cost**		**Losing Current Tenant**		**Losing New Tenants**		**Total**
	L	**S**	**L**	**S**	**L**	**S**	
Alternative A	3.00	3.00	4.00	5.00	2.00	3.00	35.00
	9.00		20.00		6.00		
Alternative B	2.00	2.00	1.00	5.00	1.00	3.00	12.00
	4.00		5.00		3.00		
Alternative C	4.00	4.00	2.00	5.00	2.00	3.00	32.00
	16.00		10.00		6.00		
Alternative D	1.00	1.00	5.00	5.00	3.00	5.00	41.00
	1.00		25.00		15.00		

Table 8.9 Assessing Associated Risks of Case Study 2

After the decision matrix was developed and the associated risks were assessed. Alternatives were compared on the bases of expected value and associated risks. Where net expected value = expected value – associated risk, see table (8.10).

	Expected Value	Associated Risk	Net Expected Value
Alternative A	66.16	35.00	31.16
Alternative B	56.19	12.00	44.19
Alternative C	86.36	32.00	54.36
Alternative D	27.37	41.00	-13.63

Table 8.10 Comparing Alternatives of Case Study 2

Under many sensitivity tests results showed that all alternatives were not sensitive to the changes in one variable while others were fixed. Alternative “C” represents the best alternative with net expected value of (54.36). The problem with alternative “C” is that the changing the A/C system will increase the budgeted cost. The client suggested to bear all the work required (except A/C) and reduce the rent to DHS 85000. The tenant was informed with the client desire and initial approval was gained from him.

<u>Adopting Development Decision</u>

Presenting Alternatives

A presentation meeting was held at the DSSCB where brief description of the study was introduced to the client organisation. It included presentation of the VRMP, identification of the problem in hand, structured objectives, generated and evaluated alternatives. In addition, a brief development study report was submitted to the client organisation in order to facilitate reviewing the systematic steps followed and helping adopt the proper brief development decision.

Selecting the Best Alternative

The study resulted in selecting the client organisation to alternative “C” with little modification. The client has to bear all the work required including enhancing the villa specification, adding more facilities, carrying out refurbishment and maintenance works, reducing the rent to DHS 85000, where the tenant will bear the responsibility and cost of fixing A/C units.

Implementing the Selected Alternative

Alternative "C" with its modifications was tendered and executed for the cost of DHS 21800 and the villa is occupied now.

Monitoring and Feeding Back

Based on the above, the followings were noticed:

(1) Development of the project brief could take place at later stages and not just at early stages.

(2) Adequate study of the different drivers that may affect the project brief adds better value to the project and helps achieve the client objectives and satisfactions.

8.3.3 Case Study (3)

General Project Information

Project Code	:	C/2003
Brief Development Code	:	1/C/2003
Project Type	:	Commercial Building
Client Name	:	*************
Project Location	:	Abu Dhabi
Contract Type	:	Lump Sum
Project Cost	:	DHS 6.000.000
Project Duration	:	12Months
Design firm	:	*************
Constructor	:	*************
Suppliers	:	*************
Funding Body	:	Department of Social Services and Commercial Buildings (DSSCB)
Remarks	:	Initial Handing was on 10/3/1999

Identifying Problem

Project Code	:	C/2003
Brief Development Code	:	1/C/2003

Orientation Meeting

An Orientation Meeting was held at the Department of Social Services and Commercial Buildings (DSSCB), Abu Dhabi, UAE on 05/04/2003. The researcher, client representative, the DSSCB engineer, designer and Constructor attended this meeting. The aim of this meeting was to understand the client's objectives and define the drivers to modify the project brief and how these objectives could be achieved. Strategic matter such as the selection of study team members, study date, time, duration and location were decided. One week was allowed to collect adequate information from related authorities regarding design changes and its requirements and approvals.

Selecting Team Members

The researcher as a facilitator, client representative, architect, civil engineer, maintenance engineer, aluminium specialist engineer, aluminium and marble fixing specialist contractor.

Study Data	:	12/04/2003
Study Time	:	from 8:30AM to 2:30PM
Study Duration (Days)	:	5
Study Location	:	DSSCB
Data Resource	:	Client Organisation, End User & Gov. Authorities
Data Classification	:	Client Requirements & Design and Construction
Development Driver	:	Eliminate proven poor quality materials and equipment

Development Description

The building was a recently completed project. It is initial handing over was on 10/3/1999 and its final handing over was on 15/10/2002. The building client raised complaints to the Department of Social Services and Commercial Buildings stating that tenants cancelled their contracts and left the building. Low demand of the building was traced back to the following:

(1) Design error of the curtain wall windows' calculations where the windows side arms were broken due to the excessive panels weights.

(2) Design error of the fixing system of the external finishing where the angles that carry the marble tiles were rusted and were not able to carry 30*60*2 cm marble tiles.

(3) Falling windows and marble tiles caused damaged to private properties (such as cars etc.) and jeopardise the life of pedestrians.

(4) Lack of studying market demand where the ground floor was designed as one showroom in a place with low demand for shops with such large areas. The showroom was not rented since the initial handing over.

The building client decided to increase the demand of the building by solving the above-mentioned problems. The modification will include:

(1) Removing all broken side arms and fixing new stainless steel heavy duty ones.

(2) Re-fixing the external marble tiles.

(3) Redesign the ground floor to a number of shops with suitable areas and reduce their annual rent.

Development Stage : Construction to Practical Completion

Development Initiator : Client Organisation & End User

Value Source to Client : End User

Risk Source to Client : Design Firm & Constructor

<u>Structuring Objectives</u>

Defining Objectives

Increasing the demand of the building and attracting current tenets to stay in the building as well as renting the ground floor showroom, which was not occupied for more than four years. In addition the client aims to be free from any legal responsibilities of falling the windows or marble tiles on private properties or pedestrians. A set of sub objectives were generated to achieve the client objectives:

(1) Constructing temporary fence around the building to protect private properties and pedestrian.

(2) Changing the windows side arms to heavy-duty stainless steel ones.

(3) Re-fixing the facade marble tiles.

(4) Re-design the ground floor showroom to a number of shops.

(5) Reducing shops annual rent.

Developing Objectives Value Hierarchy

Allocating Importance Weights

After the brief development objectives were identified, the brainstorming technique with the support of Microsoft Excel was used to develop objectives value hierarchy,
allocate and calculate importance weights of the defined objectives as shown in figure (8.3) and table (8.11).

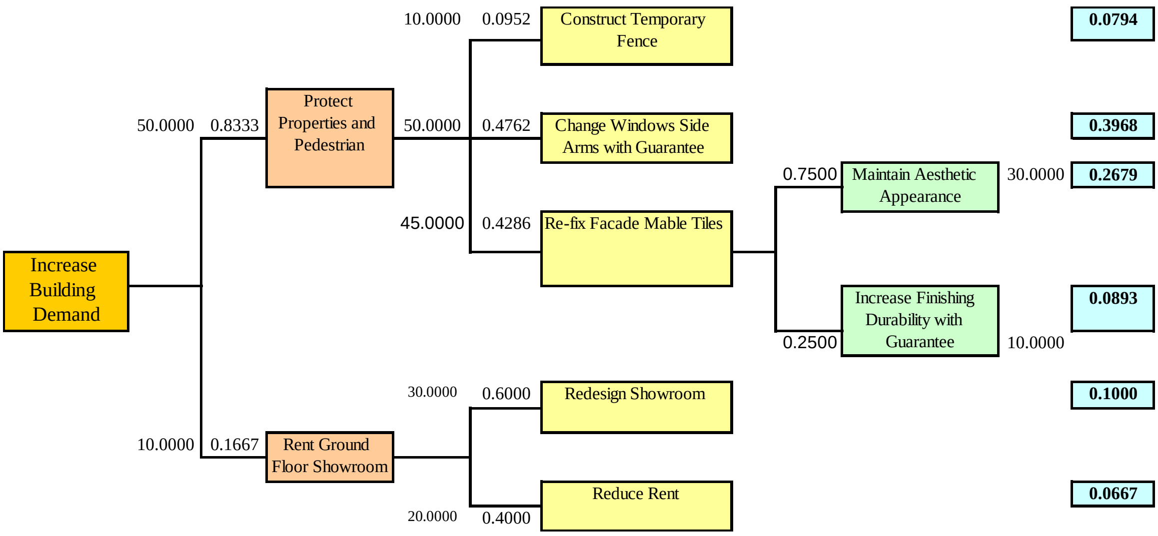


Figure 8.3 Value Hierarchy of the Brief Development Objectives of Case Study 3

Objectives	Normalised Weight
Construct Temporary Fence	0.0794
Change Windows Side Arms with Guarantee	0.3968
Maintain Aesthetic Appearance	0.2679
Increase Finishing Durability with Guarantee	0.0893
Redesign Showroom	0.1000
Reduce Rent	0.0667

Table 8.11 Importance Weights of the Brief Development Objectives of Case Study 3

Defining Associated Risks

After the objectives value hierarchy was developed and the importance weights were allocated and calculated, the associated risk that may threat the achievement of the required objectives were defined. These risks were defined as:

(1) Falling windows or marble tiles on private properties or pedestrians.

(2) Importing side arms.

(3) Losing new tenants for shops.

Scrutinising Alternative Solutions

Generating Alternatives

Brainstorming technique was used to generate creative alternatives to achieve the above aim and objectives. Table (8.12) summarises the generated alternatives.

Alternative A	Directing letters to the designer and the main contractor to replace the broken side arms, fix falling marble and bear the responsibility of any damage may occur. Particular time will be decided to complete the work, otherwise the DSSCB will do the job and the cost will be deducted from the contractor account.
Alternative B	Constructing temporary fence around the building, putting warning signs, replacing the broken side arms with suitable stainless steel heavy duty arms that can carry the heavy glass widows (the constructor will give 1 year guarantee). Re-fixing the falling marble tiles with apparent stainless steel screws (1 year guarantee). Leave the design of the ground floor as it is but reduce its rent.
Alternative C	The same as alternative (B), but re-design the ground floor show room to four shops and reduce their rent.
Alternative D	Constructing temporary fence around the building, putting warning signs, changing the heavy glass panels with light ones and replacing the broken side arms with suitable stainless steel heavy duty arms (the constructor will give 10 years guarantee). Removing all marble tiles and re-fixing them with concealed angles to preserve the facade appearance (10 years guarantee). Re-design the ground floor showroom to four shops and reduce their rent.
Alternative E	Constructing temporary fence around the building, putting warning signs, replacing the broken side arms with suitable stainless steel heavy duty arms that can carry the heavy glass widows (1 year guarantee). Removing marble tiles and replacing them with Epoxy painting (cheap and durable). Change the activity of the ground floor from showroom to other activity needed in that area.

Table 8.12 Brief Development Generated Alternatives of Case Study 3

Evaluating Alternatives

The next step was to evaluate generated alternatives. For alternative "A" a letter was directed to the main contractor, as the authority responsible for any hidden defects for 10 years due to the contract conditions, but no response was received. Final warning letter was directed to him but no response was received too. According to this reason the client with the DSSCB decided to carry out the required work and the cost will be deducted from the contractor account. The cost of the ground floor work will be paid by the building client. Other alternatives were raised for evaluation. Decision Matrix was created to evaluate each alternative against the pre-defined objectives, see table (8.13). Assessing associated risks plays an important role in identifying the risks that most threat the achievement of the development objectives. This was done by assessing risk severity and risk likelihood, where assessed risk= Likelihood (L) * Severity (S), see table (8.14).

Assessment Attributes	Construct Temporary Fence	Change Windows Side Arms with Guarantee	Maintain Aesthetic Appearance	Increase Finishing Durability with Guarantee	Redesign Showroom	Reduce Rent	Total
Weights of Importance (0-1)	**0.0794**	**0.3968**	**0.2679**	**0.0893**	**0.1000**	**0.0667**	
Alternative B	100.00	60.00	50.00	60.00	0.00	100.00	57.16
	7.94	23.81	13.39	5.36	0.00	6.67	
Alternative C	100.00	60.00	50.00	60.00	100.00	100.00	67.16
	7.94	23.81	13.39	5.36	10.00	6.67	
Alternative D	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	7.94	39.68	26.79	8.93	10.00	6.67	
Alternative E	100.00	60.00	25.00	75.00	100.00	0.00	55.14
	7.94	23.81	6.70	6.70	10.00	0.00	

Table 8.13 Using the Decision Matrix to Evaluate Alternative Solutions of Case Study 3

Assessment Attributes	Falling Windows or Marble Tiles		Importing Side Arms		Losing Tenants for Shops		Total
	L	S	L	S	L	S	
Alternative A	3.00	5.00	4.00	5.00	4.00	4.00	51.00
	15.00		20.00		16.00		
Alternative B	3.00	5.00	4.00	5.00	2.00	2.00	39.00
	15.00		20.00		4.00		
Alternative C	1.00	5.00	4.00	5.00	2.00	2.00	29.00
	5.00		20.00		4.00		
Alternative D	3.00	5.00	4.00	5.00	3.00	5.00	50.00
	15.00		20.00		15.00		

Table 8.14 Assessing Associated Risks of Case Study 3

After the decision matrix was developed and the associated risks were assessed. Alternatives were compared on the bases of expected value and associated risks. Where net expected value = expected value – associated risk, see table (8.15).

	Expected Value	Associated Risk	Net Expected Value
Alternative B	57.16	51.00	6.16
Alternative C	67.16	39.00	28.16
Alternative D	100.00	29.00	71.00
Alternative E	55.14	50.00	5.14

Table 8.15 Comparing Alternatives of Case Study 3

Under many sensitivity tests results showed that all alternatives were not sensitive to the changes in one variable while others were fixed. Alternative "D" and "C" represent the best alternatives with net expected value of (71) and (28.16) respectively. Since changing the glass panels is out of the scope of the contract, the DSSCB decided that if the client wishes to change the glass panels it would be on his own budget as well as the cost of redesigning the ground floor show room. In such a case alternative “C” with net expected value of (28.16) represents the best alternative.

Adopting Development Decision

Presenting Alternatives

A presentation meeting was held at the DSSCB where brief description of the study was introduced to the client. It included presentation of the VRMP, identification of the problem in hand, structured objectives, generated and evaluated alternatives. In addition, a brief development study report was submitted to the client organisation in order to facilitate reviewing the systematic steps followed and helping adopt the proper brief development decision.

Selecting the Best Alternative

Alternative “C” was selected as the best alternatives with net expected value of 28.16.

Implementing the Selected Alternative

Alternative “C” was tendered and executed for the cost of DHS 72500. The cost of the work was deducted from the constructor account in the DSSCB. The cost of showroom re-design was paid by the client.

Monitoring and Feeding Back

Based on the above step the following recommendations and feedback were concluded:

(1) Care should be paid by design firms when designing curtain walls. Calculations and catalogues for length of side arms and its manufacturing materials should be followed.

(2) Reduce the use of marble tiles as external finishing because its expensive cost and the possibility of falling and instead designers could specify cheap and durable materials.

(3) Market research and market demand should be investigated before design in order to avoid any problem of leaving showrooms not rented for years.

8.4 Reliability and Validity of the Brief Development Manager

The Brief Development Manager (BDManager) prototype software could not be considered as a successful tool to manage dynamic brief development in construction that could be count on, unless it is reliable and valid. According to the definitions of reliability and validity as mentioned in chapter 2, a reliable prototype software is the one which gives consistent results if applied by different researchers more than once to the same peoples under standard conditions, where a valid prototype software is the one which measures what it is intended to measure (Hall and Hall, 1996).

In order to check the reliability of the Brief Development Manager, the systematic steps of the VRMP, which were used to build the BDManager prototype software, were applied to a real case study. Then the same case study was examined with the same team members under the same conditions using the Brief Development Manager prototype software. Results of the two studies are consistent, but the second one was done faster because of the use of computer applications. In addition, the prototype software was then applied on a number of real case studies to check its ability to deal with different problems. Results are encouraging which ensures the reliability of the brief development manager as an effective decision making tool to manage dynamic brief development in construction.

Findings of the case studies showed the validity of the Brief Development Manager. This was clearly shown in the ability of the BDManager in achieving its objectives and features as well as measuring what it is intended to measure.

- The Brief Development Manager was intended to enable the client organisation and construction professionals adopt the proper decision to mange brief development and the results of the case studies showed that the prototype software achieved that objective efficiently.
- The Brief Development Manager aimed to facilitate constructing general project information database. This was accomplished through the use of “General Project Information” data entry screen where the project data was stored and updated in Microsoft Access files.
- The Brief Development Manager was intended to facilitate the precise identification of brief development problem, structuring objectives, scrutinising alternatives, and adopting development decisions. This was achieved through using the “Value and Risk Management Protocol - Data Entry” screen.
- The Brief Development Manager aimed to facilitate entering, organising, retrieving, sharing and updating information, as well as facilitating calculations. Application of the protocol showed that this was achieved through the use of different user-friendly screens and using various data entry methods such as typing data in pre-defined boxes, selecting from pre-designed pull down menus, and inserting Microsoft Word and Microsoft Excel

linked files. In addition, it has the advantage of being linked to other computer based activities and software.

- The Brief Development Manager was designed to allow more than one user apply the prototype simultaneously. This was achieved by providing another user number and password of (abc) and (def) respectively. More users numbers and password could be added to meet organisations requirements.
- The Brief Development Manager facilitated the communication between different parties through exchanging information and files through electronic mail.
- The Brief Development Manager was designed to facilitate the inquiry of information based on different search categories such as development drivers and this was achieved through the use of "Inquiry Centre" screens.
- Finally, the Brief Development Manager was designed to enable the user view and get printed reports of general project information using different categories such as drivers, stage, or initiator, for instance. This was achieved by using the "Reports Centre" screens.

In an endeavor to complete the picture of reliability and validity of the brief development manager, it was essential to ensure the reliability and validity of the methods and findings of the prototype.

8.4.1 Increasing the Reliability and Validity of the Methods used to Develop the BDManager

In order to increase the validity and reliability of the Brief Development Manager, certain courses of action were adopted to escalate the reliability and validity of the methods used to develop the Brief Development Manager, these were:

(1) Providing an explicit explanation of the prototype objectives and features.

(2) Explaining the different steps followed in designing the prototype.

(3) Explaining the reasoning behind key decisions made (Denscombe, 1998) such as the selection of the Microsoft Access as a prototyping package as mentioned in chapter 7.

(4) Standardising the process of recording data (Kirk and Miller, 1986) such as the designed data entry screens.

(5) Illustrating the system architecture for the Brief Development Manager and explaining how its components are connected.

(6) Increasing the reliability and validity of survey questionnaire used to evaluate the Brief Development Manager by:

- Ensuring that the designed questionnaire fully represent the underlying concepts of Brief Development Manager. This was called content validity (Baker, 1994).
- Consulting a number of specialists to assess the extent to which the questions relate to the subject being investigated (Nachmias and Nachmias, 1996).
- Using as much as possible of fixed choice answers.
- Using representative and non-biased sample.
- Making sure that each respondent understood the questions in the same way as other respondents and their answers were coded correctly (Silverman, 2001). This was ensured by attending the author to all the brief development sessions.
- Encouraging respondents to answer the questions honestly and competently (Adams and Schvaneveldt (1991).
- Comments of the evaluators were considered and the design of the prototype was enhanced.

8.4.2 Escalating the Reliability and Validity of the Findings of the BDManager

According to Burns (2000) and Denscombe (1998) the following ways were used to escalate the reliability and validity of Brief Development Manager findings:

(1) The study results were reviewed and showed its consistency with the objectives of the Brief Development Manager.

(2) Comments and feed back of the questionnaire respondents were studied and reflected in the design of the prototype.

(3) The evaluation findings were fed back to informants in order to get their opinion on the explanation being proposed.

(4) The findings of the prototype were examined to ensure their fitness with the existing knowledge, and the group of people that the findings be generalised was defined.

8.5 Results of the Evaluation Questionnaire

During the brief development study sessions, 18 evaluation questionnaires were distributed to the participants in three sessions. Respondents were asked to rate each question on a scale of 5, where 1 =poor and 5=excellent. The results of the questionnaire showed that:

(1) 85% of the respondents mentioned that the Brief Development Manger was rated 4 out of 5 in most areas such as facilitating identification of the brief development problem, structuring objectives, generating alternative solutions and adopting development decision. 80 % of the respondents pointed out that the different ways used for data entry was rated 4.25 out of 5.

They referred that using pull down menu and linked Microsoft word facilitated entering, selecting, editing and updating data.

(2) 75% of the respondents responded that the Brief Development Manager was rated 5 in facilitating adequate definition of objectives. In addition, they pointed that, with rate of 4.25 out of 5, using Microsoft Word and Microsoft Excel linked files facilitated defining and updating objectives, building objectives value hierarchy, defining associated risks, allocating and expediting calculating importance weights as well as

(3) 80% of the respondents stated that the developed prototype helped scrutinising alternative solutions with rate of 5. All respondents with rate of 4.25 out of 5, respondents pointed out that using linked files enabled the study team to enter, edit and update generated and evaluated alternatives as well as reconcile value and risk. In addition, using Microsoft Excel linked files played an important role in expediting calculations, creating decision matrix, assessing associated risks, comparing alternatives, and performing sensitivity analysis.

(4) 70% of the evaluators mentioned that the Brief Development Manager facilitated adopting development decision with rate of 4.15 out of 5. They agreed that the use of attached Microsoft Office Word files facilitated documenting, updating, and presenting alternatives, selecting the best alternatives, implementing the selected alternatives, and monitoring and feeding back.

(5) All evaluators concluded that the Brief Development Manager played an important role in managing, organising, storing, retrieving, sharing and updating brief development data with average rate of 5. In addition, with rate of 4.5 out of 5 they referred that the prototype saved time and effort and it was easy for the users to interact with different prototype screens. Furthermore, the prototype facilitated communication, teamwork between project team members as well as presenting stakeholders perspectives with average of 3.85 out of 5.

(6) The general comments of the evaluators could be summarised as:

All the evaluators were generally satisfied with the effectiveness of the Brief Development Manager in managing dynamic brief development in construction, its systematic decision process, team work, managing information and using IT capabilities to facilitate the application of the Value and Risk Management Protocol. Evaluators were delighted with applying the prototype in real case studies at different stages of the projects life cycle.

Other comments and suggestions for improvement could be summarised as:

- Providing users of the prototype software with user number and password to protect the brief development database. This was reflected in the design of the prototype by providing two levels of security. The first level allowed all the members of the brief development study session use the software as "Data Viewer" after providing a correct password without the permission to modify stored data. At the second level, permitted users with "User Number" and "Password" are allowed only to enter new brief development data, edit and update existing data.
- Encapsulate the Brief Development Manager in an online application. This recommendation was out of the scope of this research. Implementing the prototype in an online application requires resources such as financial support and software development team that are beyond the scope of this research.
- It needs some time for the organisation to get its team trained on how to professionally use the prototype software. This was facilitated by explaining how to use the prototype software in detail as explained in chapter 7.
- Evaluators suggested to use "Bar Chart" to facilitate the comparison between different alternatives scores. This suggestion was added to Microsoft Files beside Decision matrix, assessing associated risks, comparing alternatives, and sensitivity analysis.
- Evaluators recommended that top management should be persuaded with the prototype advantages and its benefits for managing brief development in order to facilitate its adoption and application.

(6) All evaluators recommended the Brief Development Manager as an effective IT tool for managing dynamic brief development in construction.

8.6 Conclusions

Evaluating the Brief Development Manager prototype software was an integral part of the prototype development. Three questions were addressed to evaluate the prototype: (1) what to evaluate, (2) how to evaluate, and (3) when to evaluate. What to evaluate question was intended to investigate how well did the Brief Development Manager facilitate managing brief development. It included assessing how well the Brief Development Manager facilitated identifying problem, structuring objectives, scrutinising alternative solutions, and adopting the proper development decision. In addition, it intended to assess the features of the Brief Development Manager as well as collect end users' comments, feedback and suggestions for improving the produced prototype. How to evaluate was concerned with the method used for evaluation. During the course of this research, participants of the brief development study sessions were asked to respond to an evaluation questionnaire where their feedback and suggestions was obtained. The last question was about when to evaluate. This was done on regular basis until a satisfactory version was produced. This version was applied to a number of case studies where participants were asked at the end of each session to fill a questionnaire designed to evaluate the produced prototype.

The Brief Development Manager was applied on 3 real case studies. The first case was about changing the design of the project from a commercial building to office building in order to get better value for money and get better use of the project location. The client in the second case aimed at attracting new tenets to rent the villa and recover the loss of leaving the building unoccupied for approximately one year and get benefits from the villa location and size. The last case was about increasing the demand of the building and attracting tenets to stay in the building as well as renting the ground floor showroom, which was not occupied for more than four years. In addition, the client aimed to solve the problems of the building and to be free from any legal responsibilities of falling the windows or marble tiles on private properties or pedestrians. Adopting the proper decision was selected after carrying out adequate studies by following up the Brief Development Manager systematic steps.

The last part of this chapter discussed how the reliability and validity of the Brief Development Manager was escalated. Two disciplined were investigated: reliability and validity of the methods used to develop the protocol and reliability and validity of the protocol findings. In addition, results of the evaluation questionnaire were summarised and recommendations for improvements were studied and appropriate ones were implemented.

Chapter 9 will conclude the work done throughout this research, and present the conclusions and contribution to original knowledge as well as recommendations for the industry and further research were highlighted.

Chapter 9

Conclusions and Recommendations

9.1 Introduction

This chapter summarises the research work undertaken to develop an innovative protocol integrating value and risk management to manage dynamic brief development in construction and produce a software tool to facilitate its use. It presents the conclusions and contribution to original knowledge including the research publications and proposed work to be published. In addition, the research recommendations for the industry and further research were highlighted.

9.2 Conclusions and Contribution to Original Knowledge

Holt (1998) and O'connor (1995) mentioned that conclusions should signal in a clear, unambiguous and succinct format the logical outcome of the research work and highlight the research significance. In addition, Merriam-Webster Dictionary (2000) defined contribution as giving or supplying in common with others, supplying an article for a publication or playing a significant part in bringing about an end or result. The relationship between conclusions and contribution to original knowledge is obviously strong since the outcome of a good research work builds on prior research and contributes to a large body of knowledge (Neuman, 1994; Nachmias and Nachmias, 1996).

Achieving client satisfaction was identified as a key factor to measure construction projects' success and one of the most important challenges facing today's construction industry. This perspective stemmed from the important role played by clients' organisations as the core of the construction process and the driving force for improvement, accordingly, necessitated the importance to achieve their satisfaction and get their requirements attained. Because of its vital role in eliciting and communicating client's requirements to the design and construction teams, the briefing process represents a cornerstone for achieving client satisfaction. During the course of this research, formal observations, literature review, analysis of 36 case studies, documentary data and unstructured interviews with projects' architects undertaken by the author showed that very few buildings finished on time or at the right cost and clients often blame the construction industry of providing products that do not achieve their requirements and meet their expectations. Furthermore, it was articulated that clients' organisations used change orders to achieve their emerging requirements and adapt to the influence of the internal and external brief development drivers. These deficiencies were attributed to the limitations of the current briefing theories, which confine the development of the project brief to a certain stage. This approach obstructs the communication between the client and the designer and impedes exploiting value opportunities and managing risk threats associated with brief development drivers.

The rationale and motivation for this research emerged from the importance to improve the efficiency of the construction industry through improving the briefing process and overcoming its limitations. The research obtains its significance from the importance to achieve client satisfaction, the need to utilize value opportunities and manage risk threats associated with brief development drivers, the desire to manage project change orders effectively, and the necessity to improve the briefing process. The aim of this research was to develop an innovative protocol integrating value and risk management to manage dynamic brief development in construction and produce a software tool to facilitate its use. This aim was achieved through the accomplishment of the following objectives.

(1) Building a clear understanding of client satisfaction, the briefing process and managing change orders in construction.
(2) Identifying, validating, quantifying, and classifying brief development drivers.
(3) Investigating the perception of the dynamic brief development concept, the existing approaches to manage brief development and identifying their limitations.
(4) Investigating the originators of brief development, the value sources and risk sources to the project from the client's point of view.
(5) Reviewing the value and risk management methodologies, the existing approaches for their combination and identifying their limitations.
(6) Developing the Value and Risk Management Protocol (VRMP).
(7) Producing the prototype software of Brief Development Manager (BDManager).
(8) Evaluating the Brief Development Manager.

A well-established research methodology was designed to achieve these objectives in an ongoing process consisted of four activities of (1) data collection, (2) data analysis, (3) action required, and (4) reliability and validity. Choosing the research methodology was primarily evolved from two factors: (1) the specific research aim and objectives and how they could be achieved, and (2) the research nature and characteristics. Different methods were used for data collection. They were observation, literature review, survey questionnaire, interview, case study and documentary data. Collected data was analysed quantitatively and qualitatively. For the quantitative analysis approach, measuring the central tendency and dispersion, relative importance index ranking technique, and the linear relationship between drivers using Bivariate analysis were used. For the qualitative approach, the process of preparing and analysing qualitative data was established. Different actions required were taken during this research to achieve its aim and objectives where reliability and validity concepts were built in the heart of the research methodology to ensure that the methods used and the research findings gained were reliable and valid. The adopted methodology accomplished successfully the research objectives and hence achieved the research aim. The conclusions drawn from this research and contribution to original knowledge are summarised under the following headings:

9.2.1 The Dynamic Brief Development Concept

The current theories relating to brief development in construction were reviewed and their limitations were identified. These theories confined the development of the project brief to a certain stage, which in turn hindered the interaction between the client and the designer since clients' ideas develop and mature as the design alternatives unfold. In addition, they inhibited the utilisation of value opportunities and management of risks associated with the brief development drivers. This led to clients' dissatisfaction, as their expectations and emerging requirements were not met as well as the potential opportunities to enhance the project performance were not exploited.

The research contribution to address this problem was through the introduction of the Dynamic Brief Development concept. The significance of the concept evolved from the failure of the current briefing ideas to achieve client satisfaction, coupled with the need to respond to the influence of the brief development drivers, and the desire to manage project change orders effectively, as well as the importance to improve the briefing process. This concept encouraged developing the project brief throughout the project life cycle in order to achieve emerging clients’ requirements, meet user needs, cope with regulation changes, exploit business opportunities, adapt to technology improvement, add more value and manage associated risks. This concept has four underlying principles: First, the briefing process has to be deemed as an ongoing process extending throughout the project life cycle. Second, the project brief has to be considered as a live document continuously developing and adapting in an innovative manner to the influential brief development drivers for the benefit of the project. Third, feeding back the client organisation and the design and construction teams with learned lessons and comments of the facilities management team and end users will enhance the performance of the briefing process in future projects. Finally, a system to manage the brief development drivers has to be set out as early as possible. Five milestones were identified to evaluate brief development throughout the project life cycle. These milestones are at: (1) the end of the feasibility stage, (2) the end of the detailed proposals stage, (3) the end of the tender action stage, (4) the end of the construction to practical completion stage, and (5) the practical completion stage.

9.2.2 The Brief Development Drivers

Supporting the Dynamic Brief Development concept and ensuring its successful implementation, as an approach to overcome the limitations of the current briefing process, necessitated the importance of establishing a firm understanding of the drivers that lead to brief development. This was achieved by identifying, quantifying and classifying the brief development drivers. Firstly, literature review identified a group of the brief development drivers. In order to complete the picture of these drivers and validate the identified ones, 36 case studies of recently completed construction projects were collected and analysed. The work of this research confirmed the identified drivers and added new ones. The new drivers were not covered by current literature review and reflected the culture and values of the surveyed society. Literature review and case studies resulted in the identification of 47 brief development drivers. These drivers were reviewed and refined on a regular basis to omit repeated drivers and merge similar ones to produces 30 drivers. Analysis of case studies showed that most brief development happened at the construction stage. This could be attributed to the industry’s fragmented nature, long investment term, risk exposure, time consumption, and myriad other internal and external influences. In addition, quantitative and qualitative analysis of survey questionnaire used to quantify the brief development drivers showed that these drivers had different influences on developing the project brief, different relative importance indices and different correlations between each others. Furthermore, the research developed a holistic approach to classify the brief development drivers to internal, external, and internal and external drivers based on considering the project as an entity that, effects and get affected by its internal and surrounding factors.

9.2.3 The Brief Development Originators, Value Sources and Risk Sources form the Client's Point of View

The increasing awareness to achieve client satisfaction as the core of the construction industry necessitated the importance to undertake a group interview with clients’ organisations that responded to the survey questionnaire and showed the desire to participate in a brainstorming session aimed to identify the originators, value and risk sources to the project brief from the client’s point of view. The interview resulted in constructing the relationship between the brief development drivers and the project team members in a matrix format. Analysis of the matrix and feedback from the discussion showed that clients' organisations were the key originators of brief development as they change their requirements and have second thoughts at later stages, respond to market demand and provide new information which was not available during the design stage. Clients viewed design firms as originators of brief development and risk sources because they produce uncoordinated and incorrect construction documents, specify building materials or technologies, which, were not produced anymore and ignore the role of the client and behave unilaterally. Furthermore, some parties were deemed as value and risk sources simultaneously such as material suppliers who advice project team members to eliminate proven poor quality materials and equipment as they are closer to manufacturers than clients and designers. This value is associated with the risk of finding suitable materials or equipment that commensurate with the project budget, time of delivery and matches with project design. Finally, analysis of the matrix showed that there was no relationship between project team members and the brief development driver of initiating value engineering changes, this is because value engineering and value management techniques were not used in managing brief development in the surveyed society. This result was emphasised by the interview responses.

9.2.4 Managing Change Orders for the Benefit of the Project

Literature review showed that the existing approaches considered change orders as a major cause of project delay and cost overrun as well as a source of many disputes in today's construction industry and they have to be avoided and their impacts have to be minimised. Analysis of the different approaches developed to manage changes and change orders as well as analysis of the interview showed that these approaches focused on describing the change process and the best practice for its management throughout the project life cycle. In addition, they focused on representing design information, recording design rationale, facilitating design co-ordination and changes and notifying users of file changes. These approaches dealt with the change order after it happened and few approaches adopted the perspective that change orders may have positive impacts and could enhance the project performance. None of these models adopted the integrated approach of value management and risk management presented by this research to manage change orders in construction. Moreover, none of these approaches adopted the management of change orders after the practical completion stage and the post occupancy stage as well as the capabilities of information management and information technology was not fully exploited. Although, the current perceptions of change orders, the research sustained and supported the idea that change orders are useful to the project and their positive impacts should be utilised. Managing change orders for the benefit of the project could be achieved by applying the dynamic brief development concept where the different impacts of brief development drivers could be studied on the basis of value and risk and the proper decision is reflected on the project design. So, change orders could be managed effectively as early as possible.

This necessitates the role played by design firms in advising their clients even if the proper decision is to reject the client requirements and brief development.

9.2.5 Integrating Value and Risk Management in Construction

Permitting brief development without establishing the basis that control and manage brief development leaves the project brief uncontrolled and jeopardise the achievement of client satisfaction. Since brief development either add value or risk to the project or could add both, the two well-established methodologies of Value Management (VM) and Risk Management (RM) represent the most appropriate techniques to manage dynamic brief development in construction. The links between them are strong since best value could not be achieved unless associated risks have been managed. Although little progress in developing an integrated approach of VM and RM was articulated, many approaches were presented. Analysis of these approaches showed the importance of combining the two techniques and that RM could be enhanced by maximising the use of the VM workshop and its team to audit, produce a project's RM plan and generate creative alternatives to mitigate recognised risks. In addition, the benefits of using VM and RM attracted many clients to apply the two concepts in their projects. Randall (1996) stated that the suggested combined approach is still developing and the results of the pilot studies carried out may be inconclusive. In particular the question about evaluating VM under uncertainty and therefore conducting risk identification before or after value brainstorming remains to be answered. Kelly and Bowles (1998) emphasized the use of qualitative risk assessment and their suggested approach selected topics for risk brainstorming during the information phase and identifying risk associated with function is carried out during the creativity phase. Green (1996b) suggested replacing the language of "uncertainty" instead of the language of "Value" and "Risk". This approach was criticized because of the introduction of another term, namely, uncertainty management, which may exacerbate the existing confusion concerning terminology. Other approaches have benefits such as Kirk (1995), Starling (1995) and Mootanah (1998) which emphasised the integration of VM and RM. Kirk's approach was concluded to be successful in practice, where Starling used uncertainty analysis at later stages after the value engineering proposals were developed. Finally, Mootanah's approach extends the use of VM and RM to the completion and post completion phase. Based on the above review the research supported and adopted the combination between VM and RM as an integrative management tool and moved from the theoretical discussion to develop an innovative protocol integrating VM and RM to manage dynamic brief development in construction.

9.2.6 Developing the Value and Risk Management Protocol

The Value and Risk Management Protocol (VRMP) is a decision making tool developed to manage and control brief development throughout the project life cycle. It aimed to achieve client satisfaction through adopting the proper brief development decision on the basis of value addition and risk management. In addition, it aimed to respond to the different influences of the brief development drivers, manage project change orders effectively, and improve the performance of the briefing process through feedback and learned lessons. The protocol consists of four steps: identifying problem, structuring objectives, scrutinising alternative solutions, and adopting development decision. The well-established Simple Multi-Attribute Rating Technique (SMART) was used to formulate the proposed Protocol. The key principles behind the VRMP were: whole project view, dynamism and flexibility, stakeholders' involvement, co-ordination and communication, feedback, rational, and creativity. The VRMP overcame the pitfalls and limitations of the different approaches mentioned above. This was achieved by developing an innovative protocol integrating value and risk management supported by information management and information technology, responding to the questions raised by previous approaches and applying numerical value and risk assessment as well as avoiding the use of new language which may create confusion. Application of the protocol on a real case study to investigate its effectiveness in managing dynamic brief development showed that it is time consuming tool and there is a large amount of data used needs to be managed.

9.2.7 Producing the Brief Development Manager Prototype Software

The Brief Development Manager (BDManager) prototype software is the translation of the Value and Risk Management Protocol to an easy and user-friendly prototype software. It aimed to overcome the limitations of the VRMP and facilitate its application in a computer base environment. The prototype consists of four main sections: general project information, value and risk management protocol, inquiry centre, and reports centre. It has many features such as allowing all users to view the stored data, while permitted users only are allowed to modify the database contents. In addition, it enabled building a live project database and facilitated entering, archiving, classifying, sharing, storing, updating and retrieving brief development information as well as inquiring, viewing, and printing reports. In addition, because it was designed by Microsoft Access it is compatible with other Microsoft software packages such as Ms-Word, Ms-Excel, Ms-PowerPoint, so it is easy to link the developed software to other programmes for the different project uses. The prototype was applied on real case studies and it was evaluated by its users. Users’ comments and feedback are encouraging and they recommended the use of the prototype as innovative IT tool for managing dynamic brief development in construction.

9.2.8 Research Publications

The research resulted in publishing 8 academic refereed papers. Details of these papers are as follows. Copies of these papers are attached in appendix (I).

<u>Publications in Refereed Journals</u>

Othman, A.A.E., Hassan, T. M., and Pasquire, C.L. (2004). Drivers for Dynamic Brief Development in Construction. *Engineering, Construction and Architectural Management,* Vol.11, No.4, pp.248-258.

Othman, A.A.E., Hassan, T. M., and Pasquire, C.L. (2005a). Analysis of Factors that Drive Brief Development in Construction. *Engineering, Construction and Architectural Management,* Vol.12, No.1, pp.69-87.

Othman, A.A.E. (2005). Value and Risk Management Protocol for Dynamic Brief Development in Construction. Emirates Journal for Engineering Research, Vol.10, No.2, pp.23-36.

Othman, A.A.E., Hassan, T. M., and Pasquire, C.L. (2006). The Brief Development Manager: As an IT Tool for Managing Dynamic Brief Development in Construction. *International Journal of Construction Management*, Vol. 6 No. 2, pp.31-47.

<u>Publications in Refereed Conferences</u>

Othman, A.A.E. (2004). Identification, Quantification and Classification of Construction Brief Development Drivers. In: Chan, A. PC. and Chan, D.W.M. (eds.) *Proceedings of the CII-HK Conference 2004 on Construction Partnering: Our Partnering Journey-Where Are We Now, and Where Are We Heading?,* Hong Kong, 9th December 2004, pp.163-175.

Othman, A.A.E. (2004). Value and Risk Management for Dynamic Brief Development in Construction. In: Chan, A. PC. and Chan, D.W.M. (eds.) *Proceedings of the CII-HK Conference 2004 on Construction Partnering: Our Partnering Journey-Where Are We Now, and Where Are We Heading?,* Hong Kong, 9th December 2004, pp.176-188.

Othman, A.A.E., Hassan, T. M., and Pasquire, C.L. (2005b). Brief Development Originators, Value and Risk Sources to the Project from the Client's Perspective. In: Ruddock, L. et. al (eds.) *Proceedings of the 5th International Postgraduate Research Conference*, University of Salford, Manchester, UK, 14th – 15th April, 2005, Vol. 1, pp.44-54, ISBN 0-902896-72-5.

Othman, A.A.E., Hassan, T. M., and Pasquire, C.L. (2005c). Dynamic Brief Development for Better Construction Briefing. In: Ruddock, L. et. al (eds.) *Proceedings of the 5th International Postgraduate Research Conference,* University of Salford, Manchester, UK, 14th – 15th April, 2005, Vol. 1, pp.55-65, ISBN 0-902896-72-5.

9.3 Research Recommendations

Collins English dictionary (1993) defined recommendation as something that advised, praised or commended. Recommendations could be the facts identified, ideas explored, or new concepts developed based on academic endeavor that need to be advised, praised or commended to others. Alternatively, recommendations could be the particular areas of the subject studied which, were identified by the research work that yearns for further work. The first type of recommendations was directed to the industry for application and improvement, where the second type was recommended for further research.

9.3.1 Recommendations for the Industry

This research resulted in many important outputs. Some of these outputs are recommended for the construction industry to improve its performance in general and manage dynamic brief development in particular. These recommendations are:

9.3.1.1 Adopting the Dynamic Brief Development Concept

Adopting the Dynamic Brief Development concept will result in achieving client satisfaction, adapting to the influence of the brief development drivers, managing project change orders effectively, and improving the briefing process. This will be achieved through the application of the underlying principles of the concept. Because of its obvious benefits, the Dynamic Brief Development concept has to be a strategic choice of the firms acting in the construction industry and wish to compete for the future. In addition, this concept has to be built in the organisation culture and management procedures.

9.3.1.2 Focusing on Achieving Client Satisfaction

The construction industry in general is encouraged to achieve its client satisfaction through providing products that achieve their requirements and meet their expectations. In particular, it is recommended that the firms working in the United Arab Emirates (UAE) construction industry or the overseas ones that wish to compete or embark work in the UAE have to consider the new brief development drivers that reflected the culture and values of the surveyed society as well as originators of brief development, value and risk sources identified from the clients' point of view. So, project design and specification will reflect the society culture and match its values. This will result in achieving client satisfaction, meeting user need, and managing expected brief development.

9.3.1.3 Using the Value and Risk Management Protocol

The value and risk management protocol is an innovative tool developed by this research and it is recommended to be used by the construction industry in order to enable client organisations and construction professionals adopt the proper brief development decision. It was built on the systematic steps of decision making to allow adopt rationale decisions. It is assumed that the Value and Risk Management Protocol will change the way used to manage brief development. It is advised that this protocol be used at the different stages of the construction process.

9.3.1.4 Applying the Brief Development Manager Prototype Software

The Brief Development Manager is the prototype software tool designed to overcome the limitations and facilitate the use of the value and risk management protocol. Its flexible design allows that each organisation adapt it to suit its particular needs. The construction industry is encouraged to apply the developed prototype software and implement it in a comprehensive online format in order to enable the use of the software from remote places and keep the project team connected with the project database. The use of the protocol on a wide range of live projects in different places is essential to ensure its applicability to different project types.

9.3.2 Recommendations for Further Research

During the course of this research, some areas were identified and recommended for further research.

9.3.2.1 Implications of the Dynamic Brief Development Concept

The research focused on achieving client satisfaction through the provision of products that meet or exceed client expectations at the most cost-effective manner. Particular investigation is required to identify the benefits that design firms, construction companies and other organisations engaged in the construction process will gain from adopting the proposed concept and how this could be achieved. In addition, the implications of the dynamic brief development concept on the current procurement system call for further research.

9.3.2.2 Maximising the Use of the Value and Risk Management Protocol

The proposed protocol presented in this research was designed to enable clients' organisations and construction professionals adopt the proper brief development decision. Other objectives were achieved such as responding to brief development drivers, managing change orders effectively, and improving the briefing process. Confining the use of the protocol to these areas will hinder the utilisation of its benefits as innovative decision-making tool. Further use of the protocol in new areas that could profit from it needs to be identified.

9.3.2.3 Using Other Management Disciplines to Enhance the Project Performance

The research combined value and risk management to form a powerful management tool that is capable to enhance the project performance. Investigating the role of other management disciplines and the possibility of their combination, such as conflict management, development management, production management, facilities management, and resources management in enhancing the project performance for the benefit of the client is required.

9.3.2.4 Identifying New Brief Development Drivers from Different Societies

The research identified the drivers that affect the project brief in general and with particular focus on the UAE construction industry. This resulted in identifying new drivers, which, were not covered by current literature review and highlighted the culture and values of the surveyed society. In addition, recommendations for the companies working in the UAE and the companies that wish to embark work there were directed. Further research is recommended to be carried out in different societies to identify new drivers reflecting their culture and values, so the proper advises could be presented and enrich the dynamic brief development process.

9.4 Closing Comments

The effective management of brief development throughout the project life cycle is a key factor of achieving clients satisfaction, meeting user needs, coping with regulation changes, exploiting business opportunities, adapting to technology improvement, adding more value and managing associated risks. Limitations of the current briefing theories relating to brief development and the existing approaches to manage change orders as well as integrate value and risk management do not adequately address the problem of managing brief development for the benefit of the project. Since any brief development either add value or risk to the project or add both, the research documented in this thesis has developed an innovative protocol integrating value and risk management to manage dynamic brief development in construction. The use of this unique tool resulted in achieving client satisfaction, responding to the influences of the brief development drivers, managing change orders effectively, and improving the briefing process. Moreover, a powerful prototype software called the Brief Development Manager was produced to overcome the limitations of the VRMP and facilitate its implementation. This prototype was applied to real case studies to ensure its reliability and validity. End user evaluated the prototype and recommended its use as an innovative IT tool for managing dynamic brief development in construction.

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List of Appendices

A.1 Introduction

As an integral part of this research, it was important to describe the research locality and environment. Although studying dynamic brief development in construction can be investigated in any part of the world, it was decided that the Arabian gulf generally, and the United Arab Emirates (UAE) in particular, would be a suitable location for the following reasons.

(1) Since its establishment in the early 1970's the United Arab Emirates federal government has sustained high level of construction activities through spending on infrastructure and development projects such as roads, bridges, universities, hospitals, schools, commercial buildings and private housing projects for example. This necessitated the setting up of large number of national and muli-national construction organisations to execute these projects. These organisations played an important role in transforming the United Arab Emirates from desert life to a civilised and modern country. The research aimed to exploit the distinct experience of these organisations and targeted to participate them in the research.

(2) The status of the United Arab Emirates as a developing country with rapid economic and social development resulted in diverse client organisations with different construction knowledge, different requirements, and varying perception between the foreign design and construction companies and local culture and habits. In addition, it resulted in importing new technology and construction materials to cover the needs of construction projects. The above drivers and others derived continuous development of the project brief. This was obvious in the case studies used to extract brief development drivers. Such location represents an ideal environment where the study of dynamic brief development in construction could be carried out.

(3) The United Arab Emirates is the place where the researcher worked for more than 12 years and still, so he experienced the nature of its construction industry and the culture and traditions of its citizens. In addition, it was possible to collect required information for the study and carry out the research work on an area of the world, which does not receive enough attention in academic studies.

A.2 The United Arab Emirates in Brief

The UAE is a federation of seven emirates, namely Abu Dhabi, Dubai, Sharjah, Ajman, Umm Al Quwain, Fujairah and Ras Al Khaimah. All these areas were under the British Protection since 1820 and were known the Trucial States. They joined together to form the United Arab Emirates, which came into existence in 1971 and is a member in the Gulf Co-operation Council (GCC). The ruler of the seven emirates established the Supreme Council and Federal Government.

Abu Dhabi is the federal capital being the largest, most populous and richest in oil. Dubai although rich in oil is more known as a business and commercial centre. The languages spoken in the UAE are Arabic, English and others. The official currency is Dirham (DHS), where 6 DHS estimated to = £ 1. The religions in the UAE are Islam and others. The time in the UAE is four hours ahead of GMT. The total area of the UAE is 83.600 square kilometres. The Emirate of Abu Dhabi is 67.000 square kilometres of the total.

Figure A.1 The Geographic Location of the United Arab Emirates

The UAE is situated in the south-east of the Arabian peninsula, north of the equator, between latitudes 22 degrees and 26.30 degrees to the North, and longitudes 51 degrees and 56.30 degrees East of Greenwich mean time (GMT). It extends from the Sultanate of Oman in the east to Qatar in the west, and Saudi Arabia in the south.

It lies along the southern coast of the Arab Gulf stretching for 700 kilometres. Its eastern coastline stretches for 90 kilometres along the Gulf of Oman, see figures (A.1) and (A.2).

A.2.1 Climate

The UAE is one of the best world winter resorts. Between November and March, it experiences warm sunny days with an average temperature of 26°C and cool nights with an average temperature of 15°C. High temperatures (up to 49°C) and high level of humidity are the normal between June and August.

A.2.2 Population

The population of the UAE was estimated to be 2.410.000 million in 2001. 85% of the UAE populations are urban. The population of the United Arab Emirates is concentrated primarily in cities along both coasts, although the interior oasis settlement of Al-Ain has grown into a major population centre as well. Less than one-fifth of the emirates' residents are citizens. The remainder are mostly male foreign workers and their dependents, with South Asians, mainly Indians and Pakistanis, constituting nearly half of the population. Arabs from countries other than the United Arab Emirates, notably Egypt, account for more than one-tenth and Iranians nearly one-fifth of the population. Southeast Asians, including many Filipinos, have immigrated in increasing numbers to work in various capacities.

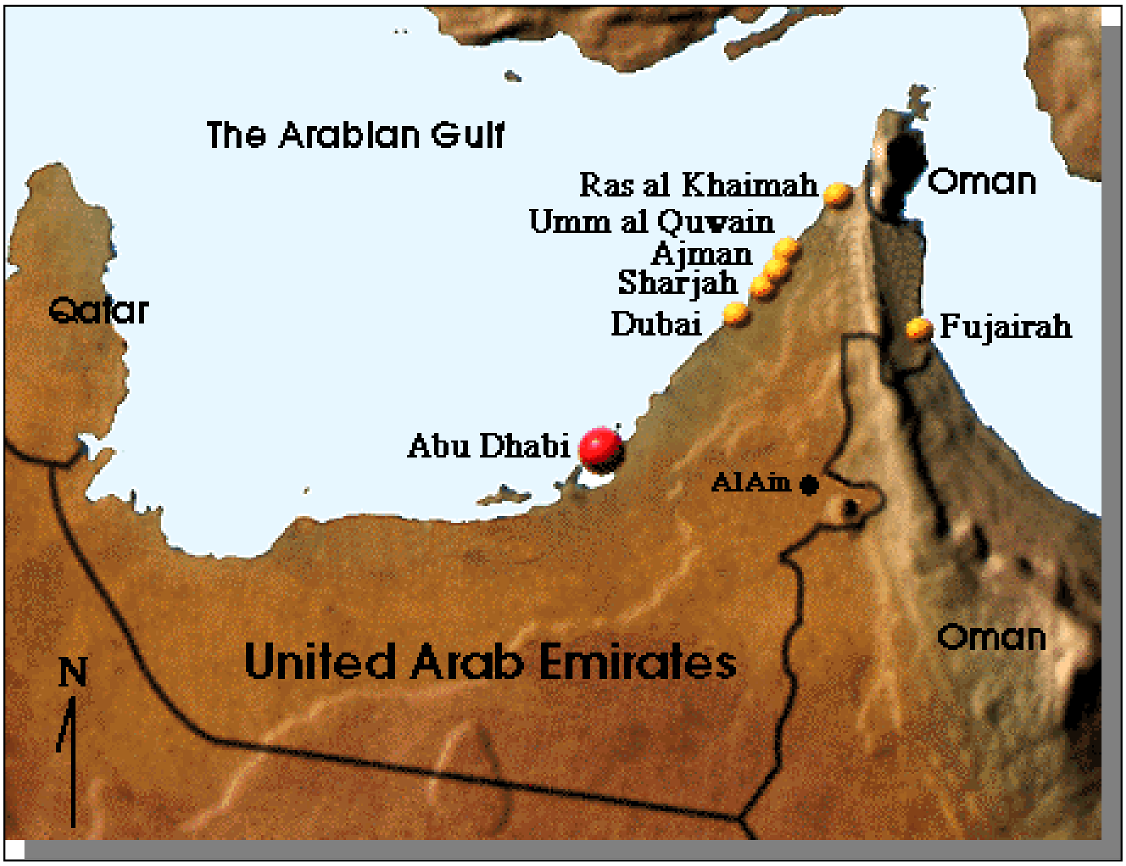


Figure A.2 The Map of the United Arab Emirates

A.2.3 Culture

The cultural traditions of the United Arab Emirates are rooted in Islam and identify with the wider Arab world, but strong cultural ties are maintained with the neighbouring Arabian Gulf states. Tribal identities remain fairly strong, despite urbanization, and the family is still considered the strongest and most cohesive social unit. The United Arab Emirates has experienced the impact of Islamic resurgence. Horseracing, camel racing, boat racing and falconry are popular and traditional sports. Change is apparent in the nation's cultural life. Changes in attitudes toward marriage, education and employment of women are discernible. New forms of entertainment have affected taste and behaviour (Freegk, 2003).

A.2.4 Progress in the UAE

Since the discovery of oil in Abu Dhabi in 1960, and especially during the last two decades, the UAE witnessed remarkable growth in its economy and social pattern. The proven oil reserves doubled over the last three decades, growing from 30 million barrels in the 1970s to 1998 million barrels in 2002, making the UAE the third largest country in oil reserves in the world. The gas reserves also rose from 626 cubic meters in the 1970s to 6 trillion cubic meters, making the UAE the second in the Arab world and the fourth worldwide. The value of oil sectors' share of the GDP grew from DHS 4.1 billion in 1972 to DHS 85 billion in 2003.

Non-oil sectors also played a remarkable role in country's economic development with its contribution to the GDP rising from DHS 2.3 billion in 1972 to DHS 199.2 billion in 2002. Banks with a total budget of DHS 333.24 billion made a great contribution to the country's economic development. There are 21 national banks operating in the UAE with 345 branches and 36 foreign banks with 86 branches. The share of productive sectors such as agriculture, industry, construction and electricity and water contributed DHS 140 billion to the GDP in 2002 compared to DHS 5 billion in 1972, growing at the rate of 11.7 per cent.

The services sector also witnessed a tremendous development with a GDP of DHS 85 billion against DHS 1.1 billion in 1972, increasing by 15.6 per cent, while educational, health and social services sectors achieved a total value of DHS 35 billion in 2002, with an average growth of 17.2 per cent. The UAE has given a special attention to the economic aspect for being the foundation of development and a prime source of income and employment.

These positive developments have played a significant role in placing the country as a leading commercial and industrial centre in the region. The major economic changes have positive impacts on the social development and in elevating the living standards of its citizens. The government allocated a great percentage of the general income to finance huge developmental projects, while federal and local governments provided necessary support to the private sector's investment activities in order to increase their efficiency to implementing projects. This has resulted in a large increase of investments, totalling of DHS 60 billion in 2002, showing 12.6 per cent annual growth.

In its report of 2003 on trade and investment in the Middle East and North Africa, the World Bank also hailed the UAE's policy on diversification of its income and lack of reliance on oil as a sole source of income. The report affirmed that major economic growth rates in the UAE came as the result of investments on non-oil sectors such as petrochemicals, fertilizers, cement and aluminium and lately in tourism, storage, trade and industry sectors. The report asserted that the UAE encouraged liberal trade as an impetus for development as the Emirate of Abu Dhabi boosted energy-based industries, while Dubai developed the sectors of trade, tourism, communication and finance, and Sharjah had relied on textile, lighting industries, while other northern Emirates focused their investments on agriculture, masonry, cement and maritime shipping. The selection of the UAE as the venue of the World Bank and International Monetary Fund Board meetings of 2003 was a testimony to the status of the UAE in world economy. 184 government delegations as well as 15.000 experts and media people attended the Dubai 2003 held from 17-24 September 2003 (Byung-il, 2003).

A.2.5 The Construction Industry

Since the establishment of the UAE, the federal government used the country's oil wealth for the country development and upgrading the life of citizens, thus making huge achievements in a very short time. Successive plans for sustainable development have been implemented for the establishment of hundreds of projects for modernisation, development, services provision, setting up of residential towns, modern metropolis, building hospitals, clinics and health centres, schools and universities. Huge projects have also been carried out for the construction of necessary infrastructure, roads and bridges and tunnels, provision of electricity and water, communications and telecommunications and other basic services, thus making the UAE in par with developed nations.

The most important source of funding for construction projects in the United Arab Emirates is the budget allocation by the federal government to finance development projects. This tends to be the case in among all other members states of the GCC. These projects include road building, bridges, drainage and sewerage, public building, and low cost housing projects. In the Emirate of Abu Dhabi, the surveyed city, there is another source of finance available for commercial buildings. This is run by the Department of Social Services and Commercial Buildings (DSSCB), more commonly known as H.H. Sheikh Khalifah Committee (Shawa, 1995). Since the case studies used to validate and extract brief development drivers were projects executed by the DSSCB, the following section will give a brief description of the department, its objectives, the execution steps of the commercial building project and the department achievements.

A.3 The Department of Social Service and Commercial Buildings (DSSCB)

The Department of Social Services and Commercial Buildings is the authority responsible for the construction of commercial buildings in the emirate of Abu Dhabi. It is playing a pivotal role in the booming and progress of the United Arab Emirates. Its beginning was marked by the setting up of the Building Credit Corporation in 1971, followed by the Committee of Commercial Buildings Supervision in 1976 and integrated with the Department of Social Services and Commercial Buildings in 1981. The department is coordinating and co-operating with other authorities and parties to achieve the highest standards and specification in the construction process (Al-Tunaiji, 1996). The department consists of Projects Directorate, Maintenance Directorate, Lease Directorate, Financial and Administrative Directorate, Legal Directorate, and Computer Section. All these directorates and sections co-operate together to achieve the objectives of the Department.

A.3.1 The Objectives of the Department of Social Services and Commercial Buildings

The establishment of the Department of Social Services and Commercial Buildings aimed to achieve the following objectives.

(1) Providing social insurance to citizens and escalating their life standards.

(2) Providing citizens with stable income to enable them to meet the challenge of life.

(3) Saving citizens from the high interest rates and debts of commercial banks.

(4) Offering solutions to housing problem in Abu Dhabi and achieving balance between offer and demand.

(5) Supporting the infrastructure projects such as roads, water and electricity to fulfil the requirements of its projects.

(6) Developing and enhancing the construction industry and other economical sectors in Abu Dhabi.

(6) Contributing in establishing national design firms, contracting and maintenance organisations to construct and maintain the department projects.

(7) Establishing the architectural development principles and boosting the tourism industry (DSSCB, 2003).

A.3.2 The Execution Steps of the Commercial Building Project

Implementing and executing a commercial building comprises of the following steps.

(1) Obtaining a commercial plot and a surety letter from Abu Dhabi Crown Prince and Deputy Supreme commander of the Armed forces.

(2) Getting a preliminary approval from the Crown Prince's court and nominating a qualified national consultant or another consultant by the department to prepare the required design.

(3) The department reviews the designs and selects those compatible with the rules and regulations issued by government bodies (Planning Department, Civil Defence Directorate, Water and Electricity Department, etc.)

(4) The building project is announced in a general tender through the newspapers giving the chance for contractors enlisted in the department to take part in the tender.

(5) After the opening of envelopes and the settling of the tender on one of the contractors, the Projects Directorate follows up the execution of the project and prepares weekly and monthly reports on work progress.

(6) After the completion of the building the department follows up the one-year obligatory maintenance then goes to the Maintenance Directorate, which pursues the building's maintenance through the announcement of a tender giving the operation to the best bidder.

(7) Rentals are made through the Lease Directorate, which manages the building's financial and administrative affairs through renting shops, showrooms, and flats and providing them with the required services.

(8) The building revenues are being distributed accordingly to the percentage ratio by the project as follows:

- The building client will receive 30 % of the building's revenue and 40% of the villa revenue.
- 60% of the building's revenues and 50% of the villa's revenue is allocated for reimbursing the surety until the mortgage is lifted. The sureties do not bear any interest.
- The department keeps the remaining 10% for the maintenance work (Al-Tunaiji, 1996; DSSCB, 1999)

A.3.3 Achievement in Figures

Table (A.1) indicates that the value of the projects has increased since the establishment of the department. The department has completed about 6000 projects at a cost of 30 billion Dirhams. They included about 94000 housing units. Figures (A.3), (A.4) and (A.5) show the numbers of the projects, flats, and costs respectively over years (DSSCB, 1997; DSSCB, 1999).

Year	No. of Bldgs.	No. of Flats	Projects cost	Year	No. of Bldgs.	No. of Flats	Projects cost
1977	37	472	79,400,000	1989	46	172	51,900,000
1978	135	3268	461,300,000	1990	73	1417	280,800,000
1979	131	2417	513,300,000	1991	108	1969	659,800,000
1980	176	3265	682,200,000	1992	342	5974	1,466,600,000
1981	774	3224	720,700,000	1993	310	6306	2,049,200,000
1982	366	3172	814,200,000	1994	187	5108	1,928,900,000
1983	318	2766	1,109,800,000	1995	313	7838	3,270,500,000
1984	177	2555	845,800,000	1996	495	11306	3,748,200,000
1985	51	1343	494,100,000	1997	545	11047	4,197,000,000
1986	28	797	576,800,000	1998	219	7426	2,769,300,000
1987	268	436	208,500,000	1999	214	6637	2,421,400,000
1988	135	489	148,100,000	2000	154	4210	1,435,900,000

Table A.1 The Development of Projects Executed by the DSSCB

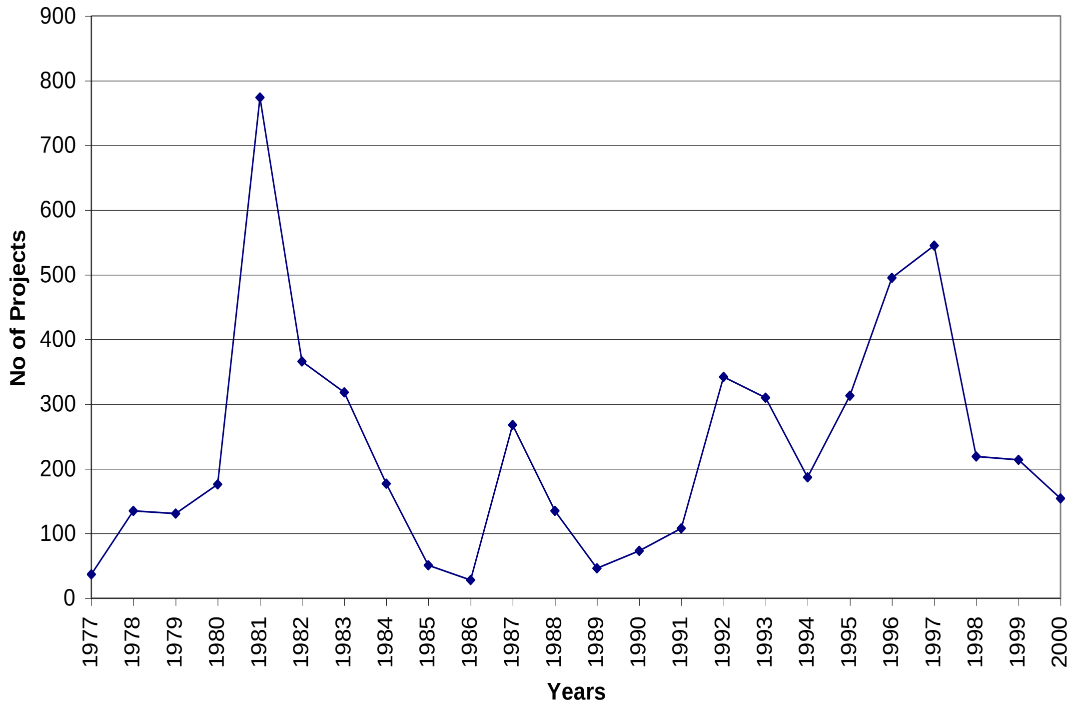


Figure A.3 The Number of Projects Executed over Years

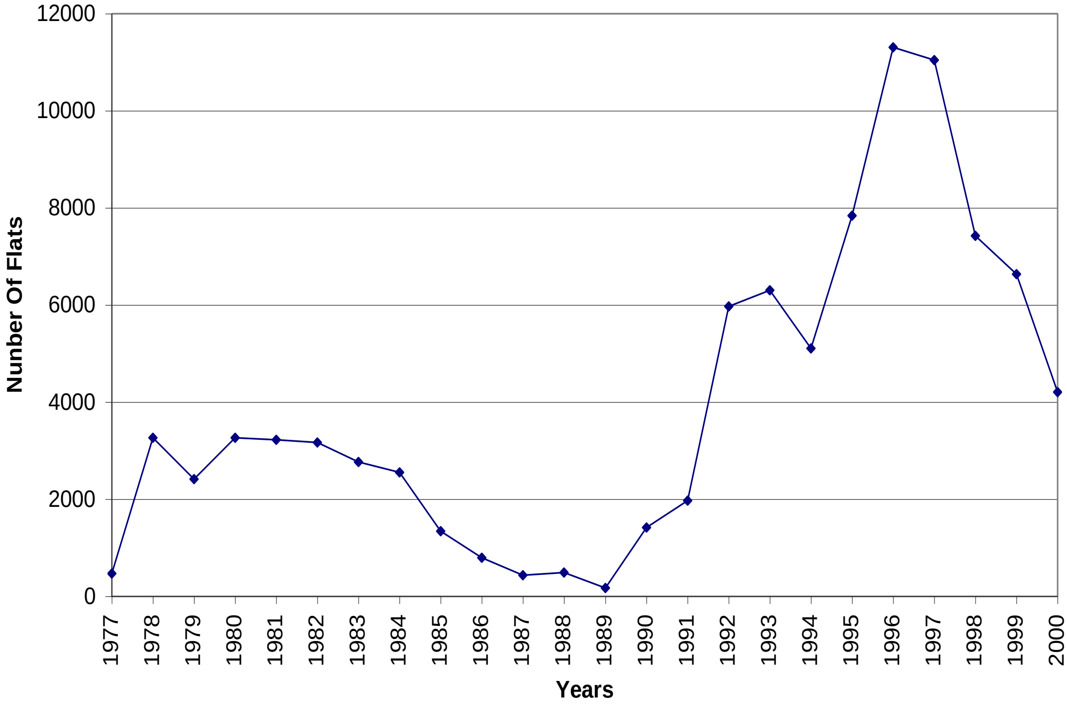


Figure A.4 The Number of Flats Executed over Years

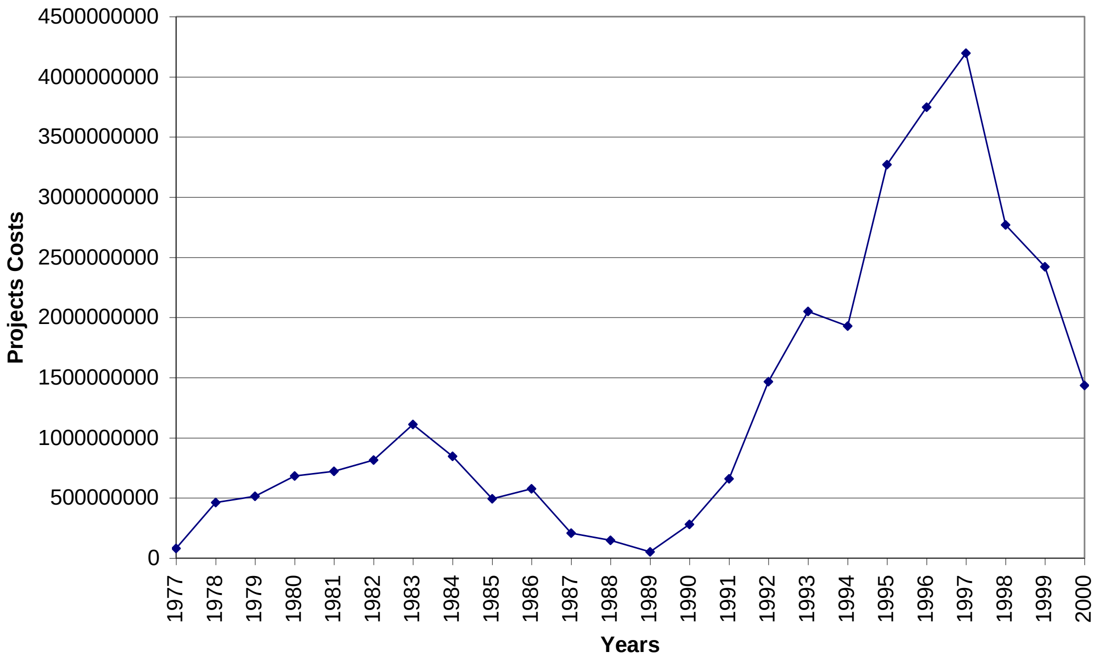


Figure A.5 The Costs of the Projects Executed

Since the last 10 years represented the highest projects' costs and number of flats and has relatively high number of buildings as well as the availability of project information, the buildings constructed from 1990 till 2000 were used as the pool for the case studies that will be analysed to identify the brief development drivers.

THE OBSERVATION SHEET

Date		Time	
Client Name			
Project Type		Project Location	
Project Cost		Project Duration	
Designer		Constructor	

Observation Focus

No.	Activity	Analysis

Value and Risk Management for Dynamic Brief Development in Construction

An Academic Survey Questionnaire Quantifying the Brief Development Drivers in Construction

This Questionnaire should be answered by the following parties:

(1) Client organisations
(2) End Users
(3) Design Firms
(4) Constructors
(5) Suppliers
(6) Government Authorities
(7) Funding Bodies

For contact:
Tel (Home) : 00971 (2) 6317233
Tel (Office) : 00971 (2) 6151329
Fax : 00971 (2) 6447537
E-mail : AOTHMAN@EMIRATES.NET.AE

Please Return the responded questionnaire to the following address:
Ayman Ahmed Ezzat Othman
P.O.Box 46172
Abu Dhabi
United Arab Emirates

Loughborough University

Section (1)

General Information

This section aims to obtain general information of the surveyed organisation

Please complete the following information to the best of your knowledge.

Organisation Name			
Organisation Address			
Contact Phone No.		**Contact Fax No.**	
Your Designation		**E-mail Address**	

Section (2)

Brief Development Concepts

Question (1)

What is the probability of brief development occurring during construction?

Rate each one where:

1 = Never 2 = Rarely 3 = Sometimes 4 = Frequently 5 =Always

Probability Of Briefing Development	Rating
(1) No development take place once the construction commences	
(2) Development within the control of clients and construction professionals	
(3) Development beyond the control of clients and construction Professionals	

Question (2)

At what stages in your opinion does brief development take place?

Rate each one where:

1 = Never 2 = Rarely 3 = Sometimes 4 = Frequently 5 =Always

Stage	Rating	Stage	Rating
(a) Appraisal		(g) Tender Documentation	
(b) Strategic Briefing		(h) Tender Action	
(c) Outline Proposals		(i) Mobilisation	
(d) Detailed Proposals		(j) Construction to Practical Completion	
(e) Final Proposals		(k) After Practical Completion	
(f) Production information			

Question (3)

Who of the following parties do you think is responsible for brief development?

Rate each one where:

1 = very low influence 2 = low influence 3 = Average influence

4 = High influence 5 = Very High influence

Party	Rating	Party	Rating
(1) Client organisations		(5) Suppliers	
(2) End Users		(6) Government Authorities	
(3) Design Firms		(7) Funding Bodies	
(4) Constructors		(8) Others, specify please	

Question (4)

What impact do you think brief development has on the following criteria?

Rate each one where:

1 = very low impact 2 = low impact 3 = Average impact

4 = High impact 5 = Very High impact

Criteria	Impact	Rating	Impact	Rating
(1) Project Cost	Increase		Decrease	
(2) Project Duration	Increase		Decrease	
(3) Project Quality	Increase		Decrease	
(4) Project Value	Add		Reduce	
(5) Project Risk	Increase		Decrease	

Section (3)

Rating Brief Development Drivers

This section aims to rate the drivers that cause brief development

Question (1)

Which of the following drivers influence the development of the project brief?

Rate each one where:

1 = very low influence 2 = low influence 3 = Average influence

4 = High influence 5 = Very High influence

No.	Brief Development Drivers	Rating
1	Unclear and incomplete project brief	

2	Improper feasibility studies	
3	Inappropriate communication between the client and the designer	
4	Lack of understanding of the clients organisations	
5	Stakeholders change project requirements and have second thought at later stages	
6	Initiating value engineering changes	
7	Project users are not involved in the briefing process	
8	Project users appear at later stages	
9	Users exaggerate their needs	
10	Lack of understanding different users' culture and traditions	
11	Designers ignore the client role and behave unilaterally	
12	Uncoordinated and incorrect construction documents	
13	Brief information is still being given during later design and construction stages	
14	Lack of design experience	
15	Lack of presentation and visualisation of design	
16	Lack of regulations up-dating	
17	Lack of functional, aesthetic, safety requirements and constructability	
18	Whole project life not considered	
19	Lack of considering environmental requirements	
20	Inadequate available design time	
21	Restricted design fees	
22	Unforeseen conditions	
23	Changing government regulation and codes	
24	Lack of information provision	
25	Lack of communication and co-ordination between government authorities and design firms over planning and approvals	
26	Meeting new technology changes	
27	Responding to market demand)	
28	Upgrade project facilities	
29	Materials are no longer available in market and use better substitute materials	
30	Eliminate proven poor quality materials and equipment	

Value and Risk Management for Dynamic Brief Development in Construction

<u>AN ACADEMIC SURVEY QUESTIONNAIRE EVALUATING THE BRIEF DEVELOPMENT MANAGER (BDManager) PROTOTYPE SOFTWARE</u>

This questionnaire should be answered by the brief development study session members

Loughborough University

Section (1)

General Information

Please complete the following information to the best of your knowledge.

Organisation Name			
Organisation Address			
Contact Phone No.		**Contact Fax No.**	
Your Designation		**E-mail Address**	

Section (2)

Evaluating the Brief Development Manager

Please rate each of the followings from 1 to 5 that best represents your assessment of a question, where 1=Poor & 5=Excellent

Identifying Problem

	Questions	Rating
1	How effectively did the BDManager facilitate the adequate identification of the brief development problem?	
2	How well the use of different methods for data entry (i.e. attached Microsoft word files and pull down menus) facilitated entering, selecting, editing, and updating different definition information?	

Structuring Objectives

	Questions	Rating
1	How effectively did the BDManager facilitate the adequate identification of the brief development objectives?	
2	How well the use of attached Microsoft Office Word files facilitated defining and updating development objectives and defining associated risks?	
3	How well the use of attached Microsoft Office Excel files facilitated building objectives value hierarchy and allocating importance weights?	
4	How well the use of attached Microsoft Office Excel files facilitated and expedited calculation of brief development objectives weights?	

Scrutinising Alternative Solutions

Questions		Rating
1	How effectively did the BDManager facilitate scrutinising alternative solutions?	
2	To what extent did the use of attached Microsoft Office Word files facilitated documenting and updating alternative solutions, evaluating alternatives, and reconciling value and risk?	
3	How well the use of attached Microsoft Office Excel files facilitated and expedited creating decision matrix, assessing associated risks, comparing alternatives, and performing sensitivity analysis?	

Adopting Development Decision

Questions		Rating
1	How effectively did the BDManager facilitate adopting development decision?	
2	To what extent did the use of attached Microsoft Office Word files facilitated documenting and updating presenting alternatives, selecting best alternatives, implementing selected alternatives, and monitoring and feeding back?	

Features of the Brief Development Manage

Questions		Rating
1	To what extent did the prototype facilitate managing, organising, storing, retrieving, sharing and updating brief development data?	
2	How well the use of use of prototype save time and effort?	
3	How easy did the user find the interact with different prototype screens?	
4	How well did the prototype facilitate communication and team work between project team members?	
5	To what extent did the BDManager ensure that all stakeholders perspectives were presented?	

Section (3)

General Comments

What are your ideas to develop the Brief Development Manager and facilitates its application?

Do you recommend the use of Brief Development Manager? Tick please the appropriate box.

Yes	
No	

If No, Why?

Department of Civil and Building Engineering

Loughborough University, Loughborough,

Leicestershire, LE11 3TU,

England,

UK.

To whom it may concern

Dear Sir,

I am currently undertaking a Ph.D. research in Construction Management at Loughborough University, England, UK. The research will develop an innovative protocol integrating value and risk management to manage dynamic brief development in construction and produce a software tool to facilitate its use.

Questionnaire is an important and integral part of academic research. The questionnaire in hand has two objectives. Firstly, investigating the perception of clients' organisations and construction professionals of the brief development during the construction process and secondly, quantifying the drivers that have more influence on brief development.

The proposed questionnaire will be sent to limited, selective number of well established clients' organisations and construction professionals such as design firms and contracting companies. Dr Tarek M Hassan and Dr Christine L Pasquire (research supervisors) and myself would be very grateful if you answer the questionnaire to the best of your knowledge. Your reliable responses will contribute towards the fulfilment of my research.

As I appreciate your busy time schedule, I devoted my effort to make the questionnaire as simple as possible. Hoping that you wish to facilitate the successful completion of this academic research, I would like to ensure that your responses will be used purely and strictly in academic studies and not for any other purposes.

If you have any queries or you would like to discuss any question, please do not hesitate to contact me on the addresses mentioned in the questionnaire.

Thanks for your co-operation

Ayman Ahmed Ezzat Othman

Research Student

Department of Civil and Building Engineering
Loughborough University, Loughborough,
Leicestershire, LE11 3TU,
England,
UK.

To whom it may concern

Dear Sir,

Thank you for attending the brief development study session and the time devoted to apply the Brief Development Manager (BDManager) prototype software.

I am currently undertaking a Ph.D. research in Construction Management at Loughborough University, England, UK. The research developed an innovative protocol integrating value and risk management to manage dynamic brief development in construction. The Brief Development Manager is the computerised version of the developed Protocol.

The aim of this questionnaire is to evaluate the produced software. This will be achieved by answering the questionnaire questions and by writing down your comments, feed back and ideas to enhance the performance of the prototype software.

The proposed questionnaire will be responded by the Brief Development study teams. Dr Tarek M Hassan and Dr Christine L Pasquire (research supervisors) and myself would be very grateful if you answer the questionnaire to the best of your knowledge. Your reliable responses will contribute towards the fulfilment of my research.

As I appreciate your busy time schedule, I devoted my effort to make the questionnaire as simple as possible. Hoping that you wish to facilitate the successful completion of this academic research, I would like to ensure that your responses will be used purely and strictly in academic studies and not for any other purposes.

Thanks for your co-operation

Ayman Ahmed Ezzat Othman
Research Student

Value and Risk Management for Dynamic Brief Development in Construction

AN ACADEMIC INTERVIEW INVESTIGATING THE CONSTRUCTION ORGANISATION MANAGEMENT'S PERCEPTION OF THE BRIEF DEVELOPMENT CONCEPTS AND THE DIFFERENT TECHNIQUES ADOPTED FOR MANAGING BRIEF DEVELOPMENT

This interview should be conducted with the followings:

(1) Design firms' managers

(2) Head of architectural, structural, civil, mechanical and electrical sections.

(3) Construction companies' managers

(4) Senior project managers

Loughborough University

Section (1)

General Information

This section aims to obtain general information of the surveyed organisation.

Please complete the following information to the best of your knowledge.

Organisation Name			
Organisation Address			
Contact Phone No.		**Contact Fax No.**	
Your Designation		**E-mail Address**	

Question (1)

Which of the following categories best describes your organisation function?

If your organisation has more than one category, Please tick the appropriate box.

Organisation Category		**Organisation Category**	
(1) Client organisations		(5) Suppliers	
(2) End Users		(6) Government Authorities	
(3) Design Firms		(7) Funding Bodies	
(4) Constructors		(8) Others, specify please	

Section (2)

Managing Brief Development

This section aims to investigate the construction organisation management's perception of the brief development concepts and the different techniques adopted for the managing brief development

Question (1)

Which of the followings best describes the implications of the brief development to your organisation?

Please tick the appropriate box.

Brief Development Implications	
(1) Achieving clients' and end users' satisfaction	
(2) Enhancing project performance	
(3) Adding more values and eliminating associated risks	
(4) Increasing organisation overhead	
(5) Reducing organisation profitability	

(6) Increasing project documents re-work	
(7) Increasing organisation supervision duties	
(8) Disturbing the organisation overall work schedule	
(9) Reducing employees / labour productivity	
(10) Rectify brief errors and missing data	
(11) A source of disputes	
(12) Others, specify please	

<u>Question (2)</u>

To what extent do you support brief development once the construction commences? Please tick the appropriate box.

Never	Rarely	Sometimes	Frequently	Always
Others, specify please				

<u>Question (3)</u>

Which of the following methods are used to facilitate the visualisation of the brief development by clients, end users and construction professionals?

Rate each one where:

1 = Never used **2 = Rarely used** **3 = Sometimes used**

4 = Frequently used **5 =Always used**

Methods Used To Facilitate The Visualisation Of The Brief Development	Rating
(1) Site visits	
(2) Meeting with the concerned parties	
(3) Photos of completed projects	
(4) Overhead projector presentations	
(5) Samples and models	
(6) CAD drawings (i.e. Coloured plans and elevations, perspectives)	
(7) Animated walk through	
(8) Feasibility studies	
(9) Others, specify please	

Question (4)

Which of the following parties participates in managing brief development?

Please tick the appropriate box.

Party		Party	
(1) Client organisations		(5) Suppliers	
(2) End Users		(6) Government Authorities	
(3) Design Firms		(7) Funding Bodies	
(4) Constructors		(8) Others, specify please	

Question (5)

Which of the following techniques is used to follow up briefing development during the construction process? Please tick the appropriate box.

The Techniques Used To Follow Up The Brief Development	
(1) Regular co-ordination meetings	
(2) The party who make development other related parties	
(3) Checklist verifying the compatibility of various components in the project	
(4) Design change management software	
(5) Others, Specify Please	

Question (6)

What are the different steps followed by your organisation to manage the brief development?

Question (7)

Which of the following techniques does your organisation adopt for managing brief development? Please tick the appropriate box.

Techniques Adopted For The Briefing Change Management			
(1) Value Management		(2) Risk Management	
(3) Information Management		(4) Information Technology	
(5) Others, specify please			

Question (8)

What is the role of correct, reliable, and up-to-date information in managing brief development? Please tick the appropriate box.

The Role Of Information In Managing Brief Development	
(1) Helping Achieve Clients' And End Users' Satisfaction	
(2) Minimising Project Cost	
(3) Reducing Project Duration	
(4) Improving Project Quality	
(5) Adding Better Value	
(6) Avoiding Associated Risk	
(7) Helping Reach Prudent Decisions	
(6) Reducing Change Orders In Future Projects	
(8) Co-ordinating With Other Related Disciplines	
(9) Others, Specify Please	

Question (9)

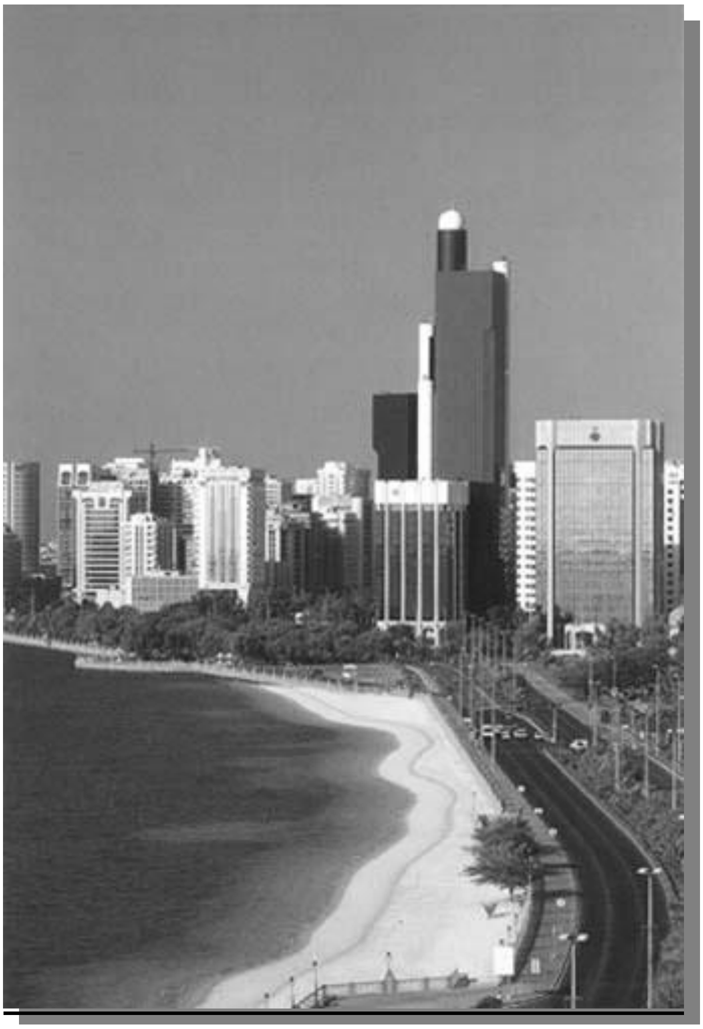
Which of the following information sources is used in managing brief development? Please tick the appropriate box.

The Information Sources Used In The Briefing Change Management			
(1) Client organisation		(7) Funding bodies	
(2) User requirements		(8) Previous projects	
(3) Design firms		(9) Building standards and codes	
(4) Constructors		(10) Business requirements and market Demand	
(5) Suppliers		(11) Central Project Database	
(6) Government Regulations		(12) Others, specify please	

Question (10)

What are the reflections of feedback on the briefing process for new projects? Please tick the appropriate box.

The Reflections Of Feedback On The Briefing Process For New Projects	
(1) No lessons are learned and mistakes are iterated	
(2) Helping achieve clients' objectives and end users' needs	
(3) improving project performance in terms of cost, time, and quality	
(4) Adding better Value	
(5) Avoiding associated risk	
(6) Helping produce co-ordinated and correct construction documents.	
(6) Reducing change orders in future projects	
(7) Others, specify please	



36 RECENTLY COMPLETED CONSTRUCTION PROJECTS COLLECTED FROM THE UNITED ARAB EMIRATES CONSTRUCTION INDUSTRY

Case Study (1)

Project Information		
Project Type	Commercial building	
Project Components	Basement + ground floor + mezzanine + 12 typical floors (each floor contains 6 one bedroom flat) + roof + central gas system + central water filter + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 873,600	DHS 20,966,400
Project Duration	**Design Duration**	**Construction Duration**
	4 months	16 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Change the finishing material in lift lobbies and main entrance from ceramic to marble.	
Change Reason	**Change Factor**	**Change Stage**
More luxury	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 days	+ DHS 75,000	Better Quality
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference and that materials should be at the same quality. The contractor claims for 60 days extension for importing materials.	

Type Of Change	Create new flat on the roof.	
Change Reason	**Change Factor**	**Change Stage**
Investment	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 45 days	+ DHS 220,000	Nil
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claim for 45 extension in order to construct the new flat.	

Type Of Change	Architectural changes in the design of the ground floor and services rooms.	
Change Reason	**Change Factor**	**Change Stage**
Meeting government authorities requirements	Government authorities	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 days	+ DHS 75,000	Better performance

Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 30 days extension.

Type Of Change	Open 56 windows in the two staircases	
Change Reason	**Change Factor**	**Change Stage**
Meeting government authorities requirements	Government authorities	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 days	+ DHS 28,000	More safety
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 30 days extension for modification.	

Type Of Change	Change the epoxy powder coated steel to ordinary Steel	
Change Reason	**Change Factor**	**Change Stage**
Change in the government regulations	Government authorities	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
Nil	- DHS 446,250	Better bond between steel and concrete.
Steps Taken To Mange The Change	Study ensures that the client will get the difference taking in account that the concrete construction will not be affected.	

Case Study (2)

Project Information		
Project Type	Commercial Building	
Project Components	Ground floor + mezzanine + 2 typical floors + roof + lift + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 214,736	DHS 5,153,657
Project Duration	**Design Duration**	**Construction Duration**
	4 months	12 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Re-design the building to be a private hospital, with adding basement floor.	
Change Reason	**Change Factor**	**Change Stage**
(1) Better Investment (2) Market Demand	Client	Design
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 100 days for re-design and approvals.	+ DHS 298,908 as fees for re-design	Reduction in specification in order to minimise the contract cost.
+ 180 days for finding financing authority for the extra contract amount.	+ DHS 2,104,318 as extra construction cost.	
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference.	

Type Of Change	Modification to the hospital design.	
Change Reason	**Change Factor**	**Change Stage**
(1) Technological changes (2) Functional requirements	Client Investor (hospital management)	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 328 days	+ DHS 607,889	Better quality
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The client claims for 328 days extension for project modification.	

Case Study (3)

Project Information		
Project Type	Commercial complex	
Project Components	2 basement floors (cinemas) + ground floor + mezzanine (showroom) + 12 typical floors floor contains 8 two bedroom flat + roof + swimming pool + gymnasium + 6 lifts + 4 escalators + central gas system + central water filter + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 2,960,000	DHS 74,000,000
Project Duration	**Design Duration**	**Construction Duration**
	6 months	20 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Delete the 2-floor cinema and construct shopping mall instead.	
Change Reason	**Change Factor**	**Change Stage**
Meeting government authorities requirements	Government authorities	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 15 days for re-design	+ DHS 246,667 for re-design	Nil
- 60 days for construction	- DHS 650,000 for construction	
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference.	

Type Of Change	Modify the glazing and aluminium system	
Change Reason	**Change Factor**	**Change Stage**
Design requirements and user needs (prevent noise, reduce humid climate effect)	Client / Users	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+90 Days	+ DHS 280,000	Better Quality And Performance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client Has to pay the difference. The contractor claim for 90 days extension in order to import the required aluminium and glass.	

<table>
<tr><th>Type Of Change</th><td colspan="2">Architectural changes in the design of the ground and mezzanine floor to accommodate with the new shopping mall.</td></tr>
<tr><th>Change Reason</th><th>Change Factor</th><th>Change Stage</th></tr>
<tr><td>Design and functional requirement</td><td>Government authorities / client</td><td>Construction</td></tr>
<tr><th>Effect On Time</th><th>Effect On Cost</th><th>Effect On Quality</th></tr>
<tr><td>+ 10 Days for re-design</td><td>+ DHS 164,444 for re-design</td><td rowspan="2">Better performance</td></tr>
<tr><td>+ 35 Days for construction</td><td>+ DHS 75,000 for Construction</td></tr>
<tr><th>Steps Taken To Mange The Change</th><td colspan="2">Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 15 days delay.</td></tr>
</table>

<table>
<tr><th>Type Of Change</th><td colspan="2">Change the finishes of the lift lobbies, kitchens, bathrooms, and toilets.</td></tr>
<tr><th>Change Reason</th><th>Change Factor</th><th>Change Stage</th></tr>
<tr><td>Use the products of the client factory (encouraging client business).</td><td>Client</td><td>Construction</td></tr>
<tr><th>Effect On Time</th><th>Effect On Cost</th><th>Effect On Quality</th></tr>
<tr><td>+100 Days</td><td>- DHS 125,000</td><td>Low quality</td></tr>
<tr><th>Steps Taken To Mange The Change</th><td colspan="2">Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 100 days extension for selection and matching of the inferior quality ceramic tiles.</td></tr>
</table>

Case Study (4)

Project Information		
Project Type	Commercial Complex	
Project Components	Basement + ground floor + mezzanine + 4 typical floors each floor contains 4 two bedroom flats + penthouse + roof + 2 lifts + central gas system + central water filter + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 244,000	DHS 5,856,000
Project Duration	**Design Duration**	**Construction Duration**
	3 months	12 Months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Change the building entrance to the parking side. According to this change the locations of the electric room, the telephone room, public toilet, watchman toilet is changed.	
Change Reason	**Change Factor**	**Change Stage**
The client changed the main entrance from the main road to the parking side (safety requirement).	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+15 Days	+ DHS 5,000	More Safety
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 15 days extension for the re-design and authorities approvals.	

Type Of Change	Adding 8 windows to the basement floor.	
Change Reason	**Change Factor**	**Change Stage**
Increase the ventilation area	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 15 Days	+ DHS 4,000	Better ventilation
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claim for 15 days for executing the required changes.	

Case Study (5)

Project Information		
Project Type	Commercial Complex	
Project Components	Basement floor + ground floor + mezzanine floor + 14 typical floors floor contains (6 studio flat + 4 one bedroom flat + 2 two bedroom flat) + roof + swimming pool + restaurant + health club + 4 lifts + central gas system + central water filter + central dish antenna + central air conditioning + glass cleaning machine.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 2,120,000	DHS 53,500,000
Project Duration	**Design Duration**	**Construction Duration**
	6 months	22 months
Contract Type	Lump sum contract	
Project Quality	High quality materials and finishes	

Project Changes

Type Of Change	Delete the swimming pool, the restaurant and the healthy club and make new typical floors instead.	
Change Reason	**Change Factor**	**Change Stage**
(1) Market demand at the project area (2) Maintenance purpose	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 120 days	+ DHS 1, 650, 000 For Construction	Better performance Better investment
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 120 days extension for construction of the new typical floors.	

Type Of Change	Provide the lift, which goes to Basement with all requirements to install Electronic Card Access System.	
Change Reason	**Change Factor**	**Change Stage**
Security requirements	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 45 days	+ DHS 5,000	Mode safety
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 45 days extension for importing and fixing security requirements.	

Type Of Change	Architectural changes in the design of the ground and mezzanine floor.	
Change Reason	**Change Factor**	**Change Stage**
Meeting the investor (user) requirements	Investor (Bank) Client	Post-Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+30 days	+ DHS 2,400 for Design + DHS 60,000 for Construction	Better functional Performance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The client claims for one month for design changes.	

Type Of Change	Change the Finishes of the lift Lobbies, kitchens, Bathrooms, and Toilets.	
Change Reason	**Change Factor**	**Change Stage**
(1) Using the products of the Client Factory. (2) Reducing the time of material importing.	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
- 60 days of importing. +100 days for matching materials.	- DHS 100,000	Low Quality
Steps Taken To Mange The Change	The Study approved the client changes based on the benefits which the client gains when his own factory products will be used in the project and the importing time and shipping cost which will be save. But because of the inferior quality of the replaced ceramic, the contractor claims for 100 days delay for refining and matching the surface evenness of the inferior quality ceramic tiles.	

Type Of Change	Modification of the Elevations design	
Change Reason	**Change Factor**	**Change Stage**
Project elevations are not fully perceived by the Client (Shortage in elevation presentation and visualisation).	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 90 days	+ DHS 2,000 for Design + DHS 50,000 for Construction	Better Aesthetic Elevation
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 3 months for importing and fixing external cladding.	

Case Study (6)

Project Information		
Project Type	Commercial Building	
Project Components	Ground floor + mezzanine floor + 15 typical floors floor contains (4 two bedroom flat) + roof + 2 lifts + central gas system + central water filter + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 845,977	DHS 20,303,463
Project Duration	**Design Duration**	**Construction Duration**
	6 months	20 months
Contract Type	Lump sum contract	
Project Quality	High quality materials and finishes	

Project Changes

Type Of Change	Change the approved sanitary fittings (Bathtubs, Shower trays, and Washbasins) to other smaller models.	
Change Reason	**Change Factor**	**Change Stage**
Designer does not match the fitting dimension with the bathrooms and toilet sizes.	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 Days	Nil	More suitable to bathrooms and toilets sizes. More Comfortable. Better Performance.
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 60 days for importing new materials.	

Type Of Change	Change the epoxy powder coated steel to ordinary steel	
Change Reason	**Change Factor**	**Change Stage**
Change in the government regulations	Government authorities	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
Nil	- DHS 153,075	Better bond between steel and concrete.
Steps Taken To Mange The Change	Study ensures that the client will get the difference taking in account that the concrete construction will not be affected.	

Case Study (7)

Project Information		
Project Type	Commercial building	
Project Components	Ground floor + mezzanine floor + 4 typical floors floor contains (4 two bedroom flat) + roof + 2 lifts + central gas system + central water filter + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 251,430	DHS 6,034,330
Project Duration	**Design Duration**	**Construction Duration**
	3 months	12 months
Contract Type	Lump sum contract	
Project Quality	High quality materials and finishes	

Project Changes

Type Of Change	Change the Construction detail of elevation decoration.	
Change Reason	**Change Factor**	**Change Stage**
Facilitate the construction Process of the Elevation decoration.	Contractor	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
- 15 Days	- DHS 10,000	The same appearance Better Performance.
Steps Taken To Mange The Change	Study approved the required changes since it will facilitate the construction process and will reduce cost and time.	

Type Of Change	Change The Sanitary fittings (Bathtubs, Shower trays, Toilets, Bedits, washbasins) to another model.	
Change Reason	**Change Factor**	**Change Stage**
The factory stopped the production of the approved model.	The production factory.	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 Days	+ DHS 150,000	Better Quality
Steps Taken To Mange The Change	Study approved the changes to the new models and the client approved to pay the difference. The Contractor claims for 60 days for importing the new fittings.	

Case Study (8)

Project Information		
Project Type	35 commercial buildings	
Project Components	Each building consists of ground floor + mezzanine floor + 1 typical floors + roof + central air conditioning (split units).	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 2,240,000	DHS 53,760,000
Project Duration	**Design Duration**	**Construction Duration**
	6 months	24 months
Contract Type	Lump sum contract	
Project Quality	Medium quality materials and finishes	

Project Changes

Type Of Change	Change the shallow Foundations to deep piles foundations (20 buildings only).	
Change Reason	**Change Factor**	**Change Stage**
(1) Soil nature is not taken in consideration during the structural design. (2) Soil investigation test does not cover the whole site. (3) Lack of information about the soil nature at the project area.	**Government authority**	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 days For re-design	+ DHS 373,333 For re-design	Without changing the foundation type, the buildings will collapse.
+ 75 Days For Construction	+ DHS 5,319,480 for construction	
Steps Taken To Mange The Change	Study approved the changes and the client will pay the difference. The contractor claims for 75 days for Constructing the required changes.	

Type Of Change	Delete the external boundary wall for every building.	
Change Reason	**Change Factor**	**Change Stage**
Reducing cost	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
- 140 Days	- DHS 352,800	Less Security
Steps Taken To Mange The Change	Study ensures that the client will get the difference.	

Type Of Change	Change the finishing of the entry walls, staircase walls, flats flooring tiles, roof tiles for all buildings.	
Change Reason	**Change Factor**	**Change Stage**
Reducing cost	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
Nil	- DHS 3,248,000	Less quality
Steps Taken To Mange The Change	Study ensures that the client will get the difference.	

Type Of Change	Change 30 ground water tanks to underground water tanks with isolation.	
Change Reason	**Change Factor**	**Change Stage**
This happens according to the deletion of boundary walls	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 150 Days	+ DHS 297,600	(1) Difficult and expensive maintenance. (2 Negative hygienic effect because of the high percentage of salt in the area groundwater.
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference.	

Type Of Change	Change the whole air conditioning system from central A/C to split units.	
Change Reason	**Change Factor**	**Change Stage**
(1) Reducing construction cost (2) Suitable for the area climate. (3) Easier maintenance	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
Nil	+ DHS 2,250,000	(1) Better quality (No Smell transfer from place to place) (2) User Electric bills are higher than the central A/C.
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference	

Type Of Change	Modification of the architectural design and adding 34 toilets.	
Change Reason	**Change Factor**	**Change Stage**
Adding facilities and merits to some flats because of their location	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 7 Days for design modification + 100 days for Construction	+ DHS 87,000 for re-design + DHS 170,000 for Construction	Better quality More demand
Steps Taken To Mange The Change	Study approved the changes since it will escalate the rent of some flats and the client approved to pay the difference. ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference	

Case Study (9)

Project Information		
Project Type	Residential building	
Project Components	Basement + ground floor + mezzanine floor + 8 typical floors + penthouse + roof + 2 lifts + escalator + swimming pool + central air conditioning + central gas system.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 590,769	DHS 14,178,444
Project Duration	**Design Duration**	**Construction Duration**
	3 months	13 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	(1) Add two staircases for the lift machine room. (2) Add Fire extinguisher box at the top roof. (3) Install 10 smoke detectors for the main Electric room. (4) Install 2 emergency lights for the main electric room. (5) Install two exhaust fan for basement Ventilation (6) Modify the gas connection points in all kitchens.	
Change Reason	**Change Factor**	**Change Stage**
Meeting Government authority requirements.	Government authority	Post - Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 Days	+ DHS 108,000	More safety
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount. The client will pay the amount for the required work since these requirements are not mentioned in the contract. The contractor claims for 60 days extension according to these changes and modification.	

Type Of Change	Constructing an additional telecommunication room at the roof.	
Change Reason	**Change Factor**	**Change Stage**
Use of new and expected communication technology	Government Authority/ Consultant	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 10 Days	+ DHS 18,000	Better quality

Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount. The client will pay the amount for the required work since these requirements are not mentioned in the contract. The contractor claims for 10 days extension according to these changes and modification.

Type Of Change	Re design of the 9th floor to private flat and office for the client, this includes (change finishing, equipment, lighting chandelier, sanitary fittings, and modification of air conditioning system).	
Change Reason	**Change Factor**	**Change Stage**
(1) Achieving client requirements. (2) Business opportunity and market demand.	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 145 Days	+ DHS 261,000	Better quality Best business achievement
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount. The client will pay the amount for the required work. The contractor claims for 145 days extension according to these changes and modification.	

Type Of Change	Making holes and trenches in the basement floor as requirements for installing the electrical escalator. These requirements changed the structural design of the bases and columns.	
Change Reason	**Change Factor**	**Change Stage**
Meeting Design Requirements and Government authority	(1) The Escalator installation company. (2) Government authority	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 7 days for re-design	+ DHS 4,176 For re-design	Compulsory requirements for installation and better performance.
+ 58 days for construction	+ DHS 104,400 for construction	
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and the contractor will bear the cost of the additional work. The contractor claims for 58 days extension for the new requirements.	

Case Study (10)

Project Information		
Project Type	Commercial building	
Project Components	Ground floor + mezzanine floor + 4 typical floors + penthouse + roof + 2 lifts + central air conditioning + central gas system.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 230,000	DHS 5,520,000
Project Duration	**Design Duration**	**Construction Duration**
	3 months	12 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Change the colour of the external ceramic tiles after the approved sample has been shipped.	
Change Reason	**Change Factor**	**Change Stage**
The client wishes to give his building distinguished appearance (the client have no experience with the construction industry and the designer did not show the client different materials)	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 Days	+ DHS 35,000	Distinguished appearance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount. The client will pay the difference. The contractor claims for 60 days extension for importing the new coloured ceramic tiles.	

Type Of Change	Change the sanitary system and accessories. The contractor purchased materials and started installation.	
Change Reason	**Change Factor**	**Change Stage**
Other client advised the client that the specified sanitary system proofed low performance.	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 Days	+ DHS 55,000	Better quality
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount. The client will bear the cost of change. The contractor claims for 30 days extension for removing the installed parts and fixing the new system.	

Case Study (11)

Project Information		
Project Type	Commercial building	
Project Components	Ground floor + mezzanine floor + 4 typical floors + penthouse + roof + 2 lifts + central air conditioning + central gas system.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 239,532	DHS 5,748,000
Project Duration	**Design Duration**	**Construction Duration**
	3 months	12 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes		
Type Of Change	Change the design of the mezzanine floor to be three offices instead of two.	
Change Reason	**Change Factor**	**Change Stage**
Investment	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 Days	+ DHS 33,595	Better investment
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount. The client will bear the cost of change. The contractor claims for 30 days extension for modification.	

Type Of Change	Increase the height and the area of telephone room at the ground floor.	
Change Reason	**Change Factor**	**Change Stage**
Meeting the requirements of government authority / new technology requirements	Government	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 3 Days	+ DHS 4,007	Better performance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount. The client will bear the cost of change. The contractor claims for three days extension for modification.	

<table>
<tr><th>Type Of Change</th><td colspan="2">Increase the height of the roof parapet.</td></tr>
<tr><th>Change Reason</th><th>Change Factor</th><th>Change Stage</th></tr>
<tr><td>Hide the A/C Chillers and water tanks (aesthetic purpose).</td><td>Client</td><td>Construction</td></tr>
<tr><th>Effect On Time</th><th>Effect On Cost</th><th>Effect On Quality</th></tr>
<tr><td>+ 7 Days</td><td>+ DHS 8,050</td><td>Better quality</td></tr>
<tr><th>Steps Taken To Mange The Change</th><td colspan="2">Study ensures that the required changes should not exceed the contract amount. The client will bear the cost of change. The contractor claims for 7 days extension for modification.</td></tr>
</table>

Case Study (12)

Project Information		
Project Type	Commercial building	
Project Components	Basement + ground floor + mezzanine floor + 15 typical floors + roof + 2 lifts + central air conditioning + central gas system.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 926,692	DHS 22,240,608
Project Duration	**Design Duration**	**Construction Duration**
	6 months	22 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Change the specified glass to another type; have the same technical specification (locally manufactured).	
Change Reason	**Change Factor**	**Change Stage**
Reduce the time and cost of importing the glass.	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
-60 Days	- DHS 155,000	Nil
Steps Taken To Mange The Change	Study approved the change since the replaced type has the same quality and could be gained faster than the specified type.	

Type Of Change	Delete the equipment which was designed to be installed in kitchens (washing machine, oven, and refrigerator)	
Change Reason	**Change Factor**	**Change Stage**
(1) Reduce cost (2) Reduce maintenance cost. (3) User requirements (since users have their own equipment)	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
- 30 Days	- DHS 225,000	Nil
Steps Taken To Mange The Change	Study approved the client changes since these changes will eliminate the cost of equipment and the time of installation. In addition, it will minimise the cost of maintenance because the client is responsible for maintaining these equipment.	

Type Of Change	Change The specified reinforcement steel to another steel with the same specification.	
Change Reason	**Change Factor**	**Change Stage**
The specified steel are not available in the market	Consultant / contractor / client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
Nil	Nil	Nil
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. In addition, the study ensures that the structure will not be affected.	

Case Study (13)

Project Information		
Project Type	Commercial building	
Project Components	Basement + ground floor + mezzanine floor + office floor + 13 typical floors floor contains (2 two bedroom flat and 4 one bedroom flat) + penthouse (2 bedroom flat) + roof + 2 lifts + central gas system + central water filter + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 912,912	DHS 21,909,888
Project Duration	**Design Duration**	**Construction Duration**
	6 months	20 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Adding air conditioning units to the building staircase.	
Change Reason	**Change Factor**	**Change Stage**
Avoid doors and walls rot due to the high humidity weather during summer, which extends about 7 months.	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 Days	+ DHS 100,000	Better performance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 30 days extension for ordering and installing the new A/C machines.	

Type Of Change	Change The internal finishes from terrazzo and marble to ceramic tiles.	
Change Reason	**Change Factor**	**Change Stage**
More luxury with new designs	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
Nil	+ DHS 388,800	Better quality
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference.	

Case Study (14)

Project Information		
Project Type	Residential Villas	
Project Components	Basement + ground floor + first floor + roof + boundary wall + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 126,880	DHS 3,045,120
Project Duration	**Design Duration**	**Construction Duration**
	4 months	12 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes		
Type Of Change	Change the external finishing to more luxurious marble tiles.	
Change Reason	**Change Factor**	**Change Stage**
More luxurious and better appearance	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 Days	+ DHS 60,177	Better appearance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 60 days extension for ordering marble tiles.	

Type Of Change	Adding an extra water tank on the top roof	
Change Reason	**Change Factor**	**Change Stage**
Meeting the water Capacity requirements according to government Authority regulations.	Government	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 15 days	+ DHS 18,772	Better performance
Steps Taken To Mange The Change	Study approved the required changes since it will comply with the government regulations and will enhance the building performance.	

Type Of Change	Construction of 2 sheds for the water tanks	
Change Reason	**Change Factor**	**Change Stage**
Isolating water tanks from sun effect.	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 5 Days	+ DHS 4,030	Better quality
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference.	

Case Study (15)

Project Information		
Project Type	Commercial building	
Project Components	Ground floor + mezzanine floor + 4 typical floors + penthouse + roof + 2 lifts + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 226,865	DHS 5,444,760
Project Duration	**Design Duration**	**Construction Duration**
	4 months	12 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	(1) Delete the central dish antenna (2) Delete the central water filter (3) Delete the external glass cleaning machine (4) Delete the kitchen cooker hoods	
Change Reason	**Change Factor**	**Change Stage**
(1) Reducing project cost (2) Reducing maintenance cost	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Qouality**
- 180 Days	- DHS 340,000	Less quality
Steps Taken To Mange The Change	Study approved the client changes because he can not afford the money to complete the building.	

Type Of Change	Fixing aluminium handrail in the outer balcony in the penthouse	
Change Reason	**Change Factor**	**Change Stage**
Meeting government regulations (more protection)	Government	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 7 days	+ DHS 5,272	More safety
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 7 days extension for ordering and fixing the required work.	

Case Study (16)

Project Information		
Project Type	Commercial building	
Project Components	Ground floor + mezzanine floor + 15 typical floors + roof + 2 lifts + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 954,749	DHS 22,913,998
Project Duration	**Design Duration**	**Construction Duration**
	5 months	20 months
Contract Type	**Lump sum contract**	
Project Quality	High quality specification	

Project Changes

Type Of Change	(1) Change the sanitary ware in bathrooms and toilets. (2) Change the kitchens, toilets, and bathrooms mixtures	
Change Reason	**Change Factor**	**Change Stage**
Better quality models	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+60 Days	+ DHS 75,000	Better Quality
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 60 days extension for ordering, removing the already fixed materials and fixing the new models.	

Type Of Change	Change the kitchen cabinets from wood to high quality aluminum cabinets.	
Change Reason	**Change Factor**	**Change Stage**
(1) Durable and Better quality (2) Reduce maintenance cost	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 Days	+ DHS 210,000	More durable Better quality
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 60 days extension for ordering the required work.	

Type Of Change	Change the location and distribution of electrical equipment in the electrical and transformer room.	
Change Reason	**Change Factor**	**Change Stage**
The electrical Design does show in detail the distribution of the electrical equipment.	Government Authority	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 Days	Nil	Better performance
Steps Taken To Mange The Change	Study ensures that the required changes are necessary for connecting the building with electricity. The contractor claims for 30 days extension for getting authority approval for the new distribution.	

Case Study (17)

Project Information		
Project Type	Commercial Building	
Project Components	Basement floor + Ground floor + mezzanine floor + 15 typical floors + roof + 2 lifts + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 959,355	DHS 23,983,884
Project Duration	**Design Duration**	**Construction Duration**
	5 months	20 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Shifting the watchman room from the ground floor to the roof floor, and according to this: (1) Use the previous watchman room for electrical generator. (2) Use the generator room as telephone room.	
Change Reason	**Change Factor**	**Change Stage**
Meeting the new telecommunication system requirements.	Government authority	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 Days	+ DHS 30,000	Better performance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 30 days extension for constructing the new room in the roof and makes arrangements for the new requirements.	

Type Of Change	Change the sanitary ware models in bathrooms and toilets.	
Change Reason	**Change Factor**	**Change Stage**
The specified models are no longer available in market and have been discontinued from production.	Supplier / client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 Days	+ DHS 175,000	Better performance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount. The contractor claims for 60 days extension for ordering the new selected model.	

Case Study (18)

Project Information		
Project Type	Commercial building	
Project Components	Ground floor + mezzanine floor + 2 typical floors + roof + 2 lifts + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 167,200	DHS 4,180,000
Project Duration	**Design Duration**	**Construction Duration**
	3 months	11 months
Contract Type	Lump Sum Contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Change the project specification to other cheaper materials.	
Change Reason	**Change Factor**	**Change Stage**
The project site had a hidden international telephone exchange. This exchange was discovered during the site excavation. The contractor was delayed about 339 in order to enable the telecommunication company to shift it to another location. Since the client was not able to pay the shifting cost, he agreed that the contractor pay the shifting cost in return of reduction in project specification.	Government authority / Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+339 Days	Nil	Low Quality
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 339 days extension for shifting the telecommunication exchange.	

Case Study (19)

Project Information		
Project Type	Commercial building	
Project Components	Basement floor (services and show room) + ground floor (services and show room) + mezzanine floor (4 offices) + 4 typical floors (4 two bedroom flat) + roof + 2 lifts + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 282,920	DHS 7,073,000
Project Duration	**Design Duration**	**Construction Duration**
	4 months	13 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Change the foundation type from piles to mat foundation.	
Change Reason	**Change Factor**	**Change Stage**
During construction the contractor found solid rock layers after 4.5 m excavation (soil investigation failure, short of municipal information)	Contractor / Designer / government engineer	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
- 45 Days	- DHS 75,000	The same performance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference.	

Type Of Change	Change the external finishing from epoxy paint to granite.	
Change Reason	**Change Factor**	**Change Stage**
Better aesthetic elevation.	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 120 Days	+ DHS 135,500	Better appearance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 120 days extension for ordering and fixing the required granite.	

<table>
<tr><th>Type Of Change</th><td colspan="2">Deleting the staircases between basement and ground floor.</td></tr>
<tr><th>Change Reason</th><th>Change Factor</th><th>Change Stage</th></tr>
<tr><td>Separating the two floors To meet functional purpose and user needs.</td><td>Client</td><td>Construction</td></tr>
<tr><th>Effect On Time</th><th>Effect On Cost</th><th>Effect On Quality</th></tr>
<tr><td>- 7 Days</td><td>- DHS 3,200</td><td>Better performance</td></tr>
<tr><th>Steps Taken To Mange The Change</th><td colspan="2">Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference.</td></tr>
</table>

<table>
<tr><th>Type Of Change</th><td colspan="2">Installing false ceiling for the ground floor.</td></tr>
<tr><th>Change Reason</th><th>Change Factor</th><th>Change Stage</th></tr>
<tr><td>Hiding A/C ducts and sanitary pipes.</td><td>Client</td><td>Construction</td></tr>
<tr><th>Effect On Time</th><th>Effect On Cost</th><th>Effect On Quality</th></tr>
<tr><td>+ 15 Days</td><td>+ DHS 43,200</td><td>Better appearance</td></tr>
<tr><th>Steps Taken To Mange The Change</th><td colspan="2">Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 15 days for installing the required work.</td></tr>
</table>

Case Study (20)

Project Information		
Project Type	**Commercial building**	
Project Components	Basement floor (show room) + ground floor (services and show room) + mezzanine floor (4 offices) + 12 typical floors (6 one bedroom flat) + roof + 2 lifts + central dish antenna + central air conditioning + external glass cleaning machine.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 687,520	DHS 16,500,480
Project Duration	**Design Duration**	**Construction Duration**
	5 months	18 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	(1) Deleting all the decoration in kitchens, bathrooms, and toilets. (2) Deleting the plaster above the false ceiling.	
Change Reason	**Change Factor**	**Change Stage**
Reducing project cost	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
- 15 Days	- DHS 36,306	Less quality
Steps Taken To Mange The Change	Study approved the required changes because it will minimise the project cost.	

Type Of Change	(1) Changing the specified bathtubs to local made type. (2) Changing the staircase handrail from wood to aluminium.	
Change Reason	**Change Factor**	**Change Stage**
Reducing project cost	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
- 60 Days	- DHS 28,480	Less quality
Steps Taken To Mange The Change	Study approved the required changes because it will minimise the project cost.	

Case Study (21)

Project Information		
Project Type	Commercial building	
Project Components	Ground Floor (Services and show room) + Mezzanine floor (4 offices) + 12 typical Floors (4 two bedroom flat) + Penthouse + Roof + 2 lifts + Central Dish Antenna + Central Air Conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 759,359	DHS 18,983,976
Project Duration	**Design Duration**	**Construction Duration**
	6 months	18 months
Contract Type	**Lump sum contract**	
Project Quality	High quality specification	

Project Changes

Type Of Change	Change the design of the penthouse from two flats to be like the typical floors.	
Change Reason	**Change Factor**	**Change Stage**
Investment	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 Days	+ 45,000	Better investment
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 30 days for the construction of the required changes.	

Type Of Change	Move the watchman room to the roof in order to increase the show room area.	
Change Reason	**Change Factor**	**Change Stage**
(1) Meeting market Demand (2) Business opportunity	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 15 Days	+ DHS 5,000	Better investment
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 15 days extension for construction the required changes.	

Type Of Change	Change the internal flooring finishing of the building from mosaic tiles to marble tiles.	
Change Reason	**Change Factor**	**Change Stage**
Raise the finishing quality in order to attract prestigious companies	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 Days	+ DHS 388,800	Better quality
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 60 days for ordering the required materials.	

Case Study (22)

Project Information		
Project Type	Commercial building	
Project Components	Ground Floor + Mezzanine floor + 4 typical Floors + Penthouse + Roof + 2 lifts + Central Dish Antenna + Central Air Conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 249,600	DHS 5,990,400
Project Duration	**Design Duration**	**Construction Duration**
	4 months	12 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Modifications of the bases steel reinforcement.	
Change Reason	**Change Factor**	**Change Stage**
Increase project safety	Contractor / Municipality Engineer	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 15 Days for re-design and approvals	+ DHS 5,000 for re-design	More safety
+ 15 Days for construction	+ DHS 25,000 for construction	
Steps Taken To Mange The Change	Study ensures that the contractor has to bear the cost of change since he certified when he won the contract that he reviewed the project drawing as if it was prepared by himself.	

Type Of Change	Minimizing the area of the electric room to add a telephone room.	
Change Reason	**Change Factor**	**Change Stage**
(1) Design Fault. (2) Meeting government regulations	Government	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 7 days for re-design and approvals.	+ DHS 2,400 for re-design	(1) Necessary requirement (2) Better performance
+ 10 Days for construction	+ DHS 17,000 for construction	
Steps Taken To Mange The Change	Study ensures that the designer should bear the cost of constructing the new telephone room including the contractor expenses required to cover this job.	

Type Of Change	Constructing shed to protect the on roof water tanks from sun effects.	
Change Reason	**Change Factor**	**Change Stage**
(1) Protect the water tanks from sun effect (user satisfaction) (2) Minimize maintenance cost	Client	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 5 Days	+ DHS 1,505	Better quality
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The contractor claims for 5 days for constructing the required materials.	

Case Study (23)

Project Information		
Project Type	Twin residential villas	
Project Components	Ground floor + first floor + roof + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 174,000	DHS 2, 650, 000
Project Duration	**Design Duration**	**Construction Duration**
	4 months	12 months
Contract Type	Lump sum contract	
Project Quality	**High quality specification**	

Project Changes

Type Of Change	The whole design has been changed.	
Change Reason	**Change Factor**	**Change Stage**
Client requirements have not been accurately perceived by the designer.	Client	Design
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 Days	+ DHS 353,000	(1) Better quality (2) Better performance (3) Client satisfaction
Steps Taken To Mange The Change	The engineering consultant re-designed the whole project and bearded the cost of change.	

Case Study (24)

Project Information		
Project Type	Fibreglass workshops Complex	
Project Components	Ground Floor (working area) + Mezzanine floor (offices) + store.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 174,000	DHS 4, 350, 000
Project Duration	**Design Duration**	**Construction Duration**
	4 months	12 months
Contract Type	The client is the contractor (lump sum contract)	
Project Quality	High quality specification	

Project Changes

Type Of Change	Adding workers dormitory + Dining Hall + Toilets + Facilities room.	
Change Reason	**Change Factor**	**Change Stage**
(1) Facilitating workers access since the workshop was located out of the town. (2) Increasing productivity. (3) Meeting market demand	Client	Post - Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 15 Days for design	+ DHS 65,960 for design	(4) Workers satisfaction (5) Increasing profitability
+ 90 Days for Construction	+ DHS 1,649,530 for construction	
Steps Taken To Mange The Change	The changes were approved according to the client desire to add the mentioned facilities and because his approval to pay the design and construction cost.	

Case Study (25)

Project Information		
Project Type	Luxurious office building	
Project Components	Ground floor + mezzanine floor + 17 typical floors + roof + 6 lifts + central dish antenna + central air conditioning + external glass cleaning machine	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 5,035,840	DHS 125, 896,000
Project Duration	**Design Duration**	**Construction Duration**
	8 months	24 months
Contract Type	Lump Sum Contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	(1) Changing the internal sections, zones and rooms distribution. (2) Changing the internal finishes and colours (flooring, walls, furniture).	
Change Reason	**Change Factor**	**Change Stage**
(1) Coping with the new market and technology requirements. (2) Grouping related activities and offices in the same area, which ensures better performance. (3) Creating friendly and productivity environment. (4) Meeting user demands.	Client / users	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 90 Days for design	+ DHS 776,395 for design	(6) Better work performance. (7) Employees and users satisfaction (8) Increasing profitability
+ 180 Days for Construction	+ DHS 19,409,890 for construction	
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The changes were approved according to the client desire to enhance the working environment and because his approval to pay the design and construction cost.	

Case Study (26)

Project Information		
Project Type	Urban planning project in the desert	
Project Components	Recreation area + fountains + open sittings + swimming pool + car parking + water Fall.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 84,000	DHS 2,100,000
Project Duration	**Design Duration**	**Construction Duration**
	4 months	12 months
Contract Type	Lump Sum Contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Changing the conceptual project design.	
Change Reason	**Change Factor**	**Change Stage**
(1) Lack of perception of the client needs and requirements. (2) The designer added some items without notifying the client, which do not commensurate with the project environment, the client objectives and escalates the project cost.	Designer	Late Design
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 120 Days for design	+ DHS 88,000 for design	(1) Better Quality (2) Meeting client Objectives (3) Commensurate with surrounding environment
Steps Taken To Mange The Change	The designer changed the client requirements with out prior notification. The project was delayed and was over budget. The client changed the design firm and the previous firm lost the project.	

Case Study (27)

Project Information		
Project Type	Commercial building	
Project Components	Basement floor + ground floor + mezzanine floor (4 offices) + 4 typical floors (4 two bedroom flat) + roof + 2 lifts + central dish antenna + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 248,520	DHS 6,213,000
Project Duration	**Design Duration**	**Construction Duration**
	4 months	12 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes		
Type Of Change	(1) Changing the external facade from curtain wall to solid walls and windows. (2) Change the specified cement block work to light thermal isolator block	
Change Reason	**Change Factor**	**Change Stage**
(1) Reducing Cost (2) Minimising cleaning and maintenance cost (3) Reducing A/C Capacity required for cooling the exposed areas. (4) Minimising the building weight, and then reducing foundation design.	**Client / Designer**	Design
Effect On Time	**Effect On Cost**	**Effect On Quality**
- 30 Days for designing and calculating curtain walls. - 60 days for fixing and testing curtain wall.	- DHS 62, 130 for design - DHS 210,000 for construction	(1) Better performance (2) Better environment climate.
Steps Taken To Mange The Change	Study ensures that the required changes would enhance the project performance, escalates its quality, reducing its cost without sacrificing its function or objectives.	

Case Study (28)

Project Information		
Project Type	Commercial building	
Project Components	Ground floor + mezzanine + 4 typical floors + roof + 2 lifts + central air conditioning + central dish antenna.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 327,146	DHS 8,178,657
Project Duration	**Design Duration**	**Construction Duration**
	4 months	12 Months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	After the building license has been issued as a commercial building, the client changed the building to be a medical centre.	
Change Reason	**Change Factor**	**Change Stage**
(1) Better Investment (20 years lease contract). (2) Market Demand	Client	Early construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 120 days for re-design and approvals.	+ DHS 327,146 as fees for re-design	Better quality
Steps Taken To Mange The Change	Study ensures that the client has to bear the cost of change.	

Type Of Change	Modification of the building finishes (internal and external)	
Change Reason	**Change Factor**	**Change Stage**
(1) Meeting user Requirements (atheistic purpose) (2) Functional Requirements	(1) Client (2) Investor (Hospital Management)	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 150 days	+ DHS 2,891,518	(1) Better Quality (2) Better performance
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The client claims for 150 extensions for modification.	

Case Study (29)

Project Information		
Project Type	Commercial building	
Project Components	Ground floor (services and show room) + mezzanine floor + 15 typical floors (2 one bedroom flat, 4 two bedroom flat) + roof + 3 lifts + central dish antenna + central air conditioning + external glass cleaning machine.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 687,520	DHS 16,500,48
Project Duration	**Design Duration**	**Construction Duration**
	5 months	18 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Moving the services rooms (pump room, telephone room, electrical room, transformer room) to the basement.	
Change Reason	**Change Factor**	**Change Stage**
Meeting the different clients' culture. After the design is already approved, the project clients changed the design to be two identical projects. For that reason the sole services are shifted to the basement.	Clients	Early Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 Days for re-design and approval of different related authorities.	+ DHS 19,008 for re-design	(1) Increase the show Room area. (2) Achieving clients' Satisfaction
+ 35 Days for construction	+ DHS 47,520 for construction	
Steps Taken To Mange The Change	Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference. The client claims for 65 days extension for constructing the required work.	

<table>
<tr><th>Type Of Change</th><td colspan="2">Changing the already approved elevation design.</td></tr>
<tr><th>Change Reason</th><th>Change Factor</th><th>Change Stage</th></tr>
<tr><td>Two different clients with different points of view.</td><td>Clients</td><td>Design</td></tr>
<tr><th>Effect On Time</th><th>Effect On Cost</th><th>Effect On Quality</th></tr>
<tr><td>+ 30 Days</td><td>+ DHS 13,750</td><td>Achieving clients' satisfaction.</td></tr>
<tr><th>Steps Taken To Mange The Change</th><td colspan="2">Study ensures that the required changes should not exceed the contract amount and in case the client has to pay the difference.</td></tr>
</table>

Case Study (30)

Project Information		
Project Type	24 Villas complex	
Project Components	Each villa consists of: Ground floor + First Floor + Roof + Garden + Parking + Central Air Conditioning + Swimming Pool + playgrounds.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 5,000,000	DHS 120,000,000
Project Duration	**Design Duration**	**Construction Duration**
	6 months	48 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Re-design the complex (general layout and villas).	
Change Reason	**Change Factor**	**Change Stage**
The designer did not understand the client and tenants' culture and traditions as well as the project land is not competently used.	Clients	Design
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 Days for re-design and approval of different related authorities.	+ DHS 45,000 for re-design	(1) Better quality (2) Achieving client's and tenants' satisfaction
Steps Taken To Mange The Change	Study ensures that the required changes should be made since the design does not satisfy the client requirements and tenants' needs and traditions. The design firm agreed to bear the cost of modification because its fault.	

Type Of Change	Changing the external finishes.	
Change Reason	**Change Factor**	**Change Stage**
(1) Minimising the project Cost. (2) Using local and Durable materials Instead of importing Materials (minimise Importing time).	Clients	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
- 60 Days	- DHS 185,750	Nil
Steps Taken To Mange The Change	Study approved the required changes since it will minimise the project cost & encourage the local industry without sacrificing the project quality. In addition, it will not exceed the contract amount and in case the client has to pay the difference.	

Case Study (31)

Project Information		
Project Type	Commercial Building	
Project Components	basement + ground floor + mezzanine floor + 4 typical floors + penthouse + roof + 2 lifts + central air conditioning + central gas system.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 85.534	DHS 5.200.195
Project Duration	**Design Duration**	**Construction Duration**
	3 months	12 months
Contract Type	Item price contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	Change the whole drainage line of the building	
Change Reason	**Change Factor**	**Change Stage**
The Drainage government authority made compete change to the direction of the drainage main line in the whole area.	Government Authority	Late Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 30 Days for re-design and approval of the related authority. + 45 days for construction of the new drainage line	+ DHS 25,000 for re-design + DHS 75.000 for construction of the new drainage line.	Meeting government authority requirements
Steps Taken To Mange The Change	No study made, but the contractor has to do the work in order to hand over the building.	

Type Of Change	Isolate the electrical cable in the basement floor and the A/C machine and the fan coil unit in the roof.	
Change Reason	**Change Factor**	**Change Stage**
Preventing any water leakage in the A/c room and prevent any electrical shock.	Government Authority	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+15 Days for executing the changed work	+ DHS 5,500 for re-executing the changed work.	More safety
Steps Taken To Mange The Change	No study made, but the contractor has to do the work in order to hand over the building.	

Case Study (32)

Project Information		
Project Type	District Mosque	
Project Components	Basement + Men Prayer hall + women prayer hall + mezzanine floor + roof + central air conditioning.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 300,000	DHS 15,000,000
Project Duration	**Design Duration**	**Construction Duration**
	4 months	18 months
Contract Type	Item price contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	(1) Increase the project area and modify the project Design (2) Adding car parking around the mosque.	
Change Reason	**Change Factor**	**Change Stage**
The project design and area does not meet the increase in the district population.	Government Authority	Late design
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 40 Days for re-design and approval of the related authorities. + 90 days for construction the additional and changed works	+ DHS 50,000 for re-design + DHS 500.000 for constructing the additional and changed work	Meeting district inhabitants' needs
Steps Taken To Mange The Change	Study ensured that these changes will enhance the project performance and the design firm will be paid the fees for re-design and authorities' approval and the contractor will be paid for constructing the new building as well.	

Case Study (33)

Project Information		
Project Type	Hospital	
Project Components	Basement + Ground floor + mezzanine floor + 5 typical floors + roof + central air conditioning + Central Gas system.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 600,000	DHS 30,000,000
Project Duration	**Design Duration**	**Construction Duration**
	6 months	18 months
Contract Type	**Design and build**	
Project Quality	High quality specification	

Project Changes

Type Of Change	Constructing a new building for the external clinics	
Change Reason	**Change Factor**	**Change Stage**
The ministry of health decide to shift the external clinics to a new building away from the hospital but connected with links in order to keep the hospital as quiet as possible.	Government Authority	Late construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
+ 60 Days for re-design and approval of the related authorities. + 240 Days for constructing the new building.	+ DHS 2,000,000 for additional construction work	Enhance the hospital performance
Steps Taken To Mange The Change	Study ensured that these changes will enhance the project performance and the design firm will be paid the fees for re-design and authorities' approval and the contractor will be paid for constructing the new building as well.	

Case Study (34)

Project Information		
Project Type	Commercial building	
Project Components	Basement + Ground floor + mezzanine floor + 17 typical floors + roof + central air conditioning + Central Gas system.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 1,520,000	DHS 76,000,000
Project Duration	**Design Duration**	**Construction Duration**
	6 months	18 months
Contract Type	Lump sum contract	
Project Quality	High quality specification	

Project Changes

Type Of Change	(1) Changing the woodwork, cupboards, and kitchen cabinets. (2) Changing the aluminum, glazing system, false ceiling, and the internal finishes.	
Change Reason	**Change Factor**	**Change Stage**
The prices mentioned in the Bill of Quantities are less than the market prices, so the contractor will lose if he followed these prices. According to this the contractor changed the specified materials with other materials and brought false but more expensive quotations and asked for extra money. It is worth to mention that the contractor deceived the client that the changed materials are better that the specified noes	Contractor	Construction
Effect On Time	**Effect On Cost**	**Effect On Quality**
Nil	- DHS 2.500.000 for additional construction work	Nil
Steps Taken To Mange The Change	No study made. But when the project is completed and during the initial settlement the contractor asked for DHS + 5,000,000 but after the checking of the false prices the designer decided that the amount of DHS 2,500,000 has to deduct from the contractor balance.	

Case Study (35)

Project Information		
Project Type	Office building	
Project Components	Basement + Ground floor + mezzanine floor + 17 typical floors + roof + central air conditioning + Central Gas system.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 800,000	DHS 40,000,000
Project Duration	**Design Duration**	**Construction Duration**
	6 months	18 months
Contract Type	Item price contract	
Project Quality	High quality specification	

Project Changes		
Type Of Change	Changing the structural design system from reinforced concrete system to steel structure system.	
Change Reason	**Change Factor**	**Change Stage**
(1) Reducing project duration. (2) Creating wide spaces without columns	Contractor	Late design
Effect On Time	**Effect On Cost**	**Effect On Quality**
+1 month for re-design and approval of the related authorities. - 4 months for constructing the new changes	+ DHS 30,000 for rd-design + DHS 1.500.000 for additional construction work	Enhance functional performance
Steps Taken To Mange The Change	Study ensured that these changes will enhance the project performance and reduce the project duration. The design firm will be paid the fees for re-design and authorities' approval and the contractor will be paid for constructing the new building as well.	

Case Study (36)

Project Information		
Project Type	Secondary school	
Project Components	Ground floor + 2 typical floors + roof + central air conditioning + play ground + lectures theatre + activities hall + swimming pool + library hall.	
Project Cost	**Design Cost**	**Construction Cost**
	DHS 700,000	DHS 35,000,000
Project Duration	**Design Duration**	**Construction Duration**
	6 months	24 months
Contract Type	Fixed price + percentage	
Project Quality	High quality specification	

Project Changes

Type Of Change	(1) Delete the traditional lecture theatre and Amalgamate it with the activities hall equipped with movable amphitheatre. (2) Minimise the library hall because of using electronic library system connected to information centres.	
Change Reason	**Change Factor**	**Change Stage**
(3) Reducing project cost. (4) Collect similar activities in one place. (5) Adapt to information Technology.	Client (Government authority)	Late design
Effect On Time	**Effect On Cost**	**Effect On Quality**
+1 month for re-design and approval of the related authorities. - 4 months for constructing the new changes	+ DHS 30,000 for rd-design - DHS 500,000 for changed work	Enhance functional performance
Steps Taken To Mange The Change	Study ensured that these changes would enhance the project performance and reduce the project cost. The design firm will be paid the fees for re-design and authorities' approval and the contractor will be paid for constructing the new building as well.	

Drivers for dynamic brief development in construction

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Keywords

Construction industry, Project management

Abstract

Confining the development of the project brief to a certain stage hinders the interaction between the client and the designer. In addition, it inhibits the incorporation of the influential internal and external factors that may affect the project. In spite of the frequently adverse impact of change orders on project cost, time and quality, literature review and case studies showed that client organisations continue to use change orders to achieve their expectations and enhance their projects' performance principally because current construction management process instills an expectation that, change after a specified point is somehow outside the project brief rather than part of the ongoing development of that brief. This paper introduces the concept of dynamic brief development (DBD), a process that facilitates client satisfaction, meets the need to adapt to the brief developing factors for the benefit of the project and fulfils the desire to manage project change orders. In this paper, the need, aims and principles of the concept of DBD are explained and the factors driving brief development are identified. In addition, the rationale behind each factor is given and the case study sampling method is described.

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Introduction

The recognition that clients are the core of the construction process reveals the importance of achieving their satisfaction (Bennett *et al.*, 1988; Kamara *et al.*, 2000; Latham, 1994). Two objectives have to be met in order to achieve client satisfaction. First, the translation of client needs into a design, which specifies technical characteristics, functional performance criteria and quality standards; and secondly, the completion of the project within a specified time and in the most cost effective manner (Bowen *et al.*, 1999). Clients are most likely to be satisfied when the final product matches or exceeds their expectations (Ahmed and Kangari, 1995; Hudson, 1999). Smith and Wyatt (1998) state that the early stages in the development of a project are crucial to its success. This is because the significant decisions made during these early stages influence the characteristics and form of the project. Once these decisions have been made, by their very nature, they cannot be readily deleted or dramatically changed in subsequent stages. As a result, changing the project brief, after it has been established and in particular at later stages, has an impact on project cost, time and quality. Late changes to the brief are considered a major source of dispute and litigation globally throughout the construction industry (CIC, 1994; Kubal, 1994; O'Brien, 1998; Veenendaal, 1998). In an endeavour to eliminate brief changes during the construction process, the Royal Institute of British Architects (RIBA) Plan of Work, updated and approved by the RIBA Council in 1998, freezes the modification of the project brief after the detailed proposal stage (RIBA, 2000). This is not reflected in practice, however. Emerging client requirements, the construction industry's fragmented nature, long investment terms, risk exposure, time consumption and a myriad of other internal and external influences, may urge client organisations and construction professionals to change what was established at earlier stages. Literature review and an analysis of 36 case studies undertaken by the authors showed that many of these "late" changes have enabled client organisations to more fully achieve their emerging requirements, meet user needs, cope with regulation changes, exploit business opportunities, adapt to technology improvement, add more value and manage associated risks (Bates, 1996; Burati *et al.*, 1992; Chapman, 1997; Gardiner and Simmons, 1992).

The main aim of this paper is to introduce the concept of a dynamic brief development (DBD) process justified by the importance of achieving the client's needs (Latham, 1994) and the need to focus on the customer as a driver for enhancing the performance of the construction industry (Egan, 1998). DBD must also recognise the need to manage the drivers that affect the project brief for the benefit of the project and the desire to manage project change orders. This paper argues the need for permitting development of the project brief across the project life cycle and aims to establish the concept of DBD. The specific objectives of the research are:

(1) to define and identify the drivers for brief development,
(2) to establish the principles of DBD, and
(3) to define a time frame within which to manage the defined drivers.

Methodology

The aim and objectives outlined above called for a research strategy, which could gather data sufficiently rich to reveal the drivers for the definition of DBD. Two approaches were employed, namely literature review and case studies. The literature review was used to

(1) review the current theory relating to brief development, and
(2) identify the drivers of brief development.

The literature review resources depended on textbooks, academic and professional journals, conference and seminar proceedings, dissertations and theses, organisations and government publications as well as Internet and related Web sites. In order to validate the drivers identified from the literature review, field data from 36 construction projects were collected and analysed. The research, unusual in that access, was available to a very large number of construction projects. This sample was too large for analysis within the time scale available so a random sampling method was used to define the data set for the case studies (see below). These case studies comprised of recently completed projects and the information obtained was classified into two main types: the first being project information (e.g. project type, components, cost, duration, contract type and project quality); and the second concerned the development of the project brief (e.g. development type, driver, stage, effects on time, cost, quality and the steps adopted to manage the development). The use of case studies confirmed the identification of brief developing drivers and added new drivers which were not covered by the current literature. These new drivers were specific to the culture of the surveyed society.

The case studies comprised a detailed inspection of project files to collect information about the project history and the project brief at the end of the strategic briefing stage. Particular attention was paid to gathering information from the correspondence between the related parties (such as client-designer, client-funding bodies, designer-other consultants and designer-government authorities), minutes of meetings, internal memos, drawings and specifications. Following the examination of the project files, an unstructured interview was held with the project architect, when appropriate, to investigate the way in which the project brief was developed. By using more than one source of evidence (project documentation and the recollection of the project architect) it was possible to improve the validity of the collected brief developing drivers and increase background knowledge. In an effort to ensure the reliability of the data, data collection concentrated on facts and events, rather than subjective interpretations (MacPherson *et al.*, 1993; Yin, 1989). Literature review and case study resulted in the identification of 47 drivers of brief development. The work was reviewed and refined by the authors on a regular basis in order to omit repeated drivers and merge similar ones. The end result was the identification of 30 factors that can cause the project brief to change and develop.

Case study sampling

The objective of the case study sampling was to select a representative and non-biased sample of construction projects from which to identify the brief developing drivers. The survey was undertaken in Abudhabi, United Arab Emirates and information about the distribution of the districts surveyed was collected from the Department of Social Services and Commercial Buildings, UAE. The city was divided into 87 districts (DSSCB, 2000). Random number tables were used to select 45 districts, which represented 51.72 per cent of the total. Ten districts were excluded because of the difficulty in obtaining information about the projects in general and the brief development in particular due to national security matters. Buildings in each district were counted up and each building was given a unique number to form a table of 900 buildings. A systematic sample of 36 buildings (1 : 25) was used to select the case study sample. This sampling methodology effectively covered the surveyed city, so the identified brief developing drivers were extracted from different projects constructed in different districts, with different regulations, types, clients organisations, cost, time and quality, all of which contributed to the reliability and validity of the definition of the drivers of brief development.

Engineering, Construction and Architectural Management
Volume 11 · Number 4 · 2004 · 248–258

Current theory relating to brief development

Briefing in construction has become the focus of considerable attention in the post-Latham era, both within the research community and amongst industry professionals (Hassanen and Bouchlaghem, 1999). The following section is devoted to the definition of the terms used within this paper and to present the different approaches to brief development throughout the project life cycle.

Definitions

The "brief" is a formal document which is the medium for expressing or communicating the objectives and needs of the client (Bennett *et al.*, 1988; CIB, 1997; Goodacre *et al.*, 1982; Hellard, 1993). The brief contains information for project implementation and should include:

(1) the background, purpose, content and desired outcomes of the project;
(2) the functions of the intended facility and the relationship between them;
(3) cost and time target;
(4) instructions on procurement and organisation of the project; and
(5) site and environmental conditions, safety, interested third parties and other factors which are likely to influence the design and construction of the facility (Kamara, 1999).

To "develop" is defined as to unfold gradually, or in detail; to change from one state into another by modification, omission or addition to a project document, design, process or method approved or accepted earlier. Development is defined as an unfolding growth or progress (Gardiner and Simmons, 1992; Webster's Dictionary, 2000). Therefore, for the purpose of this paper, "brief development" is defined as a "detailed, gradual unfolding, growth, progress or change either by modification, omission or addition to the brief document contents that will affect the final product and hence affect the achievement of the client objectives, needs and satisfaction".
In addition, "drivers of brief development" is defined as the drivers that lead to unfolding, growth, progress or change of the project brief.

There appears to be a split in the approach to brief development. One approach considers the brief as an entity in itself, which should be frozen after a critical period (approach A). Decisions tend to be taken as early as possible, and briefing becomes a stage or stages in the design and construction process. The other approach (approach B) considers the brief as a live and dynamic document that develops iteratively from an initial global brief in a series of stages. Briefing is deemed as an ongoing activity that evolves during the design process (Barrett *et al.*, 1996; Kamara, 1999). This approach is emphasised by Barrett and Stanley (1999) who define the "briefing process" as the process running throughout the construction project by which means the client's requirements are progressively captured and translated into effect. These schools of thoughts are illustrated by the following examples.

The RIBA plan of work

The RIBA plan of work states that the brief is normally developed in three phases. In the first phase, the client establishes the need for the project objectives, perhaps by way of a business case. In the second phase, which is the most effective if carried out after completion of feasibility studies and/or option appraisals, the strategic brief is developed from the initial statement to provide sufficient information for the consultants to commence the design process.
In the third phase, the project brief is developed from the strategic brief in parallel with the design process during the work stages C and D, namely outline proposals and detailed proposal stages, respectively. The project brief is to be frozen at the end of the detailed proposal stage (RIBA, 2000).
The RIBA plan of work emphasises the need to produce an explicit and detailed brief at an early stage, and then to work to it as closely as possible (Barrett *et al.*, 1996) and is an example of approach A.

The process protocol

The process protocol is the result of collaboration between a number of like-minded organisations from various disciplines within the UK construction industry together with the research expertise of the University of Salford and Loughborough University in UK. The process protocol is a common set of definitions, documentation and procedures that provide the basis for a wide range of organisations involved in a construction project to work together seamlessly.
It emphasises the need to improve coordination between different parties through the adoption of manufacturing industry perspective. The protocol presents a map for the construction process, where the project brief is finalised at the production information stage and places a soft gate between the production information stage and the construction stage. All solutions and various options and requirements are fixed for construction (Kagioglou *et al.*, 1998). The process protocol also leans towards approach A.

The Netherlands approach

In The Netherlands, the brief is seen as a process and not an event. It is a process that not only starts early but also continues to inform all the technical work throughout the project. The brief is explicitly managed to evolve through various stages in parallel with the technical information till specification stage and could be extended through the construction stage. Continued interaction with the client is essential in this process, the underlying principle is to make as few decisions as possible at each stage. This means identifying the critical decisions and leaving flexibility on other issues for later consideration as more information becomes available (Barrett and Stanley, 1999). This follows approach B.

Learning from experience: applying systematic feedback to improve the briefing process in construction (LEAF)

LEAF is the title of 2 years research led by the University of Sheffield, UK with the collaboration of many partners. The theme of the project is the improvement of the client briefing and evaluation process by systematising the gathering and application of feedback to improve the industry productivity and user satisfaction. It states that the failure to learn from the accumulated wealth of experience from completed construction projects is both costly and unproductive (Phiri and Haddon, 2000). This does not follow either approach but emphasises the need to improve based on learning.

The need and aims of DBD

The importance of the DBD concept arises from two significant flaws in current practice, which are discussed below.

Deficiencies of the current briefing process in achieving client satisfaction

The RIBA plan of work limits the brief development to the detailed proposal stage. Barrett *et al.* (1996) state that there are a number of problems with this approach. Clients' ideas develop as the possibilities of a design unfold and a beneficial creative dialogue with the design team can occur. An insistence on adhering to a detailed early brief will inhibit such a dialogue occurring. Many client organisations are in a state of dynamic change. That is often why they need a new building in the first place. However, the rate of change may be such that their requirements change during the course of the project. A static brief will prevent these changes from being accommodated.

Rezgui *et al.* (2001) state that clients prefer to consider the briefing process as extended until almost the final stage of construction to ensure that the final product meets their requirements and fulfils their objectives. On the other hand, consultants tend to consider the briefing as a limited process with a well-defined start and end to be able to claim fees for any extra work. In addition to this, neither the process protocol nor The Netherlands approach extend the briefing process to cover the after practical completion stage, where the lessons learned could be fed back to enable client organisations and construction professionals enhance the briefing process for new projects as promoted by LEAF.

Managing project change orders and adapting to the influential internal and external drivers

Very few projects are implemented without any change to the original scope of work (Hansen, 1994). Change orders are often taken as an indicator of someone's failure to fulfil his or her functions in the construction process. It is argued that no one benefits from change orders during the construction period. They are generally disruptive of the orderly progress of the work and are usually an economic burden on both client and contractor (O'Leary, 1992). Change orders are seen as a major cause of project delay and a source of many disputes in today's construction industry (Al-Khalil and Al-Ghafly, 1999; Hanna *et al.*, 1999; Mezher and Tawil, 1998; Zaimi, 1997). On the other hand (O'Brien, 1998; PMI, 2000), client organisations use change orders to achieve their emerging requirements and adapt to influential internal and external drivers, such as exploiting new business opportunities and installing an improved technological system not available during the brief and design stages. Smith and Wyatt (1998) state that external forces may drive changes and clients respond to these forces by demanding a design that is more effective and more efficient. Chapman (1997) emphasises that effective client organisations are those who adapt and change in response to their environment and markets. In addition, successful design practices are those who manage changes successfully. As a result, the more influential the internal and external drivers, the greater the use of change orders, in particular, during the construction and after practical completion stages. There is a need to decide on how to react to these drivers for the benefit of the project. This decision process should include the consideration of potential value and associated risk and be dynamic and ongoing.

The inability of the current briefing process in achieving client satisfaction and adapt to

influential internal and external drivers for the benefit of the project as well as the need to manage project change orders, dictate the need for DBD. This concept will
(1) enable client organisations achieve their expectations,
(2) facilitate an innovative response to the drivers that may develop the project brief by unfolding, growing, progressing or changing its content for the benefit of the project, and
(3) manage project change orders minimising their impact on project cost, time and quality.

Factors driving brief development

In order to respond effectively to the brief developing drivers, these drivers have to be identified and 30 drivers within 13 categories were extracted from literature review and case studies. Table I lists the factors that drive project brief development and indicates whether the driver was identified from literature, case study or both. The concept of DBD extends the brief development throughout the project life cycle, therefore, the case studies covered all project stages from the appraisal stage till the after practical completion as shown in Figure 1. This figure shows that brief developing factors occur more frequently during the construction stage, where it is expensive and difficult to execute changes confirming the importance of understanding this.

The rationale behind the definition of the brief developing drivers

Many of the factors driving the development of the brief were identified from the literature review and confirmed by the analysis of the case studies as shown in Table I. However, the case studies revealed additional drivers not recognised earlier in literature, although the examples collected were from one city only, they do not appear to be particularly country/culture specific. Thirty drivers were identified and considered in 13 groups, the rationale behind their occurrence is given below by a summary of literature and/or specific case study examples.

Drivers relating to communication, clarity and understanding

Barrett and Stanley (1999) stated that very few buildings finish on time or at the right price and clients often criticise the fact that the finished building is not what they expected. Clients, particularly naive ones, may find it difficult to describe their objectives and operations to another party, which leads to the production of unclear and incomplete project brief. This becomes a greater problem when the designer is not skilled in the art of questioning. In addition, lack of presentation and visualisation techniques inhibit the client's understanding of project design and what the building will look like. It would appear that at one or more stages of the construction process there must be a lack of communication between the parties involved. Male *et al.*'s (1992) analysis of case studies showed that architects are more likely to gain kudos from peer approval than from the satisfaction of their clients and may ignore the role of the client and behave unilaterally. These are factors which have resulted in clients dissatisfaction and driven them to develop the project brief by changing, modifying, omitting and adding to its contents.

Drivers relating to feasibility studies

A Feasibility Study is defined as a study to determine the probability that a specific real estate proposal will meet the objectives of the developer and/or investor (Collins, 1999). De Valence (1999) states that there are numerous examples of projects proceeding to detailed design stage without proper feasibility studies. Improper feasibility studies and the absence of reasonable alternative options including a no-build option lead to the failure of the project and the project brief to meet the client objectives and market and business needs.

Drivers relating to value

Value Engineering is defined as the process of relating the function, the quality and the cost of the project in the determination of optimum solutions for the project (Omigbodun, 2001). Initiating value engineering changes contributes to the production of better and smarter designs (Stocks and Singh, 1999). This could be achieved through developing the project brief by improving functionality (AMEC, 1999), eliminating unnecessary costs (Dell'Isola, 1997), simplifying design, using substitute cheaper materials that have same or better quality, using substitute construction methods and equipment that have greater capacities, higher efficiencies, higher speeds and lower operating costs, for instance (Tenah, 1985).

Drivers relating to project users

An example of this in the case study was identified in a housing project consisting of 400 houses designed by a foreign consultant, who did not

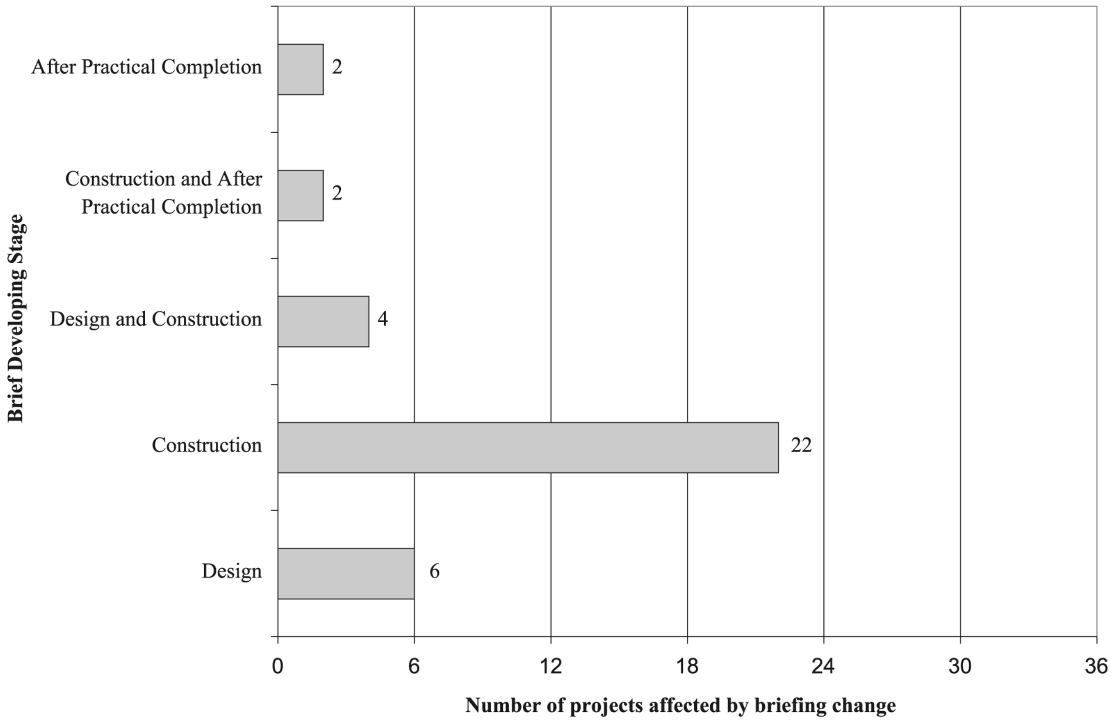
Engineering, Construction and Architectural Management
Volume 11 · Number 4 · 2004 · 248–258

Table I The brief developing factors

No.	Brief development drivers	From literary review	From case study
Drivers relating to communication, clarity and understanding			
1.	Unclear and incomplete project brief (Barrett and Stanley, 1999)	×	×
2.	Inappropriate communication between client and designer (Barrett and Stanley, 1999)	×	×
3.	*Lack of understanding of the Client organisation*		×
4.	*Designers ignore the Client and behave unilaterally*		×
5.	Lack of presentation and visualisation of design (Barrett and Stanley, 1999)	×	×
Drivers relating to feasibility studies			
6.	Inappropriate feasibility studies (De Valence, 1999)	×	×
Drivers relating to value			
7.	Initiating value engineering changes (Stocks and Singh, 1999)	×	
Drivers relating to project users			
8.	Project users not involved in the briefing process (Kernohan *et al.*, 1992)	×	×
9.	*Lack of understanding of different users' culture and traditions*		×
Drivers relating to coordination and accuracy			
10.	Uncoordinated and incorrect construction documents (O'Leary, 1992)	×	×
Drivers relating to inadequate provision of information			
11.	Brief information still being given during later design and construction stages (Barrett and Stanley, 1999)	×	×
12.	Lack of consideration of environmental requirements (Best and Valence, 1999)	×	
13.	Lack of information provision (Barrett and Stanley, 1999)	×	×
Drivers relating to regulations and technology advancement			
14.	*Lack of regulatory updating*		×
15.	Changing government regulation and codes (O'Leary, 1992)	×	×
16.	*Meeting new technology changes*		×
17.	*Lack of communication and coordination between government authorities and design firms over planning and approvals*		×
Drivers relating to Quality and Sustainability			
18.	*Lack of functional, aesthetic, safety requirements and construct ability*		×
19.	Whole project life not considered (CIB, 1996)	×	×
20.	*Upgrading project facilities*		×
21.	*Eliminate proven poor quality materials and equipment*		×
Drivers relating to design cost and time			
22.	Inadequate available design time (ICE, 1996)	×	
23.	Restricted design fees (ICE, 1996)	×	
Drivers relating to unforeseen conditions			
24.	Unforeseen conditions (O'Brien, 1998)	×	
Drivers relating to market conditions and user demands			
25.	*Stakeholders change project requirements and have second thoughts at later stage*		×
26.	*Project users appear at later stages*		×
27.	*Users exaggerate their needs*		×
28.	Responding to market demand (Smith and Wyatt, 1998)	×	×
Drivers relating to lack of design expertise			
29.	Materials are no longer available in market or use of better/substitute materials (Tenah, 1985)	×	×
30.	*Lack of design experience*		×

Note: Please note that the factors in "italics" represent the factors for which there is no allowance under existing briefing systems and are extracted from case studies

Figure 1 Number of projects affected by briefing change vs project stage



adequately understand the culture and traditions of the end-users. After the practical completion stage of the project, the users implemented significant changes in order to meet their requirements such as privacy and the ability to add more rooms for future increase in their family sizes. Mustapha and Bintaher (2000) state that the needs of the occupants may change, therefore housing cannot be considered as a final product, but rather a process that needs to be continuously updated. The development of the project brief should highlight to the client organisation, the importance of involving project users in the briefing process and understanding their requirements, culture and traditions.

Drivers relating to coordination and accuracy

Changes in the scope or details of construction originate from various sources. One of the main sources is the faulty construction documents, which will generate the unexpected need for alternative materials or process (O'Leary, 1992). Uncoordinated and incorrect construction documents emerge from the unfamiliarity of the designer with the project, time shortage, misunderstanding, information overload, over manning, etc. (Wantanakorn *et al.*, 1999). This leads to develop the project brief in order to rectify the incorrect project documentation and resolve the contradictory between different documents such as, drawings and specification in an endeavour to make sure that the client requirements are correctly reflected in the project documents.

Drivers relating to inadequate provision of information

An example of this was seen in a case study project comprising a residential compound in the desert. It consisted of 35 buildings. The project cost was Dirhams (DHS) 53,760,000[1] and the construction period was 24 months. Because of the uniqueness of the project as it was the first of its kind to be constructed in that area, brief information was being delivered during later design and construction stages. Lack of information provision such as soil nature and electricity load of the project resulted in changing the structural design from shallow foundation to deep piles and changing the electricity connection cable to suit the project size, which delayed the project handover for 180 days. In addition, lack of considering environmental requirements urged the designer to change the design to suit the area weather and shift the water tanks from exposed to underground water tanks in order to protect them from hot climate and sand storming. The above drivers resulted in developing the project brief and increasing the project cost by DHS 5,692,813 and increasing the redesign and construction period by 255 days.

Drivers relating to regulations and technological advancements

The case study project, best illustrating this, was a commercial complex consisting of basement floor (2 Cinemas), ground and mezzanine floors (showrooms), 12 typical residential floors, roof, swimming pool, health club, six lifts, four escalators, central gas system, central water filtration system and central dish antenna. The cost of the project was DHS 76,960,000 and the construction period was 20 months. Changing the government regulation and codes during the course of the project and the lack of the designer to update these changes, resulted in changing the purpose of the basement to be a shopping centre to suit the surroundings of the project and cover the shortage of shopping centres in that area.

In addition, the lack of communication and coordination between the government authorities and design firms over planning and approvals resulted in modifying the brief by adding new spaces and equipment for future telecommunication connections. The brief development, according to the above mentioned drivers, resulted in 25 days extra for redesign and approvals and DHS 246,667 as extra design cost. In addition, these changes reduced the construction period by 60 days and reduced the cost by DHS 725,000.

Drivers relating to quality and sustainability

An example, from the case studies was a refurbishment project comprising the modification of an existing residential complex and the construction of new recreation area, fountains, swimming pool and car parking. The client's objective was to upgrade the project facilities and add new services in order to enhance the project performance, increase its rent and attract new tenants. Many of the materials and equipment used in the existing project such as finishes, sanitary ware, fire fighting systems and lifts were proven poor quality and the maintenance cost as well as the whole project life was not considered. In addition, lack of functional, aesthetic, safety requirements resulted in development of the original brief in order to meet the client's objectives. This development included redesign of flats and circulation areas, changes to internal and external finishing, the construction of new aesthetic facades, enhanced safety requirements, installation of high quality durable materials and equipment, for instance. In spite of the cost, time and effort spent in developing the original brief, client objectives and satisfaction were achieved increasing the annual income as well as enhancing the project performance.

Drivers relating to cost and time

Every architect, engineer and other professional has target dates by which their documentation must be delivered. Concern about meeting deadlines limits the time available for cost comparisons and value management.

An inadequate budget for completing a design properly encourages designers to take shortcuts in the design process and can adversely affect the completed facility (ICE, 1996). These are some factors that may drive the client and designer to develop the project brief in a later endeavour to achieve maximum value and complete the design properly.

Drivers relating to unforeseen conditions

Unforeseen conditions cause brief development when the conditions of the field do not match the contract documentation. This most often occurs with regard to underground conditions, such as uncharted utilities, uncharted existing foundations, rock or other strata at higher elevation than expected, high groundwater, and so on (O'Brien, 1998). Such conditions force the client and the designer to change and modify the project brief in an attempt to overcome these obstructions and deal with unexpected circumstances.

Drivers relating to market conditions and user demands

An example was found in a project designed to be a commercial building. After the design was completed and the building license was issued, the client received an offer to lease the building for 20 years, if the design was changed to a medical centre provided with the latest technological equipment and facilities. Because of the lack of market demand for commercial buildings and the business opportunity offered, the client decided to change the project design accordingly. This development of the project brief, which happened at the end of the pre-construction period, resulted in 100 extra days and additional cost of DHS 298,908 for redesign and approvals. A further 180 days was required to find a funding body to finance the extra DHS 2,104,318 for hospital equipment. The benefits that the client gained, however, far outweighed the increases in cost and time. The annual return for the commercial building was DHS 550,000, excluding the maintenance cost, which was the responsibility of the client, whereas the annual return of the medical centre was DHS 1,000,000, excluding the operation and maintenance cost, which was the responsibility of the medical centre.

Drivers relating to lack of design expertise
An example from the case study was a luxurious office building. Its facades were covered with curtain walls and most of the specified materials were imported. Rapid material and technological improvement, coupled with the lack of designer experience to follow-up these improvements meant many of the specified materials were no longer produced or available in the market. As a result, the client had to change the design of the facades and decided to use locally made materials. This development of the project brief enhanced the project performance. First, the redesign of the project facades reduced the air-conditioning cooling capacity required and became more suitable for a country having a hot and humid climate. In addition, these developments to the project brief minimised the project duration by eliminating the time required to import material from abroad and reduced the project cost by using locally made materials (Tenah, 1985). The construction period was reduced by 90 days and the cost was reduced by DHS 380,000.

The definition and identification of the factors of drive brief development demonstrates the need to allow the brief to develop without confining this to a specific design or design stage. Facilitating brief development in this way will increase client satisfaction and reduce the number and improve the management of project change orders.

Principles behind the concept of DBD

The following underlying principles of the DBD concept have been identified within the research. These principles represent the basis that will facilitate the achievement of the concept aims.

(1) The briefing process has to be deemed as an ongoing process extending throughout the project life cycle, responding in an innovative manner to emerging client requirements, meeting user needs, coping with regulatory changes, exploiting business opportunities, adapting to technological improvement, adding value and managing associated risks. This flexible approach will contribute to the achievement of client expectations, adapt to the influential internal and external drivers for the benefit of the project and hence, avoid the consequences of change orders as a result of not considering these drivers.
(2) The project brief has to be considered as a live document, which needs to be continually developed throughout the project life cycle.
(3) Feed back to the client organisation as well as the design and construction team of the lessons learned and comments from the facilities management team and end-users will enhance the performance of the briefing process in future projects.
(4) A system to manage the brief developing drivers is required. This system must respond to these drivers in a way that adds value and reduces associated risk in an endeavour to achieve client satisfaction and manage project change orders.

Time frame/process stages

According to the RIBA plan of work, the work stages into which the process of designing building projects and administrating building contracts is divided into three main stages, namely feasibility, pre-construction period and construction period (RIBA, 2000). The DBD concept proposes five stages throughout the project life cycle during which factors influencing the development of the brief could occur. The completion of each stage provides a milestone indicating an opportunity to evaluate the progress of the brief development and its success in meeting client requirements. The rationale behind selecting these milestones is attributed to the following:

Milestone (1) comes at the end of one of the most important stages, the feasibility stage, where the client requirements are first identified, studies that enable the client to decide whether to proceed and select the probable procurement method are prepared and the strategic brief is identified. Evaluating the project brief at this milestone represents the basis to compare subsequently developed brief versions.

Milestone (2) evaluates the brief development at the end of the detailed proposals stage where the information becomes more concrete and the pace of change is reduced as well as the detailed proposals are prepared. This milestone should reflect the influence of internal and external drivers on design since clients' ideas develop as the design alternatives unfold.

Milestone (3) comes at the end of the tender action stage, which represents the end of the pre-construction period and the beginning of the construction period, the tender documentation is ready, potential contractors and/or specialists for the construction of the project are identified and evaluated. In addition, tenders are obtained, appraised and recommendations are submitted to client. Evaluating brief development takes a particular importance because the cost of change or modification after this stage is expensive.

Milestone (4) evaluates the brief development at the end of the construction to practical completion stage. Implications of the drivers that affected the project brief during construction in terms of cost, time and quality, should be reflected in the developed brief. Figure 1 shows that the construction stage represents the stage that witnesses most frequent development of the project brief. This can be attributed to the industry's fragmented nature, long investment term, risk exposure, time consumption, and myriad of other internal and external influences.

Milestone (5) comes at the practical completion stage, where the final inspections and settlement of the final account occur. Evaluating brief development at this milestone provides the client organisation, design team and construction professionals with learned lessons and feedback from the end-users and facilities management team, all of which play an important role in improving the briefing process for future projects.

Summary of findings and conclusion

This paper investigates the existing theory on briefing activities and seeks to identify the factors that drive the need to change and develop the original brief. Achieving client satisfaction implies that the final product matches or exceeds client expectation and that the final product should be a reflection of the requirements of the brief. Changing the project brief has, often negative, impact on project cost, time and quality, however, literature review and case studies showed that changing the project brief better enabled client organisations achieve their expectations and enhance the performance of their projects. Although the Process Protocol and The Netherlands approach extend the project briefing activities beyond the detailed design stage where the brief is frozen under the RIBA plan of work, they do not cover the stage after practical completion, where a wealth of learned lessons and feedback could enhance performance on new projects.

Literature review and case studies revealed 30 brief developing drivers within a broad classification of 13 categories, requiring the attention of client organisations and construction professionals throughout the project life cycle if client satisfaction is to be achieved, the number of project change orders minimised and these drivers adapted for the benefit of the project.

The failure of current briefing theory and practice to fully embrace the factors that drive brief development in order to achieve client satisfaction, coupled with the need to manage project change orders and the desire to adapt to the influential internal and external drivers, reveals a need to change the existing procedures. The concept of DBD would facilitate the incorporation of these fluctuating demands and relies on the following four underlying principles.

(1) The briefing process has to be deemed as an ongoing process extending throughout the project life cycle.
(2) The project brief has to be considered as a live document continually developing and adapting in an innovative manner to the influential internal and external drivers for the benefit of the project.
(3) Feeding back the client organisation and the design and construction team with learned lessons and comments of the facilities management team and end-users in order to enhance the performance of the briefing process in future projects.
(4) A system to manage the brief developing drivers has to be set out as early as possible.

Note

1 UAE dirham was valued at $0.27 US on 17 September 2003 by Expedia.com

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Analysis of factors that drive brief development in construction

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Abstract

Purpose – The purpose of this paper is to analyse the factors that drive changes to the construction project brief and the background to those factors. The founding argument, that incorporating these changes is paramount for achieving client satisfaction, introduces the concept of dynamic brief development (DBP), which permits changes throughout the project life cycle. The understanding and attitude of the major construction project stakeholders towards DBP are investigated along with identifying the originators of brief development and the value and risk sources.

Design/methodology/approach – A threefold method was used comprising a comprehensive questionnaire survey followed by structured interviews. The results of these were further investigated though a brainstorming session with major construction project stakeholders. A total population of 266,434 units for the survey was identified, reduced to a random stratified sample of 530. The response rate was 49.2 per cent and the responses were analysed using a weighted relative importance index. A total of 88 interviews were carried out and 12 client organisations participated in the brainstorming session.

Findings – The findings lead to the conclusion that there is a need to set out a detailed brief development management system that incorporates both value management and risk management. This system should enable the appropriate project participant to make informed decisions at the right time for the benefit of the client. The system must facilitate feedback to both client organisations and construction professionals to enable lessons to be learned. Understanding the relationship between the factors that drive brief development and the various project team members will facilitate managing brief development in a way that increases client satisfaction and enhances the performance of the project.

Originality/value – The paper identifies deficiencies in current practices and techniques and presents a system which overcomes them.

Keywords Dynamic audit, Construction industry, Customer satisfaction

Paper type Research paper

Introduction

Achieving client satisfaction has been identified as one of the most important challenges facing the construction industry in the 1990s (Torbica and Stroh, 2001), with Latham (1994) emphasising achieving client need and Egan (1998) focusing on the customer as a driver for enhancing performance. Clients are likely to be satisfied when the final product matches or exceeds their expectations (Ahmed and Kangari, 1995; Hudson, 1999). The need to achieve client satisfaction coupled with the dynamic, changing and fragmented environment of the construction industry (Bowen and Edwards, 1996; Kamara, 1999) results in the need to investigate the factors that drive the development of the brief. The research work presented in this paper aims to:

Engineering, Construction and Architectural Management
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(1) Investigate the brief developing drivers listed in Table I, determining their relative importance and establishing the correlation between them. This investigation intends to direct the attention and raise the awareness of clients' organisations and construction professionals to the most influential drivers of brief development.
(2) Investigate the understanding of design firms, constructors and funding bodies of the concept of brief development and identify the different techniques adopted to manage it.
(3) Establish the relationship between the brief developing drivers and the project team members in order to identify the originators of brief development and the value and the risk sources to the project brief from the client's point of view.

This paper presents the empirical findings from an unusually large sample and high participation rate that measures the behaviour of factors that drive changes which have hitherto only been partially or intuitively identified. Privileged access was available to the total population of construction project data within a single city

No.	Brief developing drivers
1	Unclear and incomplete project brief
2	Improper feasibility studies
3	Inappropriate communication between the client and the designer
4	Lack of understanding of the client organisations
5	Stakeholders change project requirements and have second thoughts at later stages
6	Initiating value engineering changes
7	Project users are not involved in the briefing process
8	Project users appear at later stages
9	Users exaggerate their needs
10	Lack of understanding different users' culture and traditions
11	Designers ignore the client role and behave unilaterally
12	Uncoordinated and incorrect construction documents
13	Brief information is still being given during later design and construction stages
14	Lack of design experience
15	Lack of presentation and visualisation of design
16	Lack of regulatory up-dating
17	Lack of functional, aesthetic, safety requirements and constructability
18	Whole project life not considered
19	Lack of consideration of environmental requirements
20	Inadequate available design time
21	Restricted design fees
22	Unforeseen conditions
23	Changing government regulation and codes
24	Lack of information provision
25	Lack of communication and co-ordination between government authorities and design firms over planning and approvals
26	Meeting new technology changes
27	Responding to market demand
28	Upgrade project facilities
29	Materials are no longer available in market and use better substitute materials
30	Eliminate proven poor quality materials and equipment

Table I.
List of brief developing drivers

(Abu Dhabi, United Arab Emirates) but as the quantity of data was too large for analysis, a rigorous method of sampling was applied. The objective of the sampling methods used was to represent the total population as closely as possible and give authority to the findings.

Methodology

Survey questionnaire, relative importance index and bivariate analysis were used to achieve aim (1), where structured interviews and a brainstorming session were used to achieve aims (2) and (3), respectively.

Data sampling

The sampling plan using a random probability sampling method was applied across all population categories so every unit had an equal chance of being included in the sample (Hannagan, 1986; De Vaus, 1990). This selected a representative and non-biased sample that was used to serve three different, but complementary, objectives. Firstly, to identify the questionnaire respondents' sample, then from the questionnaire responses, the second stage identified the parties who most influenced the brief development for interview. Finally, the client organisations that responded to the survey questionnaire were selected to attend a brainstorming session.

Questionnaire survey sample

The total population of 266,434 units was classified into seven different strata including client organisations, end-users, design firms, constructors, suppliers, government authorities and funding bodies. Stratified random sampling was adopted to ensure that the resulting sample would be distributed in the same way as the population in terms of the stratifying criteria (Bernard, 2000; Bryman, 2001). The units of the stratified random sample were chosen from a list of client organisations (DSSCB, 2000), the yellow pages directory (ETC, 2001) and the chamber of commerce and industry directory (ADCCI, 2000) using a sampling factor of 1:20 applied to each stratum resulting in the numbers shown in Table II. In order to select a more reasonable sample for end-users and government authorities, a sampling factor of 1:2000 was used for end-users sample to produce 131 units and 1:1 for government authorities, which means that all seven government authorities were chosen (Barnett, 1991). Table III shows a sample size of 329 with the total stratified sample of 530 units used for the questionnaire survey shown in Table IV. The sample size suits the population taking into account a 95 per cent confidence interval and 4.25 sampling error (De Vaus, 1990).

Stratum	No. of units	Stratum type	Sampling factor	Stratified sample
Client	1,390	Individual	1:20	69.5
End-user	261,298	Individual	1:20	13064.9
Design firm	175	Organisation	1:20	8.75
Constructor	315	Organisation	1:20	15.75
Suppliers	147	Organisation	1:20	7.35
Government authority	7	Organisation	1:20	0.35
Funding body	45	Organisation	1:20	2.25

Table II. Initial stratified sample size

Interview sample

The questionnaire responses showed the parties that most influenced brief development were client organisations, design firms, constructors and funding bodies. As client organisations were to participate in a brainstorming session, interrogation of the other three parties would be through interview. A total of 88 interviews were conducted with the interviewees all being either managers of design firms, heads of architectural, civil, structural, electrical and mechanical sections, managers of construction companies, senior project managers or heads of engineering sections in funding bodies.

Likert scale

It would have been possible to make a long list of relevant questions, particularly when asking about attitudes and opinions. To contain the length of the list, scaling methods were used as an alternative to asking questions, by utilising simultaneously a number of observations on each respondent (Hannagan, 1986). The Likert scale of 1 to 5 was employed to measure respondents' attitudes to the questions. Although there are many forms of scaling, the Likert scale was adopted because it is commonly used (Bernard, 2000), simple to construct, permits the use of latent attitudes and it is likely to produce a highly reliable scale (Baker, 1997).

Data analysis

A three-stage approach was adopted for the data analysis. The first stage was simply to measure the central tendency and dispersion of the questionnaire and interview responses. The measure of central tendency was used to get an overview of the typical value for each variable by calculating the mean, median and mode. The measure of dispersion was used to assess the homogenous or heterogeneous nature of the collected data by calculating the variance and the standard deviation (Bernard, 2000). Secondly, since not all-brief developing drivers have the same influence on brief development, a

Table III.
The average numbers of employees in construction and engineering departments

Category	Design firms	Constructor	Suppliers	Government authority	Funding body
Average no. of employees	6	6	3	20	9
No. of organisations	9	16	7	7	2
Sample size	54	96	21	140	18

Table IV.
The numbers of planned and returned questionnaires with their response rates

Surveyed category	Questionnaire planned	Questionnaire returned	Response rate (%)
Client organisation	70	38	54.28
End users	131	85	64.88
Design firms	54	35	64.81
Constructor	96	48	50
Suppliers	21	14	66.67
Government authorities	140	71	50.71
Funding body	18	8	44.44
Total	530	261	49.25

relative importance index was used to differentiate between drivers (Olomolaiye *et al.*, 1987; Shash, 1993). In order to investigate the correlation between the brief developing drivers, the third stage established the linear relationship between the drivers using bivariate analysis. The data were analysed with the aid of Microsoft Excel spreadsheet and the Statistical Package for Social Sciences (SPSS) computer software (Kirkpatrick and Feeney, 2001). Analysis of the collected data showed close values of means, medians and modes, indicated typical central values and showed also low values of variance and standard deviation. This confirmed the quality and the homogeneity of the collected data as well as a low degree of dispersion resulting in reliable findings.

Questionnaire survey responses

The response rate was 49.2 per cent and is illustrated in Table IV. The questionnaire was aimed to quantify the brief developing drivers in order identify the most influential ones. The questionnaire was designed to be answered by:

- client organisations;
- end-users;
- design firms;
- constructors;
- suppliers;
- government authorities; and
- funding bodies; and
- consisted of three sections.

Firstly, general information on the respondent, e.g. organisation name and address, contact phone number, contact fax number, the respondent designation, and the organisation e-mail address. Secondly, the investigation of the respondents' perception of the brief development concept. Finally, to quantify the 30 brief developing drivers. The questions asked and the analysis of the responses are discussed in the following sections.

The probability of brief development occurring during construction

All respondents claimed brief development occurs during the construction process as a result of change orders. Brief development which occurs within the control of client organisations and construction professionals was rated 4.82 out of 5 with median of 4.5, mode of 5, variance of 0.355 and standard deviation (SD) of 0.596. Brief development that occurs outside the control of client organisations and construction professionals was rated 2.3 out of 5 with median of 2, mode of 2, variance of 1.137 and SD of 1.067. These figures show that brief development occurs and is mostly within the control of client organisations and construction professionals. This reinforces the need argued by Othman *et al.* (2004) to adopt a dynamic brief development concept.

The stages where brief development takes place

The calculations of the measures of central tendency and dispersion are shown in Table V. The rate of development reduces as the project information becomes clearer and more concrete. The results also show that the rate of brief development increases again during construction. This could be attributed to drivers such as:

Table V.
The stages of brief development against their measures of central tendency and dispersion

Brief developing stage (1)	Mean (2)	Median (3)	Mode (4)	Variance (5)	Standard deviation (6)
Appraisal	4.09	4	4	1.012	1.006
Strategic briefing	4.05	4	4	1.004	1.002
Outline proposals	3.92	4	4	1.01	1.005
Detailed proposals	3.87	4	4	1.027	1.013
Final proposals	3.25	3	3	1.0393	1.045
Production information	3.13	3	3	1.027	1.013
Tender documentation	2.19	2	3	1.053	1.026
Tender action	2	2	2	1	1
Mobilisation	1.69	2	2	1.144	1.07
Construction to practical completion	3.6	4	3	1.243	1.115
After practical completion	2.39	2	2	1.225	1.107

- stakeholders changing the project requirements and having second thought at later stages;
- uncoordinated and incorrect construction documents;
- brief information is still being given during later design and construction stages;
- lack of consideration of environmental requirements; and
- unforeseen conditions.

This emphasises the importance of evaluating and managing the brief development throughout the project life cycle (Othman *et al.*, 2004).

The parties responsible for brief development

Analysis of the questionnaire responses illustrated in Table VI shows client organisations are the party perceived to have the most influence on brief development. The roles of the most influential parties need to be understood and managed for the achievement of the project objectives. For example, clients have to provide the architect with all the information required to achieve their requirements; design firms should not ignore the role of the client and behave unilaterally, they should devote effort to enable clients, particularly naive ones, to understand project design; project users should be engaged in the briefing process. Understanding the role of each party will facilitate managing brief development, eliminate project contradictions, managing change orders and contribute to client satisfaction.

Table VI.
Brief developing parties against their measures of central tendency and dispersion

Brief developing party (1)	Mean (2)	Median (3)	Mode (4)	Variance (5)	Standard deviation (6)
Client organisations	4.44	4.00	5	1.296	1.139
End users	2.91	3.00	3	1.013	1.006
Design firms	3.47	4.00	3	1.419	1.191
Constructors	3.12	3	3	1.023	1.011
Suppliers	2.97	3	3	1.002	1.001
Government authorities	2.93	3	2	1.008	1.004
Funding bodies	3.19	3	3	1.005	1.027

The impact of brief development on project cost, duration, quality, value and risk

Brief development has varying impacts on project cost, time, quality, value and risk. The responses (see Table VII), show that brief development has a high impact on cost, time and risk, largely because of reworking construction documents and the implementation of additional work. These, coupled with the effect of development in one discipline on other disciplines as well as the consequences of unexpected events, are risks that may lead to project failure and client dissatisfaction. On the other hand, brief development could escalate the project quality and add value through upgrading project facilities, eliminating poor quality materials and equipment as well as responding to market demand.

Relative importance of brief developing drivers

The numerical scores from the questionnaire responses provided an indication of the varying degree of influence that each driver has on developing the project brief. To further investigate the data, a relative importance index (RII) was used to rank the drivers according to their influences (Olomolaiye *et al.*, 1987; Shash, 1993). This was calculated using the following formula:

$$\text{Relative importance index (RII)} = \frac{\sum \text{w}}{\text{AN}}$$

Where w = weighting given to each driver by the respondents and range from 1 to 5 where 1 = very low influence and 5 = very high influence; A = highest weight (five in our case); and N = total number of sample (Kometa and Olomolaiye, 1997). The RII ranges from zero to one. As would be expected, while some drivers have very high influence on brief development, others do not. Table VIII provides a full list of the RIIs and ranking of drivers. The numbers in brackets in the "rank" column represents the sequential ranking, as some drivers have similar RIIs as in the case of the first two drivers.

Inspection of the results showed that the brief developing drivers could be classified into three categories (see Figure 1). Firstly, the drivers with very high influence with RII above 0.800. This includes:

- stakeholders change project requirements and have second thoughts at later stages;
- uncoordinated and incorrect construction documents;
- brief information is still being given during later design and construction stages;

Brief development impacts (1)	Mean (2)	Median (3)	Mode (4)	Variance (5)	Standard deviation (6)
Increase project cost	4.2	4	5.00	1.06	1.03
Decrease project cost	2.77	3	3.00	1.08	1.038
Increase project duration	4.26	4	5.00	1.10	1.05
Decrease project duration	3.89	3	4.00	1.02	1.009
Increase project quality	4.31	4	5.00	1.15	1.071
Decrease project quality	2.93	3	3.00	1.07	1.004
Add project value	4.06	4	5.00	1.01	1.003
Reduce project value	2.87	3	2.00	1.03	1.013
Increase project risk	4.21	4	5.00	1.07	1.033
Decrease project risk	2.68	3	2.00	1.16	1.075

Table VII. The implications of brief development against their measures of central tendency and dispersion

Table VIII. Brief developing drivers with their relative importance indices and ranking

Brief developing drivers (1)	Percentage of respondents scoring <3 (2)	3-4 (3)	>4 (4)	Relative importance index (7)	Rank (8)
Stakeholders change project requirements and have second thoughts at later stages	0.00	0.00	100	1.000	1 (1)
Uncoordinated and incorrect construction documents	0.00	0.00	100	1.000	1 (2)
Brief information is still being given during later design and construction stages	0.00	9.20	90.80	0.982	2 (3)
Materials are no longer available in market and use better substitute materials	0.00	15.71	84.29	0.969	3 (4)
Lack of information provision	0.00	19.16	80.84	0.962	4 (5)
Meeting new technology changes	0.00	20.69	79.31	0.959	5 (6)
Lack of regulatory up-dating	0.00	24.14	75.86	0.952	6 (7)
Project users are not involved in the briefing process	0.00	27.59	72.41	0.945	7 (8)
Unforeseen conditions	0.00	27.59	72.41	0.945	7 (9)
Lack of understanding of different users' culture and traditions	0.00	47.51	52.49	0.865	8 (10)
Eliminate proven poor quality materials and equipment	0.00	51.34	48.66	0.863	9 (11)
Lack of design experience	0.00	48.66	51.34	0.857	10 (12)
Changing government regulation and codes	0.00	52.49	47.51	0.857	10 (13)
Responding to market demand	0.00	49.04	50.96	0.856	11 (14)
Improper feasibility studies	0.00	55.94	44.06	0.844	12 (15)
Restricted design fees	0.00	52.87	47.13	0.831	13 (16)
Lack of understanding of the client organisations	0.00	81.61	18.39	0.810	14 (17)
Inappropriate communication between the client and the designer	0.00	62.45	37.55	0.803	15 (18)
Unclear and incomplete project brief	0.00	86.59	13.41	0.775	16 (19)
Designers ignore the client role and behave unilaterally	0.00	81.23	18.77	0.771	17 (20)
Lack of communication and co-ordination between government authorities and design firms over planning and approvals	0.00	89.66	10.34	0.745	18 (21)
Lack of presentation and visualisation of design	12.26	87.74	0.00	0.697	19 (22)
Users exaggerate their needs	15.71	84.29	0.00	0.689	20 (23)
Upgrade project facilities	18.01	81.99	0.00	0.672	21 (24)
Project users appear at later stages	24.14	75.86	0.00	0.648	22 (25)
Inadequate available design time	28.35	71.65	0.00	0.623	23 (26)
Lack of functional, aesthetic safety requirements and constructability	13.41	86.59	0.00	0.615	24 (27)
Lack of consideration of environmental requirements	41.38	58.62	0.00	0.500	25 (28)
Whole project life not considered	46.36	53.64	0.00	0.474	26 (29)
Initiating value engineering changes	66.28	33.72	0.00	0.467	27 (30)

- materials are no longer available in the market or better substitute materials are identified;
- lack of information provision;
- meeting new technology changes;
- lack of regulatory up-dating;
- project users are not involved in the briefing process;

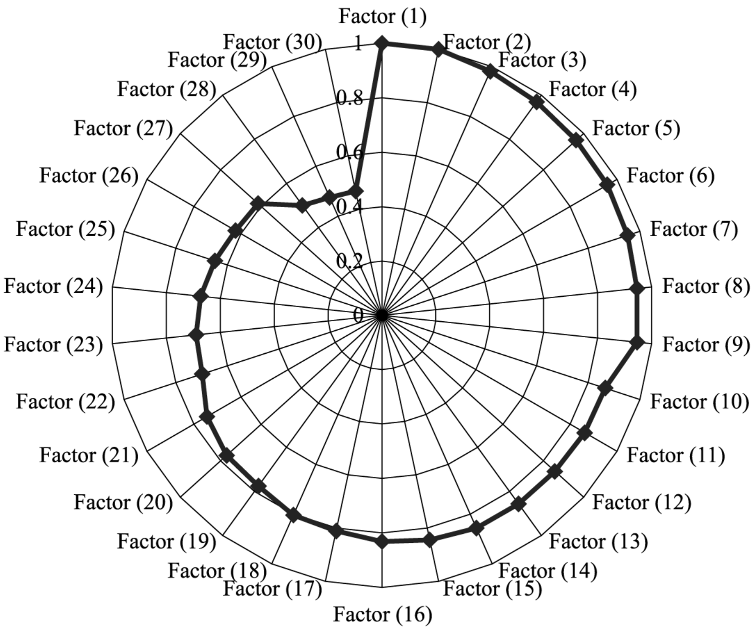

Figure 1.
Ranking and relative importance index of the brief developing drivers

- unforeseen conditions;
- lack of understanding different users' culture and traditions;
- eliminate proven poor quality materials and equipment;
- lack of design experience;
- changing government regulation and codes;
- responding to market demand;
- improper feasibility studies;
- restricted design fees;
- lack of understanding of the client organisations; and
- inappropriate communication between the client and the designer.

Secondly, the drivers with average to high influence, with RIIs lying between 0.600 and 0.800. This includes:

- unclear and incomplete project brief;
- designers ignore the client role and behave unilaterally;
- lack of communication and co-ordination between government authorities and design firms over planning and approvals;
- lack of presentation and visualisation of design;
- users exaggerate their needs;
- upgrade project facilities;
- project users appear at later stages;

- inadequate available design time; and
- lack of functional, aesthetic, safety requirements and constructability.

Finally, the drivers with very low to low influence with RIIs less than 0.600. This includes:

- lack of consideration of environmental requirements;
- whole project life not considered; and
- initiating value engineering changes.

Bivariate analysis of brief developing drivers

To investigate the correlation between the brief developing drivers, bivariate analysis was carried out to establish any linear relationship using the most common measure of correlation, Pearson's r (Clarke and Cooke, 1992). Bivariate analysis is used to reveal the relationship between two variables and to what extent the variation in one variable coincides with the variation in another variable. Bivariate analysis with the aid of SPSS computer software was used to generate the correlation matrix, an extract of which is shown in Table IX. The chief feature of using Pearson's r is that the correlation coefficient will almost certainly lie between 0 (no relationship between the two drivers) and 1 (a perfect relationship). The closer the coefficient is to 1, the stronger the relationship, the closer it is to zero, the weaker the relationship.

The coefficient will be either positive or negative, this indicates the direction of a relationship (Bryman, 2001). For example, the scatter diagram presented in Figure 2 shows a perfect positive relationship, with a Pearson's r correlation of $+1$. This means that, as the lack of understanding of different users' culture and traditions increase, the lack of design experience increases by the same amount. In other words the different user's culture and traditions will only be fully perceived and reflected in design if the designer is experienced and possess the art of questioning, extracting and analysing information from the user.

The scatter diagram presented in Figure 3 shows a perfect negative relationship with a Pearson's r correlation of -1. This means that, as project users exaggerate their needs in an effort to enhance the facility function and performance, the initiation of value engineering changes will reduce.

Finally, Figure 4 shows that there is no correlation between the 15th and 20th ranked drivers as the correlation is close to zero and there is no apparent pattern in the scatter diagram. This means that the variation in each driver is associated with drivers

Surveyed category	Interviews planned	Interviews held	Response rate (%)
Design firms' managers	9	6	66.67
Head of architectural, structural, civil, mechanical and electrical sections	45	21	46.67
Construction companies' managers	16	8	50
Senior project managers	16	10	62.5
Head of engineering section in design firms	2	2	100
Total	88	47	53.41

Table IX.
The numbers of planned and held interviews with their response rates

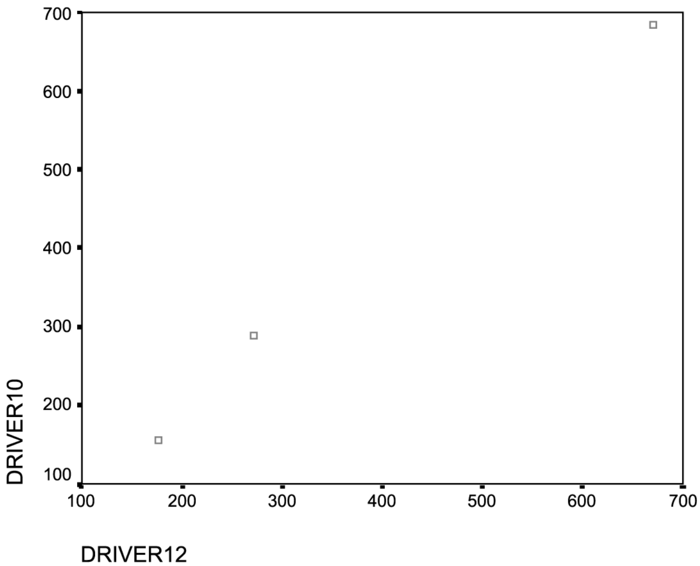

Figure 2.
Scatter diagram showing a perfect positive relationship between driver 10 and driver 12

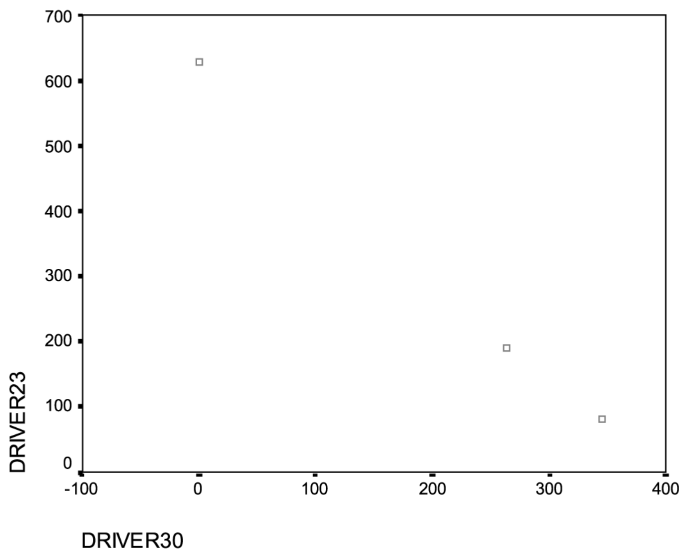

Figure 3.
Scatter diagram showing a perfect negative relationship between driver 23 and driver 30

other than the ones present in this analysis (Bryman, 2001) for instance driver 15 is associated with drivers 20, 29 and 28 and driver 20 is related to drivers 27 and 21. Therefore understanding the correlation between the brief developing drivers will help client organisations achieve their emerging requirements, meet user needs, cope with regulation changes, exploit business opportunities, adapt to technology improvement, add value and manage associated risks.

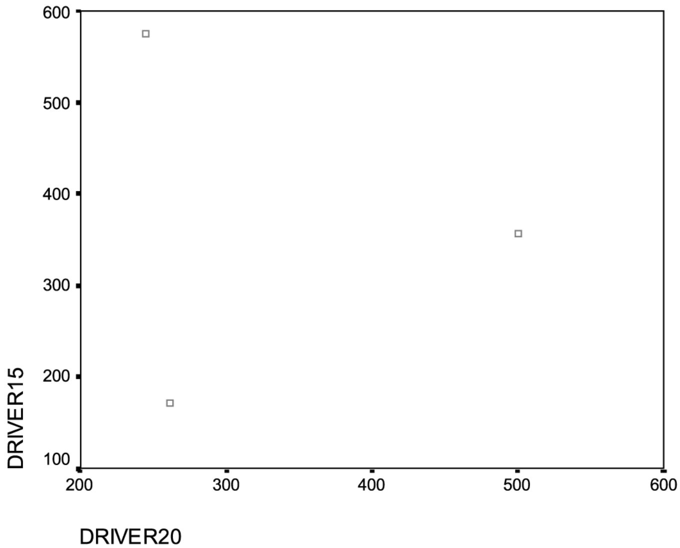

Figure 4.
Scatter diagram showing no relationship between driver 15 and driver 20

Interviews with managers

The interview sample is illustrated in Table IX. The interview was designed to investigate the understanding of design firms, constructors and funding bodies of the brief development concept advocated by Othman *et al.* (2004), and to identify the different techniques adopted to that development and is summarised in the following sections.

The implications of brief development on the interviewed organisations

The responses showed that 92.2 per cent of the interviewees felt that brief development helps achieve the clients' and end-users' satisfaction and enhances project performance. On the other hand it increases the rework of project documents, increases organisation supervision duties, disturbs the overall work schedule and could be considered as a source of disputes. A total of 94.15 per cent of the interviewees mentioned that brief development could add value, rectify brief errors and missing data and eliminate associated risks but at the same time could increase organisation overhead and reduce employee/labour productivity. Finally, 47 per cent of the interviewees agreed that developing the brief could reduce profitability. Therefore, brief development has positive and negative impacts on both the project and interviewed organisation. If positive impacts are to be exploited and negative ones managed and reduced, a brief developing management system capable of responding in ways that add value and eliminate associated risk is important if client satisfaction is to be achieved.

The support of brief development once the construction commences

When asked if they supported brief development once construction had started, 38.30 per cent of the interviewees said never, 31.91 per cent said rarely and 29.79 per cent sometimes. Their reluctance to support this could be attributed to negative impacts occurring with brief development at later stages, although some recognise there may be benefits. Design firms, constructors and funding bodies need to adopt a more flexible approach to brief development based on a better understanding of the benefits and drawbacks associated with the changes.

The methods used to facilitate the visualisation of brief development by clients, end users and construction professionals

Site visits, meeting with the parties concerned, photos of completed projects, using CAD drawings and feasibility studies were always used methods for visualising brief development, animated walk through methods were sometimes used whilst overhead projector presentations, samples and models were rarely used.

The parties that participate in managing brief development

Client organisations, design firms, constructors and funding bodies participated most in managing brief development. End users and government authorities participated less and suppliers least. Understanding the role each party plays in the construction process will facilitate the management of brief development. Participation of end users, government authorities and suppliers should be increased since they often initiate brief development.

The techniques used to follow up brief development during the construction process

Following up brief development during the construction process allows client organisations and construction professionals to identify its nature, stage, driver, implications and the parties responsible. Additionally, decisions made, lessons learned and feedback play a vital role in improving the design and construction of future projects. Of the techniques that were used to follow up brief development, regular co-ordination meetings and the party who initiates developments informing other related parties, were the most used techniques. Checklists to verify the compatibility of various components in the project were used less.

The different steps followed by the interviewed organisations to manage brief development

All interviewees agreed that if the brief development was requested by government authorities and funding bodies because of regulation changes or to meet building codes and requirements these changes had to be made. A total of 53 per cent stated they made changes requested by the client or end user in order to secure the project or agree with the client even if they did not improve project performance. In addition, they pointed out that the client would pay compensation for documentation rework. The remaining 47 per cent stated if the client or end user requested changes the designer met with the concerned parties to study the feasibility of the change and its effect on other disciplines. The cost of development was determined from practical experience and the feasibility study. The client organisation then either arranged for additional funds or modified the project design or specifications in order to cover that cost.

A total of 60 per cent felt brief development was often undertaken due to new information, unforeseen conditions, lack of materials production, rectification of design errors, or generation of new ideas without getting prior consent of the client organisation.

All interviewees mentioned that no particular attention had been paid to the value of brief development or the extent it could enhance project performance. This was because the designer was compensated for re-work and the contractor could claim for extension of time as a result. No clear steps or procedures were established in advance that could help client organisations and construction professionals decide to/not to accept the requested development for the benefit of the project. It is important therefore that design firms play their role as client advisors and should not ignore the role of the client in brief development. Design firms should understand that achieving client satisfaction does not, necessarily, entail developing the project brief without adequate evaluation of its value and risks. The need for a system to help project participants decide to/not to embark brief development based on costs and benefits is clear.

The techniques adopted by the interviewed organisations for managing brief development

None of the interviewees claimed to use value and/or risk management in managing brief development. The principal use for information management and information technology was for organising and updating project files. CAD programmes and word processing software were used in producing and modifying construction documentation. The techniques used to manage brief development depended on calculating the cost of omission or addition, their implications on other disciplines and to what extent the client could bear the cost of development. In many cases the project design is changed or the specification reduced in order to cover the costs. The techniques adopted to mange brief development were not deep enough to consider the value of development, the associated risk or the extent brief development could enhance project performance.

The role of correct, reliable, and up-to-date information in managing brief development

Of the interview responses, 93.1 per cent believed correct, reliable and up to date information plays a vital role in achieving client and end user satisfaction, reaching prudent decisions, reducing change orders on future projects and co-ordinating with other disciplines. A total of 63.82 per cent agreed that such information helps improve project quality, adds value and avoids associated risk. Finally, 33.34 per cent mentioned that correct, reliable and up to date information could minimise the project cost and reduce the project duration. This means that in order to ensure the adequacy of the brief development decision, the parties who are responsible for brief development should rely on facts and events collected from correct, reliable and up-to-date information rather than subjective interpretations.

Information sources used in managing brief development

Client organisations, design firms, constructor, government regulations, funding body, previous projects, building standards and codes, business requirements and market demand, and central project databases were the information sources most used to manage brief development. End users' requirements and suppliers were least used. Utilising a wide range of information sources will help client organisations and construction professionals make prudent decisions. The role of end users and suppliers as sources of information has to be increased since many of the brief developing drivers are derived from end user requirements and the provision of materials and equipment by suppliers.

Reflections of feedback on the briefing process for new projects

A total of 63.82 per cent of interviewees felt that feedback plays an effective role in enhancing the design and construction as well as reducing change orders on future projects. Reflecting on the briefing process to provide feedback could help achieve client objectives and end user needs, improve project performance in terms of cost, time, and quality, add value, avoid associated risk, and help to produce accurate, co-ordinated construction documents. A total of 21.28 per cent felt lessons were not learned and mistakes repeated. Feedback from project clients, end users and facilities management teams would enable design firms and construction professionals overcome repetition of problems and make use of decisions made and corrective action taken to reduce the effect of change orders in new projects.

Analysis of the brainstorming session

The brainstorming session investigated the relationship between the brief developing drivers and the project team members in order to identify the originators of brief development and the value and risk sources from the client's point of view. Out of 38 invitations issued, a total of 12 client organisations agreed to attend the session and the results were analysed in a matrix summarised in Table X.

The session used the following definitions:

- Brief developing originator: the person or authority that begins, initiates or is the cause of brief development either by modification, omission or addition to the brief document contents (*Webster's Dictionary*, 2000).
- Value: a measure expressed in currency, effort, exchange or on a comparative scale, which reflects the desire to obtain or retain an item, service or idea (Kelly and Males, 1993). Thiry (1997) states that value is a very subjective concept with different meanings for different people. A consumer may regard it as the "best buy", a manufacturer may consider it as "the lowest cost", and the designer may view it as the "highest functionality". Value can be considered as the ratio of function achieved to its life cycle cost, i.e. Value = Function/Cost (LCC) (ICE, 1996). Hence, the value source to the client may be defined as the person or authority that can improve the function of the project at no extra cost or by maintaining the function and removing unnecessary cost in a way that achieves client requirements and enhances the performance of the project.
- Risk: a variety of unexpected events that may occur during the process of building procurement, often causing losses to the client or other interested parties (Shen, 1999). The outcome may be better or worse than expected, known as upside and downside risks (Raftery, 1994). Therefore, the risk source for the client may be defined as the person, authority or event that either threatens the achievement of the client objectives or provides an opportunity to improve the project performance.

Analysis of the matrix and feedback from the discussion in the brainstorming session showed that client organisations are the key originators of brief development. Project clients are dissatisfied with design firms' performance as client advisors. Clients view

Table X. Originators of brief development, value sources and risk sources to the project from the client's point of view

No.	Brief development drivers	Development originator							Project team members Value source to client							Risk source to client						
		CO	EU	DF	C	S	GA	FB	CO	EU	DF	C	S	GA	FB	CO	EU	DF	C	S	GA	FB
1	Stakeholders change project requirements and have second thoughts at later	X	X	X	X	X	X	X	X	X												
	stages										X	X	X	X	X	X	X	X	X	X	X	X
2	Uncoordinated and incorrect construction documents			X													X	X	X	X	X	X
3	Brief information is still being given during later design and construction	X	X	X	X	X	X	X	X	X												
	stages										X	X	X	X	X	X	X	X	X	X	X	X
4	Materials are no longer available in market and use better substitute materials	X		X		X							X					X	X	X		
5	Lack of information provision	X	X	X	X	X	X	X								X	X	X	X	X	X	X
6	Meeting new technology changes	X	X			X	X											X	X	X	X	
7	Lack of regulatory up-dating			X			X										X	X	X		X	
8	Project users are not involved in the briefing process	X		X												X	X	X				
9	Unforeseen conditions															X	X	X	X	X	X	X
10	Lack of understanding of different users' culture and tradition		X	X													X	X				
11	Eliminate proven poor quality materials and equipment	X	X			X	X			X			X	X				X	X	X		
12	Lack of design experience			X												X	X	X	X	X	X	X
13	Changing government regulation and codes						X										X	X	X	X	X	
14	Responding to market demand	X	X							X								X	X	X		X
15	Improper feasibility studies			X														X				X
16	Restricted design fees	X					X										X	X	X	X	X	X
17	Lack of understanding of the client organisations	X		X												X		X				
18	Inappropriate communication between the client and the designer	X		X												X		X				
19	Unclear and incomplete project brief	X	X	X												X	X	X				
20	Designers ignore the client role and behave unilaterally			X														X				
21	Lack of communication and co-ordination between government authorities			X			X															
	and design firms over planning and approvals																	X			X	
22	Lack of presentation and visualisation of design			X													X	X	X	X		X
23	Users exaggerate their needs		X							X							X	X	X	X		
24	Upgrade project facilities	X	X						X	X							X	X	X	X		
25	Project users appear at later stages		X							X							X	X	X	X		
26	Inadequate available design time	X		X													X	X	X	X	X	X
27	Lack of functional, aesthetic safety requirements and constructability			X													X	X	X	X	X	
28	Lack of consideration of environmental requirements	X	X	X	X		X										X	X	X		X	
29	Whole project life not considered	X		X													X	X	X	X		X
30	Initiating value engineering changes																					

Note: CO = Client organisation; EU = End user; DF = Design firm; C = Constructor; S = Supplier; GA = Govern. authority; FB = Funding body design firms as originators of brief development and risk sources because they may produce uncoordinated and incorrect construction documents, specify building materials or technologies that are either not produced anymore or outdated. Design firms may also ignore the role of the client and behave unilaterally. All these can hinder the construction process due to contradictions between the construction documents, time delay due to selecting and importing substitute materials and modern technologies as well as future changes as a consequence of implementing decisions which do not reflect the client's point of view. In addition, the matrix showed that some parties could be deemed as value and risk sources at the same time. For example, material suppliers could advise other project team members on the quality of specified materials and equipment as they are closer to manufacturers. Value can be associated with the risk of finding suitable materials or equipment which are commensurate with the project budget, time of delivery and matches with project design. Furthermore, analysis of the matrix showed that there is no relationship between project team members and the brief developing driver of initiating value engineering changes, although this is principally because value engineering and value management techniques are not used in managing brief development in the surveyed city and may not be representative of the industry generally.

Findings and conclusions

The principal findings of this paper hinge on the importance of achieving client satisfaction. To this end the factors that drive the development of the project brief identified through literature review and analysis of 36 case studies (Othman *et al.*, 2004) were examined in more depth through 261 survey questionnaires, 47 structured interviews and a brainstorming session with 12 clients. The main findings drawn from the data collected and analysed are:

- Questionnaire responses showed there was a need to continue developing the project brief throughout the project life cycle.
- This dynamic brief development should concentrate on achieving client satisfaction, responding in an innovative manner to the different brief developing drivers and managing project change orders.
- In addition, there is a need to identify specific points through project life cycle (milestones) where the brief development activities undertaken can be evaluated and performance feedback undertaken.
- The interview responses confirmed there was no widely used technique for managing the brief development and that little attention is paid to identifying the value and/or risk of brief development activities or the extent to which they can enhance the project performance.
- The brainstorming session revealed clients dissatisfaction with current project processes and the way project team members executed their roles in terms of originating development of the brief, generating value and managing risk.

The findings lead to the conclusion that there is a need to set out a detailed brief development management system that incorporates both value management and risk management. This system should enable the appropriate project participant make informed decisions at the right time for the benefit of the client. The system must facilitate feedback to both client organisations and construction professionals to enable lessons to be learned in order to improve the briefing process for future projects. Understanding the relationship between the factors that drive brief development and the various project team members will facilitate managing brief development in a way that increases client satisfaction and enhances the performance of the project.

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VALUE AND RISK MANAGEMENT PROTOCOL FOR DYNAMIC BRIEF DEVELOPMENT IN CONSTRUCTION

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النظريات الحالية لعملية استخلاص متطلبات المشروع تحدد تطوير هذه المتطلبات الي مرحلة معينة. هذا المنظور يعوق التفاعل بين المالك و المصمم، كما يمنع الاستفادة من فرص القيمة التي قد تؤدي الي تحسين أداء المشروع. مبدأ التطوير الديناميكي لمتطلبات المشروع تم تقديمه كمدخل للتغلب علي قصور النظريات الحالية. هذا المبدأ يدعم و يشجع تطويرهذه المتطلبات طوال دورة حياة المشروع من أجل الوصول الي رضاء المالك والاستجابة لمحركات تطوير متطلبات المشروع والارتقاء بعملية استخلاص تلك المتطلبات و ادارة الأوامر التغييرية بشكل فعال. نظراً لأن السماح بتطوير المتطلبات طوال دورة حياة المشروع قد يساعد في اضافة إما قيمة أو مخاطرة أو كليهما للمشروع، فإن إدارة القيمة و إدارة المخاطرة تعتبران أكثر الوسائل المناسبة لإدارة التطوير الديناميكي لمتطلبات المشروع. بسبب مزايا عملية دمجهما، حيث أن الحصول علي قيمة أفضل لن يتم إلا تم ادارة المخاطر المصاحبة، فإن هذين المنهجين تم دمجهما لتشكيل بروتوكول ادارة القيمة و المخاطرة. هذه الورقة البحثية تهدف الي وضع القوانين، و إقامة الأسس لادارة و ضبط التطوير الديناميكي لمتطلبات المشروع، و تقديم وسيلة مبتكرة و جديدة لصناعة القرار، تم تطويرها بواسطة المؤلف، لتمكين الملاك و المشتغلين بصناعة الانشاءات من الوصول الي قرار مناسب لتطوير متطلبات المشروع.

The current briefing theories confine brief development to a certain stage. This perspective hinders the interaction between the client and the designer and inhibits utilising value opportunities that may enhance the project performance. The Dynamic Brief Development (DBD) concept is presented as an approach to overcome the limitations of the current briefing approaches. This concept supports and encourages brief development throughout the project life cycle in order to achieve client satisfaction, respond to the brief development drivers, improve the briefing process, and manage change orders effectively. Since permitting brief development to take place throughout the project life cycle can add either value or risk or both to the project, Value Management and Risk Management were the most appropriate tools to manage dynamic brief development. Because of the benefits of their integration, as better values could not be achieved unless associated risks have been managed, the two methodologies were integrated to formulate the Value and Risk Management Protocol (VRMP). This paper aims to set the rules and establish the grounds that manage and control dynamic brief development and presents an innovative decision making tool, developed by the author, to enable clients and construction professionals reach an appropriate brief development decision.

1. INTRODUCTION

Achieving client satisfaction was identified as one of the most significant issues facing today's construction industry. This perspective stems from the important role played by clients as the core of the construction industry and the driving force for improvement [1,2]. The briefing process is defined as the process running throughout the construction project by which means the project requirements are progressively captured and translated into effect [3]. Because of its pivotal role in eliciting and communicating clients' requirements to the design and construction teams, the briefing process is a cornerstone for achieving client satisfaction. Hence, it has to be flexible, well organised, and responsive to the client requirements [4,5].

Formal observations, literature review, analysis of 36 case studies, documentary data and unstructured interviews with projects' architects undertaken by the author showed that very few buildings are finished on time, or at the right cost and clients often blame the construction industry of providing products that do not achieve their requirements and meet their expectations. Furthermore, clients articulated that they used change orders to achieve their expected requirements and to adapt to the influence of the internal and external brief development drivers. This is attributed to the limitations of the current briefing approaches, which confine the development of the project brief to a certain stage. This perspective hinders the interaction between the client and the designer and impedes exploiting value opportunities and managing risk threats caused by brief development drivers. In order to overcome the limitations of the current briefing approaches, the Dynamic Brief Development (DBD) concept was developed. This concept supports and encourages brief development throughout the project life cycle as an approach to achieve client satisfaction and respond in an innovative manner to the brief development drivers, improve the briefing process, and to manage change orders effectively [6].

Permitting brief development to take place without establishing the procedures that control its development leaves the project brief uncontrolled and jeopardise achieving client's satisfaction. Because brief development can add value or risk to the project or could add both, the well-established methodologies of Value Management (VM) and Risk Management (RM) are the most appropriate tools to manage dynamic brief development. Since better value could not be achieved unless associated risks have been managed, both methodologies have been integrated to formulate the Value and Risk Management Protocol (VRMP), which will be used to manage dynamic brief development in construction.

This paper aims to establish the basis and set the rules for this approach, and develop the tool that will manage and control dynamic brief development. Two objectives were developed to achieve this aim. The first one is theoretical, which focused on examining the role of VM and RM in managing dynamic brief development. The second objective is practical which presents an innovative decision making tool, developed by the author that will be used in the process of making an appropriate brief development decision.

2. VALUE MANAGEMENT FOR MANAGING DYNAMIC BRIEF DEVELOPMENT

VM has been defined as a systematic, multi-disciplinary effort directed towards analysing the functions of projects for the purpose of achieving the best value at the lowest overall life cycle cost [7]. The use of VM in construction projects is steadily increasing as clients seek better outcomes from their investment in building and structure. Some clients include the requirements for VM workshop in building contracts, as a way of ensuring optimal solutions. VM is a fundamental tool that brings together a range of project stakeholders in the VM workshops, where different views can be debated, and problems could be avoided [8]. VM as a structured approach with its powerful philosophy and approach plays an important role in managing dynamic brief development for the following reasons.

1. VM is a totally client driven technique oriented towards understanding client objectives, value systems, business case, and presenting better ways of providing the same performance at overall lower cost [9].
2. The fruitful diversity of VM workshop team members can help achieve successful results and ensures that stakeholders' views, objectives and requirements are perceived and reflected in the brief development decision as well as gaining their commitment to implement the selected decision.
3. VM is based on systematic steps, which ensures that the problem is thoroughly studied, innovative alternatives are generated and evaluated, and best alternatives are selected. In addition, following up and monitoring the implementation process can improve the briefing process through learned lessons and feedback.
4. VM has different chances to be applied in order to achieve emerging client requirements and can adapt to the influence of the brief development drivers. These chances are at: conception formulation, sketch design, working drawings, construction, and operation stages [10].
5. Using VM for identifying client requirements at the early stages of the project and responding to the brief development drivers can reduce later change orders and manage them for the benefit of the client.
6. Applying Value Engineering during the construction and operation stages is recommended and considered as fruitful area for applying VM as a large potential saving could be gained [10].

3. RISK MANAGEMENT FOR MANAGING DYNAMIC BRIEF DEVELOPMENT

The growing interest in RM in the UK construction industry produced a multitude of frameworks and risk analysis software packages being available to the project management practitioner [11-14]. This is because the construction industry is recognised as a high-risk industry. RM is also increasingly popular because it can provide value for money[15,16]. In addition, Latham[1] highlighted the need for risk assessment to be carried out at important stages of the construction process. Because of the dynamic nature of clients and the different internal and external brief development drivers, RM should be seen as a continuing activity throughout the project life cycle[17]. RM is an appropriate tool to manage dynamic brief development for the following reasons.

1. RM is a well-established technique directed towards identifying, analysing and responding to the different risks that affect and hinder the achievement of clients' objectives.
2. RM enables project stakeholders decide if the potential benefits associated with a particular course of action are sufficient to warrant accepting associated risks and safeguards the sponsor's interest when a course of action is been selected[18].

3. RM plays an important role in ensuring that best value for money is achieved since reducing risk means adding value [15].
4. Edwards and Bowen[19] stated that risks are dynamic and change during most projects therefore; RM should be an ongoing activity throughout the project life cycle to meet client expectations and enhance project performance.
5. The systematic steps of RM help reasoning and adopting the appropriate alternative, where feedback and learned lessons help improving the briefing process.
6. RM plays a pivotal role in managing change orders in construction through studying the effects of associated risks on the project. Then change orders with beneficial effects, that have an acceptable risk could be approved, where as downside change orders with unacceptable risks could be avoided[17].

4. THE ARGUMENT FOR INTEGRATING VM AND RM

VM and RM have become increasingly popular among project management practitioners. It is argued that best value for money can be achieved either by enhancing the requirements of a project, or by reducing the cost of meeting them. The search for value for money is trying to find the best balance between meeting stakeholders' requirements and the resources available. Finding this balance will inevitably involve some risks that have to be identified and assessed [15]. RM can achieve cost saving and enhance project value through identifying, assessing and responding to the risks associated with VM alternatives. RM and VM appear to be compatible and complementary and therefore it is logical to argue that the potential for a common framework should be investigated [19]. RM could be enhanced by using the VM team to audit, produce project's RM plan and generate alternatives to mitigating recognised risks. In addition, VM could be enhanced by improving the awareness of the potential risks of alternative proposals [7].

5. THE VALUE AND RISK MANAGEMENT PROTOCOL (VRMP)

Protocol was defined as the rigid code of etiquette prescribing the forms and procedures for various ceremonies and social functions in government, military, and diplomatic circles[20]. The Value and Risk Management Protocol (VRMP) is the representation of the proposed framework for managing and controlling brief development in construction. It is intended to utilize value opportunities and manage associated risks for the benefit of the client. It describes the functions, activities, tools and techniques required to enable clients and construction professionals adopt the appropriate brief development decision. The VRMP is an innovative tool utilised the integration of VM and RM to manage dynamic brief development for the first time in construction. The developed protocol overcame the pitfalls and shortcomings of the existing approaches for integrating value and risk management as well as managing change orders, and it represented a real contribution to the original body of knowledge. The protocol is more comprehensive than the normal application of Value Engineering (VE). This is because the protocol encompasses a set of systematic and logical procedures to enhance the value of the facility throughout the project life cycle. The VRMP embraces the whole value process, which includes Value Planning, Value Engineering, and Value Reviewing. In addition, it integrates VM with RM and took the advantage of their ability to provide better value and manage associated risks [22].

5.1 The Need, Aims and Objectives of VRMP

The need for the new approach stems from the necessity to overcome the limitations of the current briefing theories to achieve client satisfaction [6,23,24]. The VRMP is a decision making tool that aims to:

1. Enable clients and construction professionals adopt the appropriate brief development decision based on value addition and risk management,
2. Respond in an innovative manner to the influence of the different brief development drivers,
3. Manage project change orders effectively, and
4. Improve the briefing process through feedback and learned lessons.

These aims can be achieved through a set of interrelated objectives of:

1. Adequate identification of brief development problem,
2. Better understanding of the client objectives,
3. Generating, evaluating and selecting the optimal alternative,
4. Implementing the selected alternative, monitoring its execution and feedback the client and construction professionals with comments and learned lessons.

5.2 The Conceptual Description of the Protocol

The VRMP encompasses a methodology for systematic, gradual and teamwork of client and construction professionals to adopt the appropriate brief development decision. The VRMP is based on the systematic steps of the decision making process. These steps consist of three basic phases: (1) Intelligence phase, (2) Design Phase, and (3) Choice Phase[25]. In addition, the Simple Multi Attribute Rating Technique (SMART) was used to formulate part of the VRMP [26].

The Pre-Study Phase: (Intelligence Phase)

This phase aims to clearly identify the brief development problem by:

- Assembling and empowering the team,
- Investigating brief development data, and

- Defining brief development.

The Study Phase: (Design Phase)

This phase aims to structure the development objectives and scrutinise alternative solutions by:

- Defining objectives,
- Developing objectives value hierarchy,
- Allocating importance weight,
- Defining associated risks,
- Generating alternatives, and
- Evaluating alternatives.

The Post-Study Phase: (Choice Phase)

This phase aims to ensure that the developed alternatives are presented, the best one is selected, implemented and monitored and the client, design and construction teams received feedback with comments and learned lessons in order to improve the briefing process for future project by:

- Presenting alternatives,
- Selecting the best alternatives,
- Implementing the selected alternative, and
- Monitoring and feedback.

5.3 Modelling the Value and Risk Management Protocol

Modelling provides a powerful framework to formulate and solve engineering problems. It can systematise the everyday administrative and contingency procedures that do not go as planned[25] Managing Brief Development is a multi-disciplinary process, performed in a series of interrelated steps in order to enable clients and construction professionals adopt the appropriate brief development decision that utilise value opportunities and manage associated risk to meet client's requirements and achieve his satisfaction. If the procedures to manage brief development cannot be reduced to the activities of a simple model then they could lead to complications. Modelling the VRMP will facilitate effective management of dynamic brief development, diminish confusion, lessen personality conflict, maintain focus on project completion and achieve better decisions. Modelling requires determining the events that must take place, ascertaining their sequential relationship and presenting this information in a network. Based on the characteristics of the VRMP, the process model was considered to be the appropriate model to represent the activities that are being proposed to manage brief development because it is concerned with representing consecutive steps or activities with an end product or service being delivered. The following section will describe the Integrated DEFinition (IDEF-0), the selected modelling methodology.

IDEF-0 Notation

IDEF-0 is a modelling technique based on the Structured Analysis and Design Technique (SADT), a graphical approach to system description developed by Douglas T. McGowan and SofTech, Inc. in the 1970. Since then SADT has been refined and used for solving a variety of problems. In 1981, the US Air Force Programme for Integrated Computer-Aided Manufacturing (ICAM) standardised and made public a number of IDEF (Integrated DEFinition language) modelling techniques. These comprised: IDEF0, which used to produce a functional model; IDEF1, which used to produce information model and IDEF2, which used to produce a dynamic model. Of these three, IDEF-0 is the most used for modelling manufacturing and services processes and in business process reengineering tools [27,28].

IDEF-0 models are composed of three types of information: graphic diagrams, text, and glossary, which are cross-referenced to each other. The graphic diagrams are the major component of the IDEF-0 model, containing boxes, arrows, box/arrow interactions and associated relationships. A box represents a major function of a subject. These functions are composed into more detailed diagrams, until the subject is described at a level necessary to support the goals of the project. The top-level diagram in the model provides the most general description of the subject and is followed by a series of child diagrams providing more detail about the subject. Arrows show the flow of products including data between functions [28]. The kinds of arrows used in IDEF-0, and their relationship within a box, are illustrated in Figure 1. These include Input, Control, Output, Mechanism (ICOM), mechanism call, tunnelled, internal and boundary, and boundary arrows[29].

IDEF-0 is the most appropriate methodology to represent the VRMP because:

- It deals with functional / activity modelling, which is most appropriate since the objective is to describe the functions and activities of the proposed VRMP.
- It facilitates the development of a comprehensive model due to the elaborated information required to perform a function or activity.
- It is relatively easy to use and understand, and it has been proven to be suitable for use in construction [30].
- It provides a mechanism for decomposing a function into a number of smaller sub-functions and verifies that the inputs and outputs of the function match those of its sub-functions [31].

5.4 The Contents of the Protocol

The contents of the protocol are shown in Table 1, they are: identifying problem (VRMP/A1), structuring objectives (VRMP/A2), scrutinising alternative solutions (VRMP/A3) and adopting development decision (VRMP/A4), shown in Figure 2. A top level (VRMP/A-0) presentation of the protocol is presented in Figure 3.

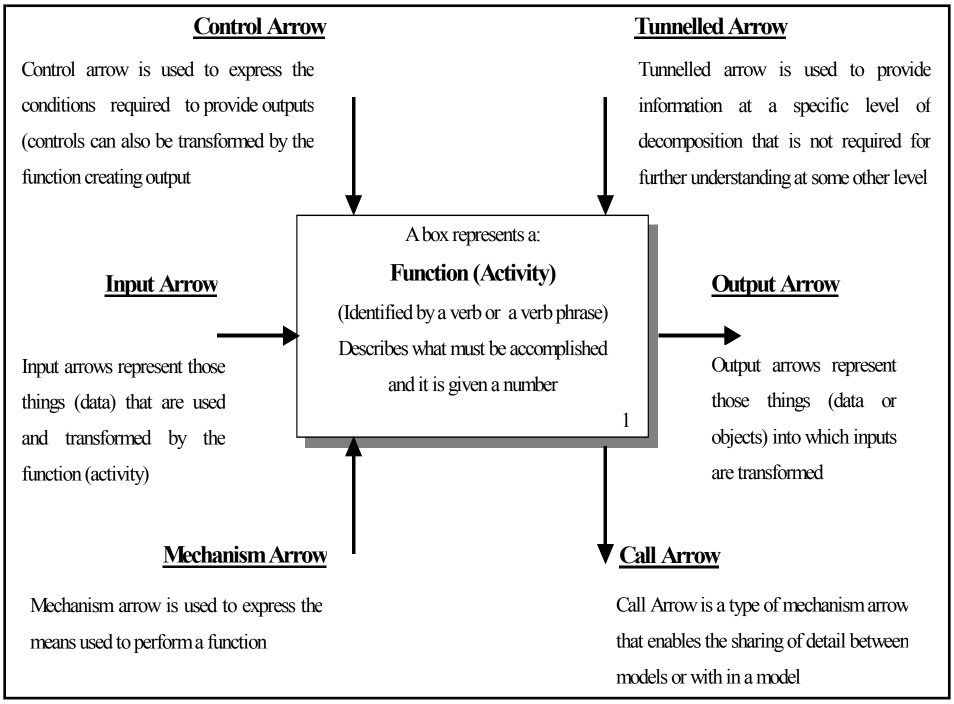

Figure 1: Basic Concepts of the IDEF-0 Method

Table 1. Table of Contents of the VRMP

Diagram Reference		Description
VRMP/A0		**Managing Construction Brief Development**
VRMP/A1		**Identifying Problem**
	A11	**Assembling and Empowering the team**
	A111	Orientation Meeting
	A112	Identifying and Selecting the team members
	A113	Deciding on study date, time, duration, location
	A12	**Investigating Brief Development Data**
	A121	Collecting Brief Development Data
	A122	Defining Development Data Resources
	A123	Classifying Development Data
	A13	**Defining Brief Development**
	A131	Describing Brief Development
	A132	Defining Development Driver
	A133	Defining Development Stage
	A134	Defining Development Initiator
	A135	Defining Value & Risk Sources to Client
VRMP/A2		**Structuring Objectives**
	A21	Defining Objectives
	A22	Developing Objectives Value Hierarchy
	A23	Allocating Importance Weights
	A24	Defining Associated Risks
VRMP/A3		**Scrutinising Alternative Solutions**
	A31	Generating Alternatives
	A32	Evaluating Alternatives
	A321	Developing Decision Matrix
	A322	Assessing Associated Risks
	A323	Comparing Alternatives
	A324	Performing Sensitivity Analysis
	A325	Reconciling Value and Risk
VRMP/A4		**Adopting Development Decision**
	A41	PRESENTING ALTERNATIVES
	A42	Selecting the Best Alternative
	A43	Implementing the Selected Alternative
	A44	Monitoring and Feeding back

Identifying Problem

The "Identifying Problem" function (Figure 4) is a decomposition of box 1 in the VRMP/A0 diagram (Figure 2) and it involves three activities: 1) Assembling and Empowering the Team, 2) Investigating Brief Development Data, and 3) Defining Brief Development.

Assembling and Empowering the Team

It is important to have an orientation meeting prior to the study in order to understand the client's objectives and identify the reasons that drive the brief development. Logistical matters such as selecting team members, study date, time, duration and location can be decided. The correct team selection with members with various areas of expertise is critical to the success of brief development study. The valuable background knowledge of clients and users representatives plays a vital role in assisting team members understand the project operations and development required. Teams ideally should contain between six and twelve full time participants to maintain optimum productivity [7].

Investigating Brief Development Data

This activity aims to investigate brief development data. It focuses on collecting brief development data, defining development data resources and classifying development data. When a brief development request is raised by the client or any other concerned parties, it is important to authenticate these data. This will be done through collecting data from relevant parties and reliable sources and then data resources will be defined and the collected data will be classified.

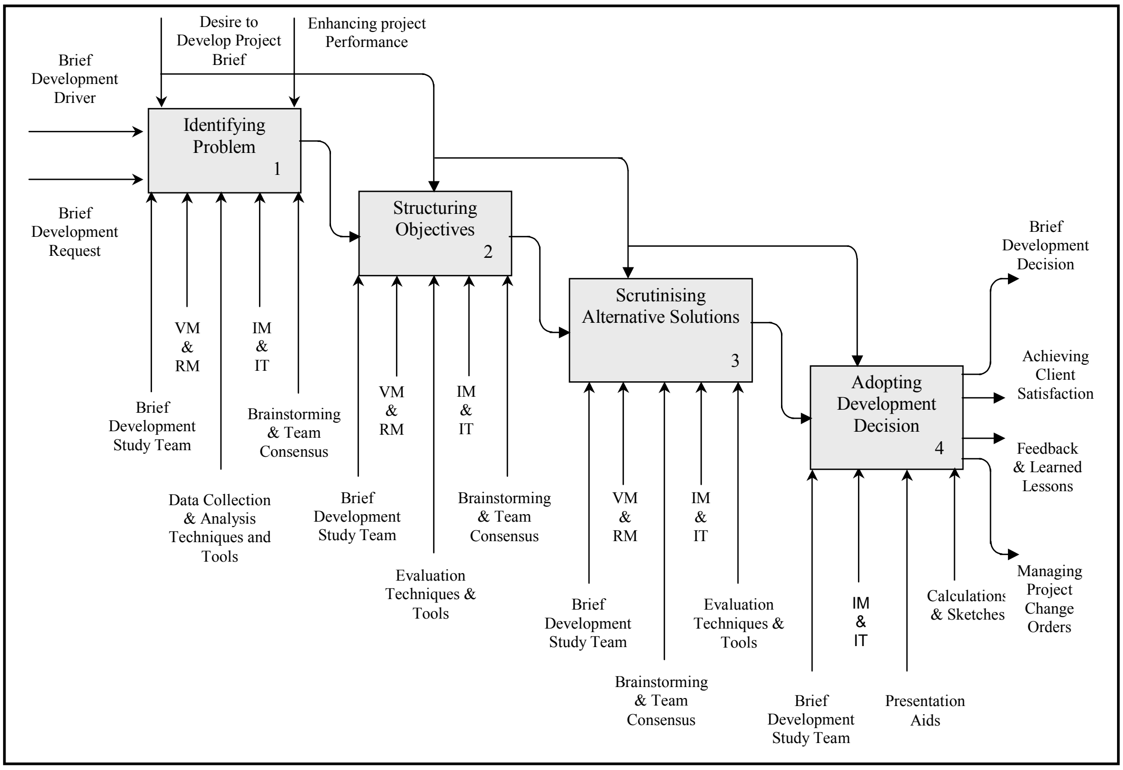

Figure 2: The Four Main Steps of the VRMP

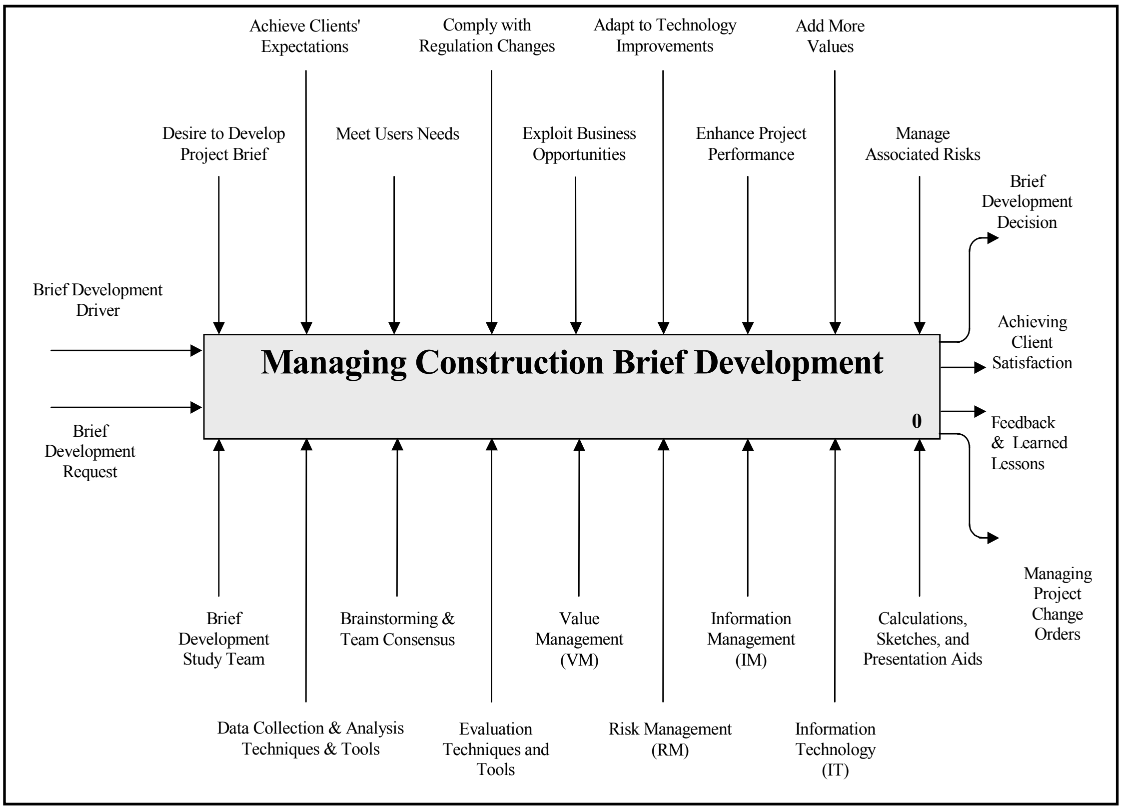

Figure 3: The Top-Level Diagram for the VRMP

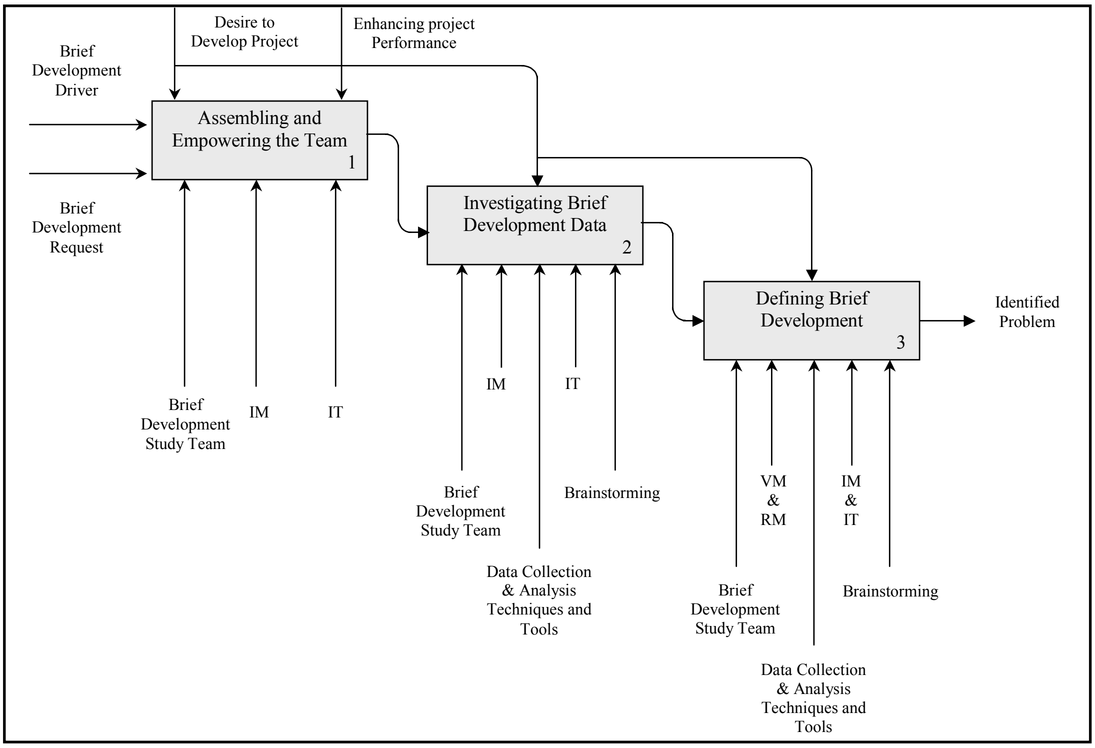

Figure 4: Identifying Problem

Defining Brief Development

This activity aims to describe brief development, define the development drivers, stages, initiators, value sources and risk sources to the client. This information is intended to enable the study team understand the development required.

Structuring Objectives

The "Structuring Objectives" function (Figure 5) is a decomposition of box 2 in the VRMP/A0 diagram (Figure 2) and it involves four activities: 1) defining objectives, 2) developing objectives value hierarchy, 3) allocating importance weight and 4) defining associated risks.

Defining Objectives

In order to enable clients and construction professionals adopt the appropriate decision, the objectives of brief development have to be adequately defined. Clear definition of objectives leads to the achievement of client satisfaction. The objective of this function can be adequately achieved through collecting data from the concerned parties and the use of brainstorming and team consensus.

Developing Objectives Value Hierarchy

This activity aims to structure the brief development objectives in a value tree to allocate importance weights in subsequent stage. The top of the tree is characterised by the overriding cause of the entire objectives. This is then progressively broken down into sub-objectives. Whilst the higher order objective represents an end in itself, the lower order objectives are considered to be a 'means-to-an-end'. It is important that the value tree is produced by brainstorming and group consensus and that each participant feels involved.

Allocating Importance Weights

It is essential after the objectives value hierarchy is developed to allocate importance weights to each attribute according to its perceived importance.

- Attributes are initially listed in order to perceived importance and the least importance is awarded an arbitrary weight of 10.
- It is then necessary to allocate weights to the other attributes on the basis of their relative importance.
- The weights are then summed and each attribute is normalised so that the total weight for the group adds up to 1.

Defining Associated Risks

Since better value is not likely to be achieved unless associated risk are identified, this function aims to define the different risks that lead to brief development or affect the achievement of development objectives.

Scrutinising Alternative Solutions

The "Scrutinising Alternative Solutions" function (Figure 6) is a decomposition of box 3 in the VRMP/A0 diagram (Figure 2) and it involves two activities: 1) Generating alternatives, and 2) Evaluating alternatives.

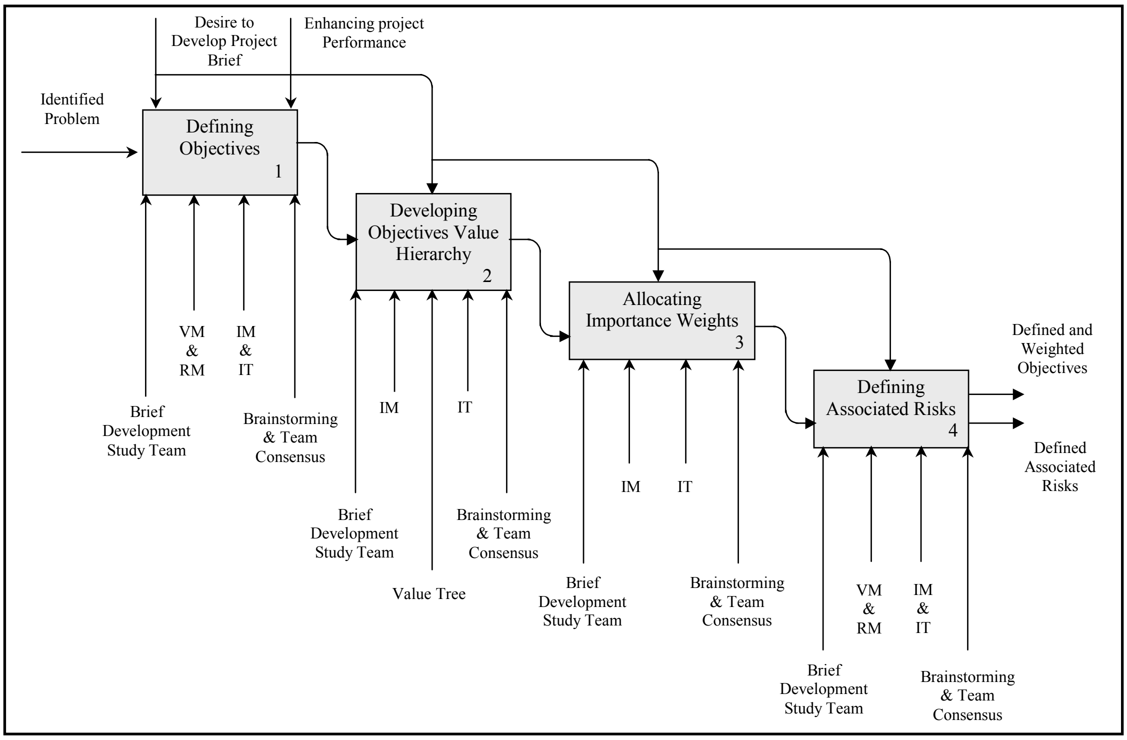

Figure 5: Structuring Objectives

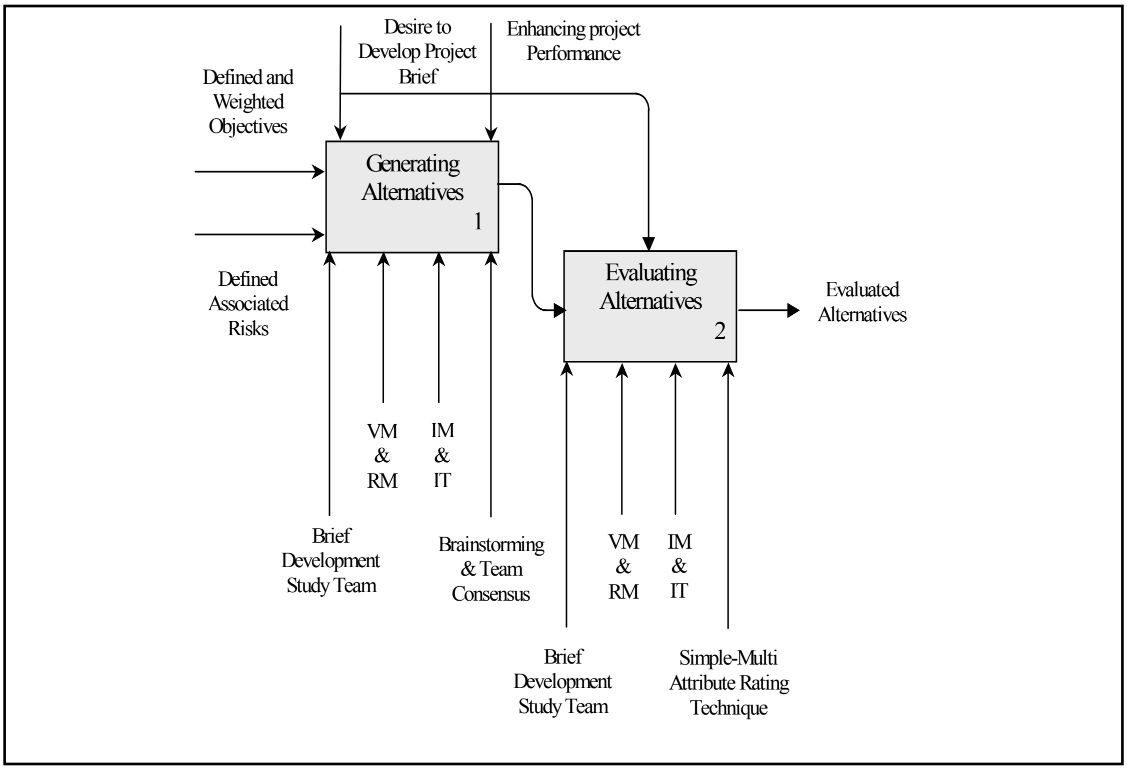

Figure 6: Scrutinising Alternative Solutions

Generating Alternatives

This function aims to create new ideas that achieve the various brief development objectives in the most cost effective manner. The brainstorming technique is used to generate and record a large number of ideas without evaluation.

Evaluating Alternatives

During this function the desire for the judgement of ideas, which was suppressed during the previous function, is applied. The allocation of importance weights to the objectives value hierarchy forms the basis of the evaluation process. Alternatives evaluation screens the ideas created, so that only the best ideas will be selected for development. Evaluation involves the following processes of:

- Developing a decision matrix,
- Assessing associated risks,
- Comparing alternatives,
- Performing sensitivity analysis, and
- Reconciling value and risk.

Firstly, each option is assessed against each of the identified attributes (i.e. objectives and sub-objectives). This is best done in the form of a decision matrix. Each brief development option is scored against each attribute on a scale from 0-100. Following the allocation of scores, these are then weighted (i.e. multiplied) by the appropriate importance weighting identified during the allocating importance weight function. The weighted scores for each attribute in brief development alternatives (i.e. alternative A) can then be added together to provide the aggregate score for brief development alternatives. By comparing the total scores of the various alternatives, the most suitable options can be arrived at with those that have the highest score [32]. Secondly, every alternative is assessed against the associated risks by assessing risk likelihood and severity. The assessed risk = Likelihood X Severity. Thirdly, all development alternatives are compared to each other on the basis of expected value and associated risks. The best alternative is the one, which has more net expected value (= expected value –associated risk). Fourthly, a sensitivity analysis has to be carried out. The purpose of this analysis is to test how sensitive the outcome of the rating process is to marginal changes in the key variables. Particular attention should be given to any importance weights which members of the team had expressed some discomfort. It may be necessary to adjust the structure of the value and risk tree[26]. Finally, it may be essential that the study team revisits the selected alternatives, in particular, when the associated risk (i.e. cost) is higher than the estimated cost. Minor modifications to the selected alternative can overcome this problem without affecting the overall performance.

Adopting Development Decision

The "Adopting Development Decision" function (Figure 7) is a decomposition of box 4 in the VRMP/A0 diagram (Figure 2) and it involves four activities: (1) Presenting alternatives, (2) Selecting best alternative, (3) Implementing selected alternatives, and (4) Monitoring and feedback.

Presenting Alternatives and Selecting the Best Alternative

The objective of the "Presenting Alternatives" function is to assist in the communication of the results from the brief development study to the decision makers. This function enables the study team to orally present their major recommendations so that the subsequent review of the written proposals is not hindered by a lack of understanding. During the "Selecting Best alternative" function the decision makers should select the most appropriate alternative that achieves client objectives and guarantees his/her satisfaction in the most cost-effective manner [7].

Implementing the Selected Alternative

If the decision-makers adopted the decision to proceed with brief development, the project manager with the collaboration of design and construction team has to establish the plans and procedures to implement this decision.

Monitoring and Feedback

This function plays an important role in following up and observing the implementation of the adopted decision. It aims to ensure that implementing the selected decision proceeds as planned and tries to take any corrective actions if any problems arise. In addition, it is necessary to make sure that the final product of brief development satisfies and achieves the client requirements. The "Feedback" function aims to improve the briefing process for future projects through feedback to the client and design and construction teams, learned lessons and comments of the facilities management team and end users.

6. APPLICATION OF THE VALUE AND RISK MANAGEMENT PROTOCOL

In order to investigate how the VRMP will be implemented in managing dynamic brief development, the protocol was applied on a number of real case studies in Abu Dhabi, the capital of the United Arab Emirates (UAE). These case studies were at different stages of the project life cycle. Details of a case study at the design stage are described below. Based on the client requirements, the project was designed as a residential building consists of:

- Ground floor (shops and services rooms),
- 4 typical floors (16 two bed rooms flats), and
- Roof floor (services rooms and watchman room).

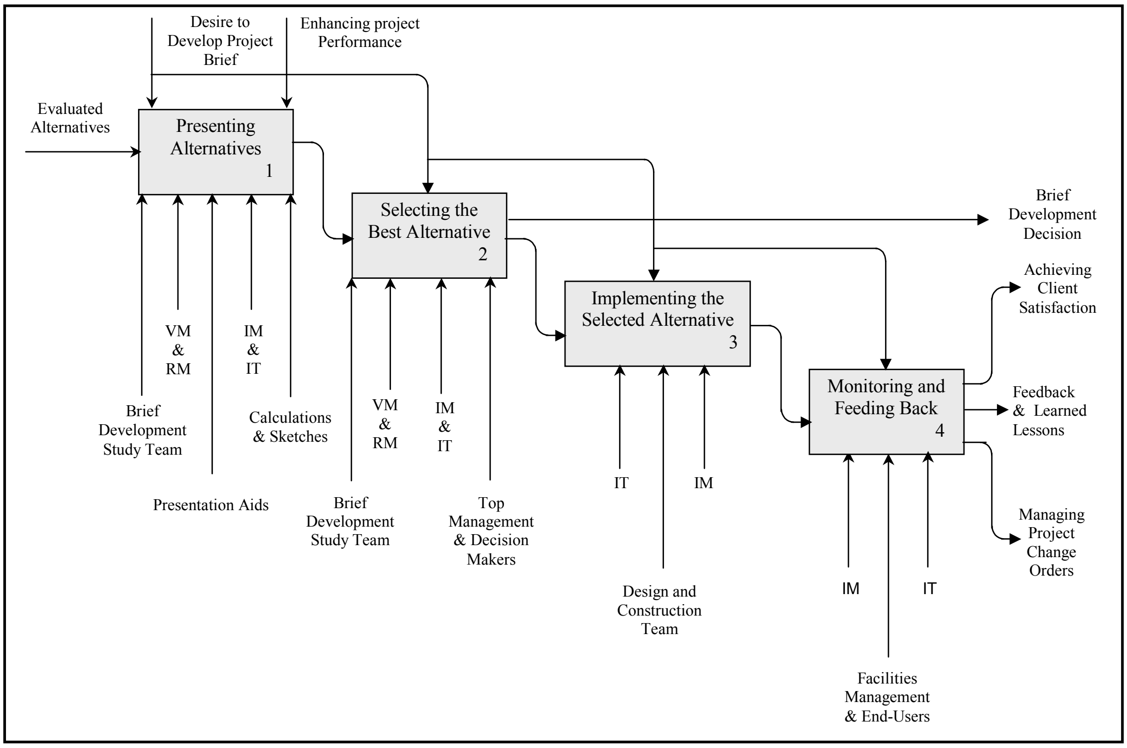

Figure 7: Adopting Development Decision

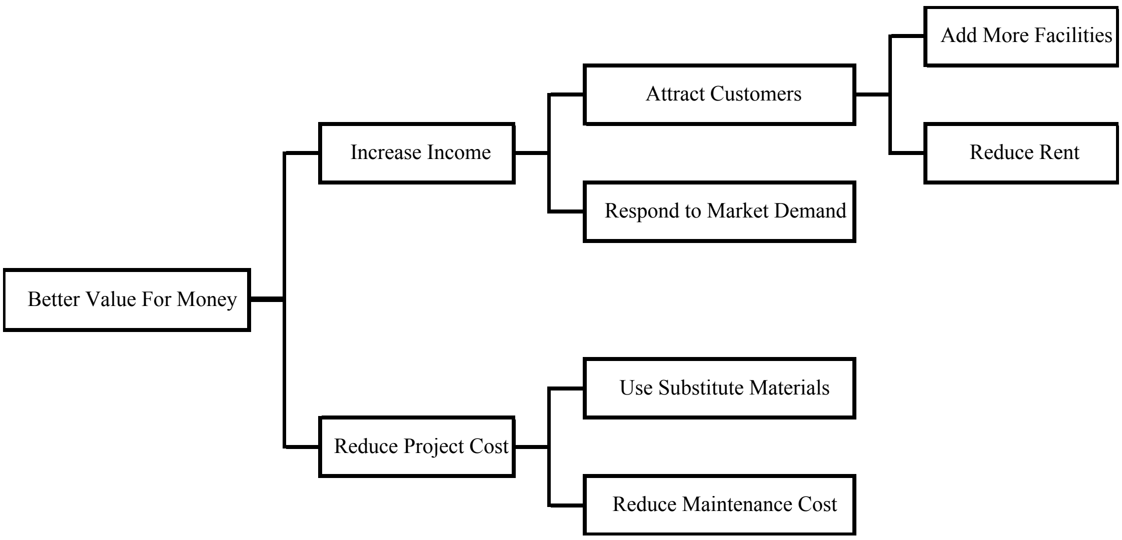

Figure 8: Brief Development Objectives Value Hierarchy

The project cost estimated to be DHS (Dirhams) 6, 000, 000 and the construction period was projected to be 12 months. At the tender action stage, the client received an offer to rent the building for 10 years if the design was changed to be an office building with no flats or shops. A request was submitted to the design firm and the funding authority that approves the design and supervises the construction work. It was made clear to the client that any changes to the project brief should be within the limit of the government loan to construct the building; otherwise the client has to provide additional funds to cover any extra cost. The client stated that he does not have the ability to provide additional funds and the modifications should not exceed the government loan. It worth to mention that the government loan is given to the UAE citizens as a way of providing social insurance and stable income to enable them meet the challenge of life, as well as save citizens from the high rates of the commercial banks. Once the building is handed over and occupied, the client will receive 30% of the building's revenues, where 60% of the building's revenues is allocated for reimbursing the government loan with no interest, and the remaining 10% will be kept for maintenance work[33].

An orientation meeting was attended by the client representative, project manager, chief architect and the author. The meeting aimed to discuss the client's request and understand his objectives and the reasons for modifying the project design and how his objectives could be achieved. A study team was formed from the author as a facilitator, client representative, project manager, architect, quantity surveyor, structural engineer, civil engineer, and electrical and mechanical engineer. The study period was 5 working days at the design firm. One week was given to the design firm to collect adequate information from related authorities and parties. Data were collected from the client, end user, Municipality and Town Planning Department, Civil Defence Directorate, Water and Electricity Department. The data collected from the first two sources focused on how the new design will meet their expectations and satisfy their needs, where the data collected from other sources was about the requirements and procedures for design change as well as how the new design will comply with government authorities' regulations.

The client's request was defined as modifying the project design from a residential building to be an office building with no flats or shops in order to get better value for money and utilize the benefits of the project location. The design team advised the client to include some flats and shops in the new design to utilize the increasing market demand for flats and shops. A set of sub objectives were generated to achieve the client objectives:

- increase income.
- respond to market demand.
- reduce project cost.
- reduce maintenance cost.
- attract customers.
- use substitute materials.

The brief development study team, who attended the brainstorming session, played an important role in developing the objectives value hierarchy and allocating importance weights for each objective based on the importance of the objective to the client (Figure 8 and Table 2). In addition, the brainstorming session was utilized to define the associated risks that may threaten the achievement of the client objectives. They were:

- Delay due to re-design time required and getting authorities approvals.
- Delay due to importing materials.
- Loss of customers.

Table 2. Importance Weights of the Brief Development Objectives

Development Objectives	Weights	Normalised Importance Weight
Add More Facilities	10.00	0.24
Reduce Rent	15.00	0.36
Respond to Market Demand	10.00	0.20
Use Substitute Materials	40.00	0.16
Reduce Maintenance Cost	10.00	0.04

Table 3. Brief Development Generated Alternative (A-G)

A	Leave the design of the typical floors as it is, move the services rooms in the ground floor to basement in order to increase the showroom area, use substitute cheaper materials
B	Increase the number of flats from 16 (two bed room) to 24 (one bed room), move the services rooms to basement to increase showroom area, construct car parking at basement, raise the building specification, and reduce rent.
C	Re-design two floors to be offices, leave the other floors to be 8 flats (two bed room), move the services rooms to basement, construct car parking at basement, and use substitute cheaper materials.
D	Re-design two floors to be offices, re-design the other two floors to be 12 flats (one bed room) instead of 8 flats (two bed room), move the services rooms to basement, construct car parking at basement, and use substitute cheaper materials.
E	Modify the design of the whole project to be office building, move the services room in ground floor to basement and add car parking, and raise building specification to attract customers.
F	Modify the design of the whole project to be office building, move the services rooms in the ground floor to the basement and add car parking, and use substitute cheaper materials.
G	Invest the client resources in another type of project.

Table 4. Decision Matrix Used to Evaluate Alternatives

Assessment Attributes	Add More Facilities	Reduce Rent	Respond to Market Demand	Use Substitute Materials	Reduce Maintenance Cost	Total
Weights of Importance	0.24	0.36	0.20	0.16	0.04	
Alternative A	0.00	0.00	20.00	100.00	0.00	20.00
	0.00	0.00	4.00	16.00	0.00	
Alternative B	75.00	25.00	30.00	0.00	0.00	33.00
	18.00	9.00	6.00	0.00	0.00	
Alternative C	50.00	0.00	40.00	100.00	42.00	37.68
	12.00	0.00	8.00	16.00	1.68	
Alternative D	50.00	0.00	50.00	100.00	40.00	39.60
	12.00	0.00	10.00	16.00	1.60	
Alternative E	75.00	0.00	80.00	0.00	85.00	37.40
	18.00	0.00	16.00	0.00	3.40	
Alternative F	50.00	0.00	80.00	100.00	85.00	47.40
	12.00	0.00	16.00	16.00	3.40	

Table 5. Assessing Associated Risks

Assessment Attributes	Re-Design Delay		Importing Materials		Losing Customers		Total
	L	S	L	S	L	S	
Alternative A	5.00	1.00	1.00	1.00	2.00	2.00	10.00
	5.00		1.00		4.00		
Alternative B	5.00	3.00	3.00	3.00	1.00	1.00	25.00
	15.00		9.00		1.00		
Alternative C	5.00	2.00	1.00	1.00	1.00	1.00	12.00
	10.00		1.00		1.00		
Alternative D	5.00	2.00	1.00	1.00	1.00	1.00	12.00
	10.00		1.00		1.00		
Alternative E	5.00	2.00	4.00	3.00	1.00	1.00	23.00
	10.00		12.00		1.00		
Alternative F	5.00	2.00	1.00	1.00	1.00	1.00	12.00
	10.00		1.00		1.00		

Table 6. Comparing Alternatives

	Expected Value	Associated Risk	Net Expected Value
A	20.00	10.00	10.00
B	33.00	25.00	8.00
C	37.68	12.00	25.68
D	39.60	12.00	27.60
E	37.40	23.00	14.40
F	47.40	12.00	35.40

The multi-disciplinary study team used the brainstorming technique to generate creative alternatives to achieve the above objectives. Table 3 summarizes the generated alternatives. All participants were encouraged to generate as many ideas as they can. In addition, every participant was prompted to build on and improve ideas which may be generated by others team members.

After the previous stage was completed, the different generated alternatives were evaluated. Alternative "G" was rejected on the basis that the government loan given to the client was intended to be spent on constructing his building and not for any other purpose. Other alternatives were raised for evaluation. A decision matrix was created to evaluate each alternative against the pre-defined objectives, Table 4. Assessing associated risks plays an important role in identifying the risks that most threaten the achievement of the development objectives. This was done by assessing risk likelihood and severity, where assessed risk = likelihood (L) X Severity (S), Table 5. After the decision matrix was developed and the associated risks were assessed. Alternative were compared on the bases of net expected value and associated risks, where net expected value = (expected value-associated risk), Table 6. The weights mentioned in all tables represent the arithmetic means of the different weights proposed by the participant in the evaluation session.

Results of comparing alternatives showed that alternative "F" has the highest net expected value of 35.40. A sensitivity analysis was carried out by fixing all evaluation criteria and changing one criterion and then observing its effect on the evaluated alternatives. Results showed that alternative "F" was still the favored option.

A presentation meeting was held at the design firm office where a brief description of the study was introduced to the client. It included presentation of the VRMP, identifying the problem, structuring objectives, generating and evaluating alternatives. In addition, a brief development study report was submitted to the client in order to facilitate reviewing the systematic steps followed and helping adopt the brief development decision.

Alternative "F" was selected as the best alternative with net expected value of 35.40. The cost of the selected alternative was expected to be DHS 5,660,270, which was within the budget of the government loan. Then, an official letter was issued by the client and the funding authority to the design firm stating that acceptance of the changes of the project design and brief development had been agreed and that the design firm would be compensated for the re-design and production of tender documents as an office building. Accordingly, the design firm re-designed the project. The feed back of the case study can be summarized as:

1. Carrying out adequate study of the client business case, client requirements and market demand will avoid later changes where its cost can be expensive and it disrupts the scheduled works.
2. The designer should bear in mind that many clients do not have in depth construction knowledge or cannot describe what they need, so the designer should have developed the art of questioning client and be able to suggest more options until the client

requirements are met and his/her satisfaction is achieved.
3. Clients should provide the design firm with all information and open communication channels to reflect their requirements as early as possible.
4. The project was constructed and occupied and the client was satisfied with the results of the study.

7. BENEFITS OF THE VALUE AND RISK MANAGEMENT PROTOCOL

The main benefit of the VRMP is enabling clients and construction professionals adopt a process for brief development decision. It clarified client aims and objectives through the participation of project stakeholders and ensuring that client requirements were clearly defined. In addition, it helped identifying the detail for brief development required for creating a collaborative work environment. Furthermore, it suggested that better values were added through generating improved and cost-effective solutions that meet client expectations as well as minimising uncertainties through the identification, analysis and responding to associated risks. The protocol helped managing change orders effectively and enhancing the briefing process through learned lessons and feedback. It is clear that the VRMP represents an innovative approach to achieve client satisfaction, responding to brief development drivers throughout the project life cycle, managing project change orders effectively, and improving the existing briefing process.

8. LIMITATIONS OF THE VALUE AND RISK MANAGEMENT PROTOCOL

The effective application of the VRMP depends to a large extent on the client organisation and construction professionals. If they do not have the desire to use the protocol, then its adoption will be limited. In addition, the application of the protocol is time consuming, and within the current culture in the construction industry where insufficient time is spent on managing brief development, this protocol might not be welcomed by some sectors of the industry. Moreover, the large amount of information used to manage this form of brief development necessitates that it must be well managed. In order to overcome the limitations of the protocol and facilitate its use, the benefits of the protocol have to be clearly presented to the client organisation and construction professionals in order to get them convinced with the role, which the protocol could play in managing brief development. This will increase the opportunities for adopting the protocol. In addition, the benefits of information management and information technology have to be utilised to minimise the time required to apply the protocol and manage the large amount of information used. For this reason, the protocol is now captured in a computer software format, which will be presented in a subsequent paper.

9. CONCLUSIONS

- Limitations of the current briefing theories to achieve client satisfaction are attributed to confining brief development to a certain stage. This perspective hinders the interaction between the client and the designer and inhibits utilising value opportunities and manages associated risks. The Dynamic Brief Development (DBD) concept is presented as an approach to overcome the limitations of the current briefing approaches. This concept supports and encourages brief development throughout the project life cycle.
- Since permitting brief development to take place throughout the project life cycle can add either value or risk or both to the project, Value Management and Risk Management were integrates to formulate the Value and Risk Management Protocol.
- The Protocol is a decision making tool designed to manage dynamic brief development throughout the project life cycle. Its need was emerged from the necessity of the dynamic brief development concept. The protocol aimed to enable client's organisation and construction professionals adopt better brief development decision on the basis of value addition and risk management. In addition, it aimed to achieve client satisfaction, respond to the influences of the brief development drivers, manage project change orders effectively, and improve the performance of the briefing process through feedback and learned lessons.
- These aims were achieved through a set of interrelated objectives of: adequate identification of brief development problems, better understanding of the client objectives, generating, evaluating and selecting the best alternative that will achieve these objectives at the most cost - effective manner, and implementing the selected alternative, monitoring its execution and feedback the client organisation, design and construction teams with comments and learned lessons.
- The protocol based on systematic steps of decision-making consists of: 1) intelligent phase, 2) design phase, and 3) choice phase. In order to select the appropriate way to represent the protocol activities the IDEF-0 methodology was considered the most appropriate tool to represent the protocol. The rational behind its selection and description of its notation was illustrated.
- The protocol consisted of four steps: Identifying problem, structuring objectives, scrutinising alternative solutions, and adopting development decision. The protocol was applied on real case studies at different stages. A case study at the design stage was presented. Benefits of the Protocol were presented and limitations were explained which will be overcome through capturing the protocol in a computer software format.

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The International Journal of Construction Management (2006) 27 - 43

THE BRIEF DEVELOPMENT MANAGER AS AN IT TOOL FOR MANAGING DYNAMIC BRIEF DEVELOPMENT IN CONSTRUCTION

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Abstract
The Value and Risk Management Protocol (VRMP) is an innovative decision making tool developed by the authors to manage dynamic brief development in construction projects. Application of the protocol on real case studies showed that it is a time-consuming tool and there is a large amount of information that needs to be managed. In order to overcome these limitations, facilitate the use of the protocol and escalate its efficiency, this paper presents a computerised version of the VRMP called the Brief Development Manager (BDManager) prototype software. Because of their importance, the role of Information Management (IM) and Information Technology (IT) in managing dynamic brief development is illustrated. In addition, development, system architecture and description of the BDManager are described. Furthermore, three questions are asked to evaluate the BDManager. They are: what to evaluate, how to evaluate, and when to evaluate. In an endeavour to ensure its success as an effective IT tool to manage dynamic brief development, the reliability and validity of the prototype are discussed. Results of the evaluation questionnaire are presented and the users' comments are applied to improve the performance of the prototype software.

Keywords
Brief Development Manager, Information Management, Information Technology.

INTRODUCTION AND RESEARCH BACKGROUND

The VRMP is presented as an innovative decision-making tool designed to manage dynamic brief development in construction. It aimed to enable clients and construction professionals adopt the proper brief development decision on the basis of value addition and risk management. In addition, it aimed to achieve client satisfaction, respond in an innovative manner to the influences of brief development drivers, manage project change orders effectively, and improve the performance of the briefing process through feedback and learned lessons. The VRMP is an outcome of four years Ph.D. research work carried out at the Department of Civil and Building Engineering, Loughborough University, UK. The research focused on integrating value management and risk management to manage dynamic brief development in construction (Othman, 2004).

The VRMP consisted of four steps: identifying problems, structuring objectives, scrutinising alternative solutions, and adopting development decision. Application of the protocol on real case studies at different stages of the project life cycle showed that it is a time-consuming tool and there is a large amount of information that needs to be managed (Othman, 2005). In order to overcome these limitations, facilitate the use of the protocol and escalate its efficiency, IM and IT were utilised to formulate a computerised version of the VRMP called the BDManager prototype software. This paper aims to introduce this prototype software as an innovative IT tool for managing dynamic brief development in construction. In addition, it aims to demonstrate how the BDManager facilitates the application of the VRMP in a computerised environment, helps saving time and managing the large amount of information used. These aims are achieved through accomplishing the following objectives:

(1) Explaining the role of IM and IT in managing dynamic brief development,
(2) Defining the objectives and features of the BDManager,
(3) Illustrating the development and system architecture for the BDManager,
(4) Evaluating and applying the BDManager, and investigating its reliability and validity.

RESEARCH METHODOLOGY AND CASE STUDY SAMPLING

The above aims and objectives called for a research strategy, which could gather data sufficiently rich to develop the BDManager and present it as a reliable and validated tool. Two approaches were employed, namely literature review and consulting software programmers. Firstly, literature review was used to (1) review the importance of IM and IT in managing dynamic brief development, (2) investigate the different way of developing prototype software, (3) review the application and evaluation methods as well as reliability and validity of prototype software. Secondly, consulting software programmers resulted in selecting the Microsoft Access as the development package for the BDManager based on its advantages and features (McLaren, 1996).

The purposive sampling method is adopted to select the samples of case studies, in which the BDManager is applied. This is because a particular group of clients agreed to apply the BDManager to their projects and a particular study team is selected to apply the prototype software. These case studies are recently constructed buildings selected from the construction industry of the United Arab Emirates.

THE ROLE OF IM AND IT IN MANAGING DYNAMIC BRIEF DEVELOPMENT

Information flow plays a key role in construction project management. Construction projects depend on the reliable and quick exchange of information to support planning, controlling, decision-making, and constructing shared meanings and mutual understanding. How data is recorded, refined, and organised affects its usefulness to the project. Effective IM is an integral part of any successful project management system. (Yates and Elnagar, 1997; Azam *et al*., 1998). Establishing a clear strategy and framework for managing project information is essential and helps specifying the pattern of information flow and the manner in which information will be managed. Managing project information helps facilitating information flow, saving time and money, avoiding disputes, and achieving client's objectives (Mitchell and Miller, 1999).

The underlying principles of the Dynamic Brief Development concept established by the undertaken research are identified as:

(1) The briefing process has to be deemed as an ongoing process extending throughout the project life cycle.
(2) The project brief has to be considered as a live document continually developing and adapting in an innovative manner to the influential internal and external drivers.

(3) Feeding back the client organisation and the design and construction team with learned lessons and comments of the facilities management team and end users will enhance the performance of the briefing process.
(4) A system to manage dynamic brief development has to be set out as early as possible (Othman *et al*., 2004).

IM has a crucial role in managing dynamic brief development in construction projects because it:
(1) Enables construction professionals respond efficiently to clients' requirements, brief development drivers and provide a building that meets agreed standards and satisfies its clients.
(2) Helps improving the briefing process through learned lessons and feedback (Jebb, 1992).
(3) Helps managing project change orders through providing information for studying their impacts on different project aspects, generating, evaluating, selecting best solution, monitoring and feedback as well as reviewing the effects of similar change orders in similar projects.

Using IT to manage documents becomes one of the most important challenges facing organisations. Using IT to support creating, approving, sustaining, applying, sharing, and reviewing information increases flexibility and fast-cycling capabilities (Amami and Beghini, 2000). The manual process for updating information could be very time-consuming, costly and ineffective, particularly when the designer who initiated the change forgets to propagate it or incorrectly assumes that no other disciplines are affected. The result is poorly coordinated documents with conflicts, inconsistencies, and mismatch. In addition, most design firms do not adequately organise the design knowledge, which often causes parts of the knowledge to be lost and makes the management of changes difficult (Bouchlaghem *et al*., 2000; Hegazy *et al*., 2001). IT has an important role in managing dynamic brief development in construction projects through building live project brief development database, facilitating entering, organising, retrieving, sharing and updating information, enhancing, and facilitating calculations.

THE IMPORTANCE AND OBJECTIVES OF BDMANAGER

The BDManager is the prototype software for the VRMP. It is intended to overcome its limitations, facilitate its use and escalate its efficiency through implementing the systematic steps of the VRMP in a computerised environment. This will be achieved through accomplishing the following objectives of the BDManager:
(1) Facilitate building live project database by collecting, verifying, organising, storing, retrieving, sharing and updating information.
(2) Facilitate identifying the brief development problem and saving time through using pre-designed pull down menus.
(3) Facilitate structuring the brief development objectives and scrutinising alternative solutions through using Microsoft Excel in developing objectives value hierarchy, accelerating the calculations of allocating importance weights, developing decision matrix, assessing associated risks, comparing alternatives and performing sensitivity analysis.
(4) Facilitate the communication between concerned parties through using electronic mail to exchanging information and follow up work progress.

(5) Facilitate constructing general project information including project code, brief development code, project type, client name, project location, contract type, project cost, project duration, design firm, constructor, suppliers, funding body, and remarks.
(6) Facilitate adopting the proper brief development decision through using presentation packages for adequate presentation of development alternatives supported with reports, calculations and CAD generated documents, as well as facilitate planning, monitoring and feeding back using project planning packages.

THE FEATURES OF THE BDMANAGER

Achieving the above objectives necessitated considering the following features during the development of the BDManager:

(1) Allowing all users to view and examine stored projects information. Authorised users are only permitted to modify and store new information.
(2) Allowing more than one user to use the prototype simultaneously.
(3) Stimulating the user through the design of friendly and attractive data entry forms and the provision of adequate use instruction.
(4) Facilitating the inquiry of different projects information or brief development data by using different search categories.
(5) Facilitating the generation, viewing, and printing of reports on various aspects of the project.
(6) Allowing the future extension of the prototype and integration with other computer-based construction activities and software.

DEVELOPMENT AND SYSTEM ARCHITECTURE FOR THE BDMANAGER

The development of the BDManager database was built on the design of tables, forms, queries and reports. A database table is the basic structure that holds the data values for the database (McLaren, 1996). Each table is designed to store information corresponding to an entity of the defined entities for the VRMP (Othman, 2005). Tables are the basis for designing forms. Forms are used for entering, displaying and editing the data stored in tables. Queries are designed to help the user of the prototype search for project information using different categories such as inquire by brief development drivers. Reports are designed to allow the user of the BDManager view and print reports of project information using different categories. The system architecture for the BDManager consists of four components: (1) general project information, (2) Value and Risk Management Protocol, (3) inquiries centre, and (4) reports centre. These components facilitate collecting, verifying, organising, storing, retrieving, sharing and updating information from the Access data repository. The user interface interacts with the interconnected system components through a set of screens, see Figure 1.

DESCRIPTION OF THE BDMANAGER

The Welcome Screen

Figure 2 shows the Welcome screen, which introduces the prototype to its users. It contains a brief statement about what the application is and what it is intended to do. In addition, the screen gives the user three options: (1) to continue as a data entry, (2) to continue as data viewer, or (3) to exit.

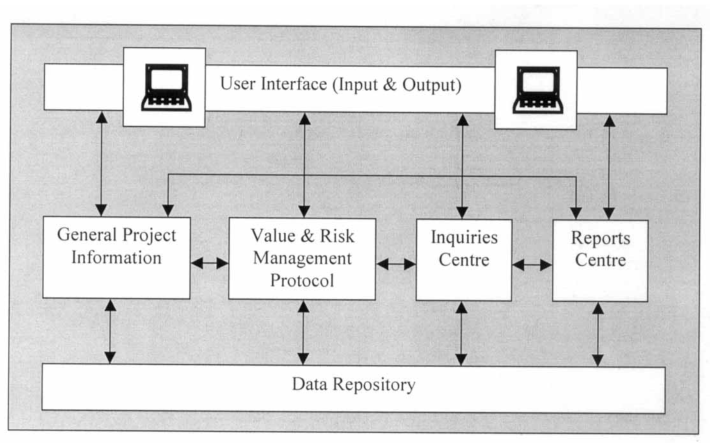

Figure 1 System Architecture for the BDManager

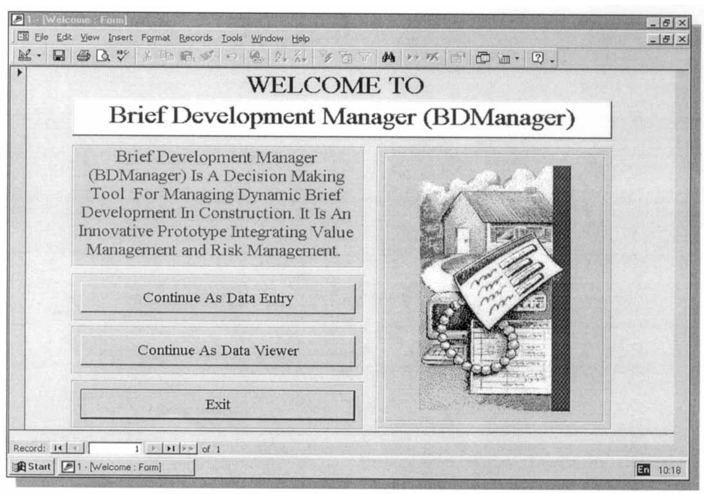

Figure 2 The Welcome Screen for the BDManager

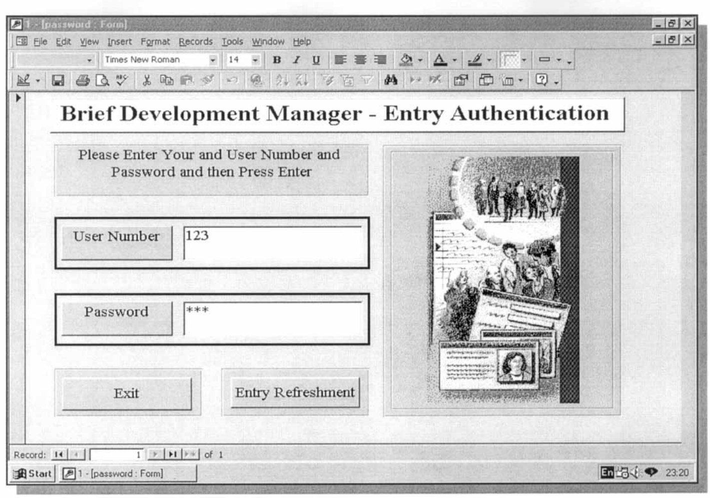

Figure 3 The "Brief Development Manger - entry Authentication" Screen"

Continue as Data Entry

Permitted users are only allowed to continue as data entry after entering a correct user number and password. They will be able to enter new data and update existing information, see Figures 3 and 4. Continue as data entry includes entering and updating general project information and applying the VRMP.

Continue as Data Viewer

All users are allowed to view stored data without the permission to modify existing information, see Figure 5. Continue as data viewer allows the user to navigate General Project Information, view the four steps of the VRMP, inquire brief development database using different categories, see Figure 6 view and print reports based on different categories, see Figure 7.

Exit

This option allows the user to exit the BDManager.

EVALUATION OF THE BDMANAGER

System evaluation is an integral part of the prototype development. Evaluation is used to appraise the whole value of the prototype. Three basic questions for system evaluation have to be asked: (1) what to evaluate? (2) how to evaluate?, and (3) when to evaluate? (Ng and Smith, 1998).

What to Evaluate?

This questions aims to determine how well the developed system facilitated managing brief development and achieving the objectives of the VRMP as well as accomplishing the prototype features. This was achieved by assessing how well the BDManager facilitated:

(1) Identifying the brief development problem,
(2) Structuring the brief development objectives,
(3) Scrutinising alternative solutions,
(4) Adopting the proper development decision.
(5) Assessing the Features of the BDManager.
(6) Encouraging end users recording their comments, feedback and suggestions to develop the BDManager.

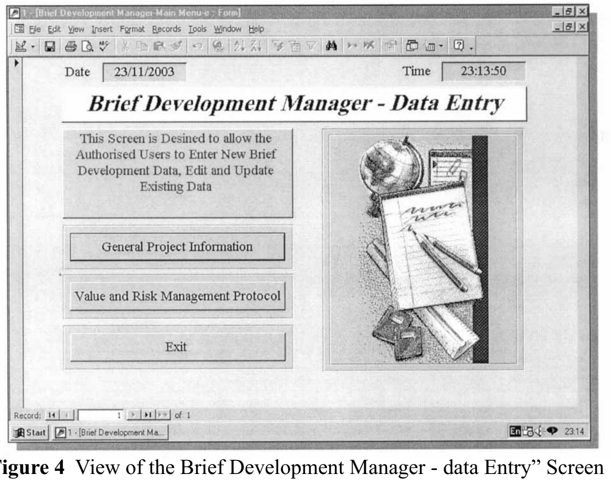

Figure 4 View of the Brief Development Manager - data Entry” Screen

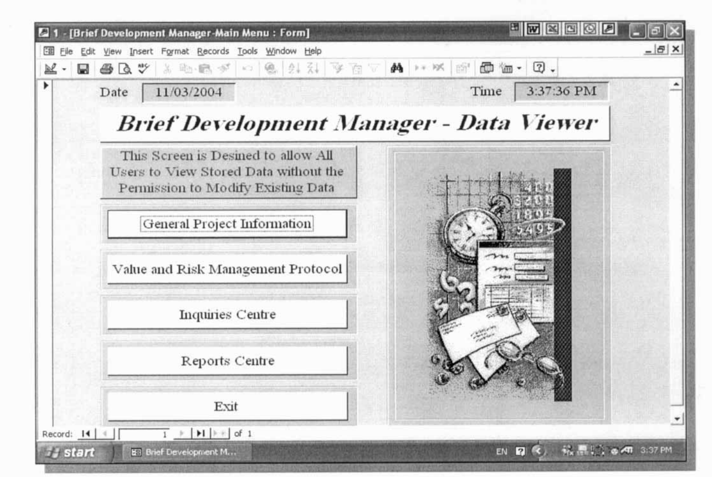

Figure 5 View of the "Brief Development Manger - Data Viewer" Screen

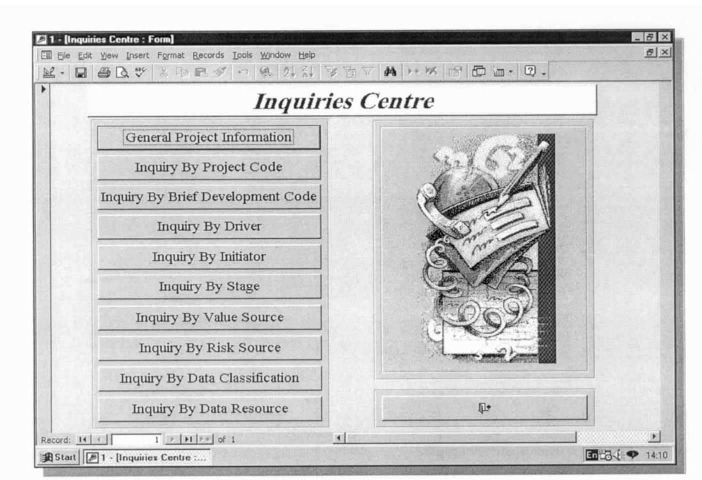

Figure 6 The "Inquiries Centre" for the BDManager

Figure 7 View of the "Report Centre" for the BDManager

How to Evaluate?

Two evaluation methods for knowledge-based systems are used. The first one is to provide end users with a working version of the system under evaluation and leave them make use of it over a prolonged time period. This gives users an opportunity to get used to its functionality and form an opinion on whether the stated benefits are actually achieved. A diary is used to record evaluators' comments, difficulties occurred, or any lacking features. This is not an easy task because many difficulties are magnified when the trial system is integrated with existing systems. Another approach is where a relatively large number of evaluators are available in a single location for a short period of time to participate simultaneously in an evaluation session. The session consists of a hands-on usage portion, where the evaluators are guided through a usage scenario with the use of appropriate notes. This is followed by the distribution and completion of questionnaire by each evaluator (Miles *et al*., 2000; Ren, 2002). During the course of evaluating the BDManager, the second method was adopted. In this approach, the major characteristics of BDManager, its development process, and the use of the prototype are demonstrated to the evaluators who applied the protocol to solve brief development problems. Evaluators were asked to complete an evaluation questionnaire.

When to Evaluate?

The development of the BDManager was done in an iterative process. Regular revision and evaluation of the prototype was carried out by the authors with the collaboration of software programmers and construction professionals to assess how well the prototype covered the requirements of the VRMP. When a satisfactory version was produced, it was applied to a number of case studies. At the end of each brief development study session, the participants were asked to fill a questionnaire designed to evaluate the suggested prototype. Evaluators' comments and suggestions were considered and applied to enhance the performance of the designed prototype.

APPLICATION OF THE BDMANAGER

In order to evaluate the BDManager and assess its performance as a decision-making tool for managing dynamic brief development, the prototype software was applied on a number of real case studies. These projects varied in their client organisations, development drivers, stages, and initiator for instance. The following section presents a detailed description of one of these case studies. It worth to mention that the identities of the client organisation, funding authority, study team, design firm, constructor and suppliers were suppressed for the purpose of confidentiality according to their request.

Case Study

General Project Information

Project Code	:	A/2003
Brief Development Code	:	1/A/2003
Project Type	:	Residential Villa
Client Name	:	*************
Project Location	:	Abu Dhabi
Contract Type	:	Lump Sum
Project Cost	:	£ 200,000
Project Duration	:	12 Months
Design firm	:	*************

Constructor	:	*************
Suppliers	:	*************
Funding Body	:	*************
Remarks	:	

Identifying Problem

Project Code	:	A/2003
Brief Development Code	:	1/A/2003

Orientation Meeting

An Orientation Meeting was held at the funding authority. This meeting was attended by the client, head of maintenance section, architect, civil engineer, maintenance engineer, electro-mechanical engineer, and the first author. The aim of this meeting was to understand the client's objectives and the reasons that derived him to enhance the building specification and how his objectives could be achieved. Strategic matter such as the selection of study team members, study date, time, duration and location were decided. One week was given to the design firm to collect adequate information from related authorities regarding design changes and its requirements and approvals.

Selecting Team Members

The study team comprised of: the first author as a facilitator, client, architect, civil engineer, maintenance engineer, and electro-mechanical engineer.

Study Data	:	29/03/2003
Study Time	:	from 8:30 AM to2:30 PM
Study Duration (Days)	:	3
Study Location	:	The Funding Authority
Data Resource	:	Client Organisation & End User
Data Classification	:	Client Requirements & Economic
Development Driver	:	Upgrade project facilities

Development Description

In this case study, the previous tenant cancelled his contract and left the villa on 30/6/2002. Since that time the villa was not occupied despite the great demand on that area as quiet and well-serviced. This was traced back to a number of reasons:

(1) Damage and failure in the ground floor flooring.
(2) Kitchen cabinets and bathrooms fittings are damaged and in a bad state of repair.
(3) Ordinary Air Conditioning (A/C) windows type system (high electricity bill).
(4) Poor building facilities (no central gas, no central Antenna, etc.).
(5) Expensive annual rent.

The building client decided to attract tenants to rent the villa, particularly after a new tenant offered to rent the villa. The modification will include:

(1) Removing all the damaged tiles on ground floor and do back filling.
(2) Fixing new ceramic tiles.
(3) Removing and shifting old kitchen cabinets and bathrooms fittings and fixing new fashionable sets.
(4) Complete refurbishment and maintenance of painting, electrical and sanitary work and replacing damaged items.
(5) Adding more facilities.
(6) Reducing Rent

Development Stage	:	After Practical Completion
Development Initiator	:	Client Organisation & End User
Value Source to Client	:	End User
Risk Source to Client	:	End User

Structuring Objectives

Defining Objectives

The client objectives were defined as attracting new tenets to rent the villa and recover the loss of leaving it unoccupied for approximately one year and get benefits from the villa location and size. A set of sub-objectives were generated to achieve the client objectives:

(1) Enhancing Specification
(2) Adding more Facilities
(3) Reducing Rent
(4) Refurbishing and Maintaining work

Developing Objectives Value Hierarchy

Allocating Importance Weights

After the brief development objectives were identified, the brainstorming technique with the support of Microsoft Excel was used to develop objectives value hierarchy, allocate and calculate importance weights of these objectives as shown in Figure 8 and Table 1.

Defining Associated Risks

After the objectives value hierarchy was developed and the importance weights were allocated and calculated, the associated risk that may threat achieving the defined objectives were defined as:

(1) Increasing the work cost than the client budget (£ 4150).
(2) Losing current tenant
(3) Losing new tenants

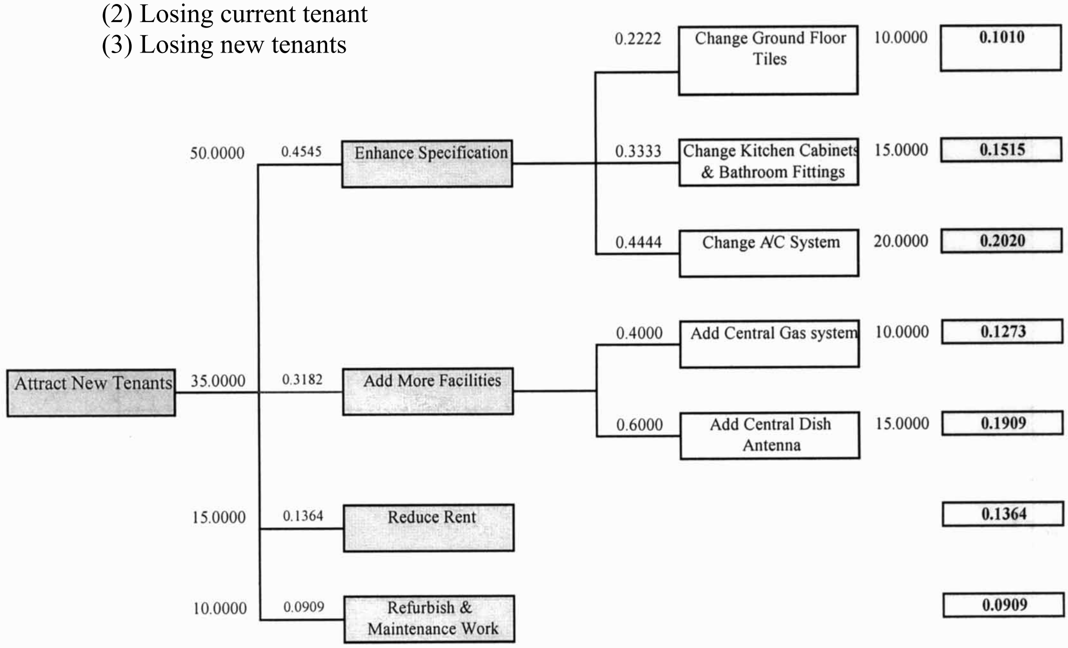

Figure 8 Value Hierarchy of the Brief Development Objectives of Case Study

Scrutinising Alternative Solutions

Generating Alternatives

Brainstorming was used to generate creative alternatives to achieve the above objectives. Table 2 summarises the generated alternatives.

Evaluating Alternatives

The next step was to evaluate the generated alternatives. Alternative "E" was rejected on the basis that the client organisation does not have sufficient funds to demolish and re-construct the villa. Other alternatives were raised for evaluation. A Decision Matrix was created to evaluate each alternative against the defined objectives, see Table 3. Risks that threat achieving client objectives were assessed by assessing risk likelihood and severity, where assessed risk = Likelihood (L) x Severity (S), see Table 4. After the decision matrix was developed, the associated risks were assessed. Alternatives were compared on the bases of expected value and associated risks. Where net expected value = expected value - associated risk, see Table 5. Performing several sensitivity tests showed that all alternatives were not sensitive to changing in one variable while others were fixed. Alternative "C" represents the best alternative with net expected value of (54.36). The problem with alternative "C" is that changing the A/C system will increase the budgeted cost. The client was suggested to bear all the work required (except A/C) and reduce the rent by 10%. The tenant was informed of the client's desire and initial approval was gained from him.

Table 1 Importance Weights of the Brief Development Objectives of Case Study

Objectives	Normalised Weight
Change Ground Floor Tiles	0.1010
Change Kitchen Cabinets & Bathroom Fittings	0.1515
Change A/C System	0.2020
Add Central Gas system	0.1273
Add Central Dish Antenna	0.1909
Reduce Rent	0.1364
Refurbish & Maintenance Work	0.0909

Table 2 Brief Development Generated Alternatives of Case Study

Alternative A	The client has to enhance the villa specification, add more facilities, complete refurbishment and maintenance works without changing the ordinary A/C system.
Alternative B	The villa's annual rent is £ 15000. A new tenant offered to rent the villa for two years with annual rent of £ 9334 against fixing wall mounted A/C units and fixing new kitchen cabinets and the client has to complete other refurbishment and maintenance works.
Alternative C	The client has to enhance the villa specification, add more facilities and complete refurbishment and maintenance works including changing the ordinary A/C system to wall-mounted units.
Alternative D	The client has to wait until he gets another tenant and does the necessary maintenance works and reduces rent without changing villa specification or A/C system.
Alternative E	Re-construction of the villa with high specification, new A/C system, including all facilities.

Table 3 Using the Decision Matrix to Evaluate Alternative Solutions of Case Study

Assessment Attributes	Change Ground Floor Tiles	Change Kitchen Cabinets & Bathroom Fittings	Change A/C System	Add Central Gas system	Add Central Dish Antenna	Reduce Rent	Refurbish & Maintenance Work	**Total**
Weights of Importance (0-1)	**0.1010**	**0.1515**	**0.2020**	**0.1273**	**0.1909**	**0.1364**	**0.0909**	
Alternative A	100.00 10.10	100.00 15.15	0.00 0.00	100.00 12.73	100.00 19.09	0.00 0.00	100.00 9.09	66.16
Alternative B	100.00 10.10	0.00 0.00	0.00 0.00	100.00 12.73	100.00 19.09	38.00 5.18	100.00 9.09	56.19
Alternative C	100.00 10.10	100.00 15.15	100.00 20.20	100.00 12.73	100.00 19.09	0.00 0.00	100.00 9.09	86.36
Alternative D	100.00 10.10	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	60.00 8.18	100.00 9.09	27.37

Table 4 Assessing Associated Risks of Case Study

Assessment Attributes	**Increasing Work Cost**			**Losing Current Tenant**			**Losing New Tenants**			**Total**
	L		**S**	**L**		**S**	**L**		**S**	
Alternative A	3.00	9.00	3.00	4.00	20.00	5.00	2.00	6.00	3.00	35.00
Alternative B	2.00	4.00	2.00	1.00	5.00	5.00	1.00	3.00	3.00	12.00
Alternative C	4.00	16.00	4.00	2.00	10.00	5.00	2.00	6.00	3.00	32.00
Alternative D	1.00	1.00	1.00	5.00	25.00	5.00	3.00	15.00	5.00	41.00

Table 5 Comparing Alternatives of Case Study

	Expected Value	**Associated Risk**	**Net Expected Value**
Alternative A	66.16	35.00	31.16
Alternative B	56.19	12.00	44.19
Alternative C	86.36	32.00	54.36
Alternative D	27.37	41.00	-13.63

Adopting Development Decision

Presenting Alternatives

A presentation meeting was held at the funding authority where a brief description of the study was introduced to the client organisation. It included presentation of the VRMP, identification of the problem in hand, structured objectives, and generated and evaluated alternatives. In addition, a brief development study report was submitted to the client organisation in order to facilitate reviewing the systematic steps followed and helping adopt the proper brief development decision.

Selecting the Best Alternative

The client organisation selected alternative "C" with little modification. The client has to bear all the work required including enhancing the villa specification, adding more facilities, carrying out refurbishment and maintenance works, reducing the rent by 10%, where the tenant will bear the responsibility and cost of fixing the A/C units.

Implementing the Selected Alternative

Alternative "C" with its modifications was tendered and executed for the cost of £ 3634 and the villa is occupied now.

Monitoring and Feeding Back

Based on the above, the followings observations were made:

(1) Development of the project brief could take place at later stages and not necessarily at early stages.
(2) Adequate study of the different drivers that may affect the project brief may add better value to the project and help in achieving the client objectives and satisfactions.

RESULTS OF THE EVALUATION QUESTIONNAIRE

Three brief development study sessions were carried out to study three real case studies. 18 evaluation questionnaires were distributed to the participants of these sessions. Respondents were asked to rate each question on a scale of 5, where 1 =poor and 5=excellent. The results of the questionnaire are shown in Table 6.

The general comments of the evaluators showed that they are satisfied with the effectiveness of the BDManager in managing dynamic brief development in construction, its systematic decision process, team work, managing information and using IT capabilities to facilitate the application of the VRMP. Evaluators were delighted with applying the prototype in real case studies at different stages of the projects life cycle.

Other comments and suggestions for improvement are summarised as:

- Providing users of the prototype software with user number and password to protect the brief development database. This was reflected in the design of the prototype by providing two levels of security as a "Data Viewer" without the permission to modify stored data and as a "Data Entry" with permission to enter new brief development data, edit and update existing data.
- Encapsulate the BDManager in a Web based online application. This recommendation was out of the scope of this research, as implementing the prototype in an online application requires resources such as financial support and software development team.

Table 6 Results of the Evaluation Questionnaire

	Area of Evaluation	% of Responsdents	Evaluation Rate
Identifying Problem	Facilitate identifying the brief development problem	85%	4 / 5
	Using Microsoft Word linked files and pull-down menus to facilitate entering, selecting, editing, and updating different definition information.	80%	4.25 / 5
Structuring Objectives	Facilitate adequate definition of objectives	75%	5 / 5
	Using Microsoft Word and Excel linked files to facilitate defining and updating objectives, building objectives value hierarchy, defining associated risks, allocating and expediting calculating importance weights.	75%	4.25 / 5
Scrutinising Alternatives Solutions	Facilitate scrutinising alternative solutions	80%	5 / 5
	Using Microsoft Word and Excel linked files to facilitate entering, editing and updating generated and evaluated alternatives, reconciling value and risk, saving time, expediting calculations, creating decision matrix, assessing associated risks, comparing alternatives, and performing sensitivity analysis.	100%	4.25 / 5
Adopting Development Decision	Facilitate adopting development decision	70%	4.15 / 5
	Using Microsoft Word linked files to facilitate documenting, updating, and presenting alternatives, selecting the best alternatives, implementing the selected alternatives, and monitoring and feeding back.		
Features of the Brief Development Manage	The role of BDManager in managing, organising, storing, retrieving, sharing and updating brief development data	100%	5 /5
	The role of the BDManager in saving time and effort	100%	4.5 / 5
	Enabling users interact easily with different prototype screens	100%	5 / 5
	The role of the BDManager in facilitating communication and team work between project team members and presenting stakeholders perspectives	100%	3.85 / 5

- Evaluators suggested to use “Bar Chart” to facilitate the comparison between different alternatives scores. This suggestion was added to Microsoft Files beside the Decision Matrix, assessing associated risks, comparing alternatives, and sensitivity analysis.
- Evaluators recommended that top management should be persuaded with the prototype advantages and its benefits for managing brief development in order to facilitate its adoption and application.

All evaluators recommended the BDManager as an effective IT tool for managing dynamic brief development in construction.

RELIABILITY AND VALIDITY OF THE BDMANAGER

The BDManager prototype software could not be considered as a successful IT tool to manage dynamic brief development unless it is reliable and valid. Reliability was defined as the extent to which a test would give consistent results if applied by a different user more than once to the same people under standard conditions (Hall and Hall, 1996). Hammersley (1992) defined validity as another word for truth. It refers to the correctness or credibility of a description, conclusion, explanation, interpretation or other sort of account. Hall and Hall (1996) mentioned that validity means the extent to which software, test, questionnaire or other method is really measuring what it is intended to measure. So, a reliable prototype software is the one which gives consistent results if applied by different researchers more than once to the same peoples under standard conditions, where a valid prototype software is the one which measures what it is intended to measure (Hall and Hall, 1996).

In order to check the reliability of the BDManager, the systematic steps of the VRMP, which were used to build the BDManager prototype software, were applied to a real case study. Then the same case study was examined with the same team members under the same conditions using the BDManager prototype software. Results of the two studies are consistent, but the second one was done in a shorter time because of the use of computer applications. In addition, the prototype software was then applied on a number of real case studies to check its ability to deal with different problems. Results were encouraging which ensures the reliability of the BDManager as an effective decision making tool to manage dynamic brief development in construction.

Findings of the case studies showed the validity of the BDManager. This was clearly shown in the ability of the BDManager in achieving its objectives and features as well as measuring what it is intended to measure.

- The BDManager enabled the client organisation and construction professionals adopt the proper decision to mange brief development as it is intended to do.
- The BDManager facilitated constructing general project information database. This was accomplished through the use of "General Project Information" data entry screen where the project data was stored and updated in Microsoft Access files.
- The BDManager facilitated the precise identification of brief development problem, structuring objectives, scrutinising alternatives, and adopting development decisions. This was achieved through using the "Value and Risk Management Protocol - Data Entry" screen.
- The BDManager facilitated entering, organising, retrieving, sharing and updating information, as well as expediting calculations. This was achieved through the use of different user-friendly screens and using various data entry methods such as typing data in pre-defined boxes, selecting from pre-designed pull-down menus, and inserting Microsoft Word and Excel linked files. In addition, it has the advantage of being linked to other computer based activities and software.
- The BDManager was enhanced by allowing more than one user apply the prototype simultaneously. More user numbers and passwords could be added to meet organisations' requirements.
- The BDManager facilitated the communication between different parties through exchanging information and files through electronic mail.
- The BDManager facilitated the inquiry of information based on different search categories such as development drivers through the use of "Inquiry Centre" screens.

- Finally, the BDManager was designed to enable the user view and get printed reports of general project information using different categories such as drivers, stage, or initiator, for instance. This was achieved by using the “Reports Centre” screens.

CONCLUSIONS

Accessing accurate, reliable, and updated information in a timely manner is essential for increasing the project value and enhancing its performance. IM and IT play an important role in managing dynamic brief development through responding efficiently to client’s requirements, brief development drivers, managing project change orders effectively, improving the briefing process. The VRMP is an innovative decision making tool developed by the authors to manage dynamic brief development in construction projects. Application of the protocol on real case studies at different stages of the project life cycle showed that it is a time-consuming tool and there is a large amount of information that needs to be managed. The BDManager is a computerised version of the VRMP designed to overcome its limitations, facilitate its use and escalate its efficiency. This is achieved through implementing the structured steps of the VRMP in a computer-based environment and show how the BDManager could save time and facilitate the effective management of brief development. The system architecture for the BDManager consists of four components: (1) general project information, (2) VRMP, (3) inquiries centre, and (4) reports centre. These components facilitate collecting, verifying, organising, storing, retrieving, sharing and updating information. Evaluating the BDManager prototype software was an integral part of the prototype development. Three questions were addressed to evaluate the prototype: (1) what to evaluate? (2) how to evaluate?, and (3) when to evaluate?. “What to evaluate” question aimed to determine how well the developed system facilitated managing brief development and achieved the objectives of the VRMP as well as accomplishing the prototype features. “How to evaluate” focused on the method used for evaluation. The last question was about when to evaluate. This was done on regular basis until a satisfactory version was produced. This version was applied to a number of case studies where participants were asked at the end of each session to complete a questionnaire designed to evaluate the produced prototype. Because of their importance, this paper discussed the reliability and validity of the BDManager. In addition, results of the evaluation questionnaire were summarised and recommendations for improvements were studied and appropriate ones were implemented.

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IDENTIFICATION, QUANTIFICATION AND CLASSIFICATION OF CONSTRUCTION BRIEF DEVELOPMENT DRIVERS

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Abstract

Achieving client satisfaction was identified as a key measure for construction projects' success and one of the most important challenges facing today's construction industry. Limitations of the current briefing theories to achieve client satisfaction are attributed to confining the development of the project brief to a certain stage. This perspective hinders the interaction between the client and the designer since clients' ideas mature as the design alternatives unfold. In addition, it inhibits incorporating the influential internal and external drivers that affect the project brief. This is not reflected in practice however. Literature review and case studies showed that clients used change orders to achieve their emerging requirements and enhance the performance of their projects. Because of the importance to perceive the brief development drivers, this paper is devoted to identify the brief development drivers, analyse the questionnaire responses used to quantify these drivers in order to identify the most influential ones, and develop a theme to classify these drivers.

Keywords: client satisfaction, briefing process, brief development drivers, quantifying brief development drivers, classifying brief development drivers

1. Introduction

The increasing recognition that clients are the core of the construction process and the driving force for improvement revealed the importance of achieving their satisfaction (Bennett et al., 1988; Latham, 1994). This could be achieved by translating the client needs into a design, that specifies technical characteristics, functional performance criteria and quality standards and by completing the project within a specified time and in the most cost effective manner (Bowen et al., 1999). Clients are most likely to be satisfied when the final product matches or exceeds their expectations (Ahmed and Kangari, 1995). The early stages of the project life cycle are crucial to its success. This is because the decisions made during these stages influence the characteristics and the form of the project. once these decisions have been made, they can not be readily deleted or dramatically changed in subsequent stages (Smith and Wyatt, 1998). Hence, changing the project brief, after it has been established and particularly, at later stages, has impact on project's cost, time and quality. Late changes to the brief are considered a major source of dispute and litigation throughout the construction industry (Kubal, 1994; O'Brien, 1998; Veenendaal, 1998). In an attempt to eliminate brief changes, the current briefing theories confine project brief development to a certain stage (RIBA, 2000; Barrett and Stanley, 1999; Phiri and Haddon, 2000). This is not

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reflected in practice however. Emerging client requirements, the construction industry's fragmented nature, long investment term, risk exposure, time consumption, and different internal and external influences, may force clients and construction professionals to change what was established at earlier stages. Literature review and analysis of 36 case studies undertaken by the author showed that many of these "late" changes have enabled clients to achieve their emerging requirements and enhance their projects' performance (Bates, 1996; Gardiner and Simmons, 1992; Burati et al., 1992; Othman et al., 2004). Because of the importance to build a clear and firm understanding of the drivers that lead to brief development, this paper aimed to identify the brief development drivers, quantify them in order to define the most influential ones, and finally classify the brief development drivers.

2. Methodology

The above outlined aims called for a research strategy, which could gather sufficient rich data to understand the brief development drivers. literature review was used to identify the brief development drivers, where case studies were used to validate these drivers. The use of case studies confirmed the identified drivers and added new ones. These new drivers were specific to the culture and values of the surveyed society of the United Arab Emirates (UAE). In an endeavour to quantify the brief development drivers, survey questionnaire was deigned and issued. Responses were collected and analysed quantitatively and qualitatively. Finally, a theme to classify the brief development drivers were developed within this research. Furthermore, documentary data and unstructured interviews were carried out with projects' architects in order to investigate the way in which the project brief was developed.

3. Case study sampling

The objective of case study sampling was to select a representative and non-biased sample of construction projects from which to identify the brief development drivers. The survey was undertaken in Abu Dhabi, UAE and information about distribution of the districts surveyed was collected from the Department of Social Services and Commercial Buildings, UAE. The city was divided into 87 districts (DSSCB, 2000). Random number tables were used to select 45 districts, which represented 51.72% of the total. 10 districts were excluded because of the difficulty in obtaining information about the projects due to national security matters. Buildings in each district were counted up and each building was given a unique number to form a table of 900 buildings. A systematic sample of 36 buildings (1:25) was used to select the case study sample. This sampling methodology effectively covered the surveyed city and hence enhanced the reliability and validity of the brief development drivers.

4. Identification of the brief development drivers

Literature review and analysis of 36 case studies identified 47 brief development drivers. These drivers were reviewed on regular basis to omit repeated ones and merge similar drivers. The result was a list of 30 brief development drivers, see table (1).

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Table 1 The Brief Development Drivers

No.	Brief Development Drivers	Lit. Rev.	Case Study
1	Stakeholders change project requirements and have second thought at later stages (Barrett and Stanley, 1999)	✓	✓
2	Uncoordinated and incorrect construction documents (O'Leary, 1992)	✓	✓
3	Brief information is still being given during later design and construction stages (Barrett and Stanley, 1999)	✓	✓
4	Materials are no longer available in market and use better substitute materials (Tenah, 1985)	✓	✓
5	Lack of information provision (Barrett and Stanley, 1999)	✓	✓
6	Meeting new technology changes (PMI, 2000)	✓	✓
7	Lack of regulatory up-dating		✓
8	Project users are not involved in the briefing process (Kernohan et al., 1992)	✓	✓
9	Unforeseen conditions (O'Brien, 1998)		
10	Lack of understanding of different users' culture and traditions		✓
11	Eliminate proven poor quality materials and equipment		✓
12	Lack of design experience (ICE, 1996)	✓	✓
13	Changing government regulation and codes (O'Leary, 1992)	✓	✓
14	Responding to market demand (Smith and Wyatt, 1998)	✓	✓
15	Improper feasibility studies (Valence, 1999)	✓	✓
16	Restricted design fees (ICE, 1996)	✓	✓
17	Lack of understanding of the client organizations (Barrett and Stanley, 1999)	✓	✓
18	Inappropriate communication between the client and the designer (Barrett and Stanley, 1999)	✓	✓
19	Unclear and incomplete project brief (Barrett and Stanley, 1999)	✓	✓
20	Designers ignore the client role and behave unilaterally (Kelly et al., 1992)	✓	✓
21	Lack of communication and co-ordination between government authorities and design firms over planning and approvals		✓
22	Lack of presentation and Visualisation of design (Barrett and Stanley, 1999)	✓	✓
23	Users exaggerate their needs		✓
24	Upgrade project facilities		✓
25	Project users appear at later stages		✓
26	Inadequate available design time (ICE, 1996)	✓	✓
27	Lack of functional, aesthetic, safety requirements and constructability		✓
28	Lack of consideration of environmental requirements (Best and Valence, 1999)	✓	✓
29	Whole project life not considered (CIB, 1996)	✓	✓
30	Initiating value engineering changes (Stocks and Singh, 1999)	✓	✓

5. The rationale behind the brief development drivers

The brief development drivers could be considered in 13 groups and the rationale behind their occurrence investigated in order to identify their role in developing the project brief.

5.1 Drivers relating to communication, clarity and understanding (No's. 17,18,19,20 & 22)

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Barrett and Stanley (1999) stated that very few buildings finish on time or at the right price and clients often criticise the fact that the finished building is not what they expected. Clients may find it difficult to describe their objectives and operations to another party, which leads to the production of unclear and incomplete project brief. This becomes a greater problem when the designer is not skilled in the art of questioning. In addition, lack of presentation and visualisation techniques inhibit the client's understanding of project design and what the building will look like. It would appear that at one or more stages of the construction process there must be a lack of communication between the parties involved. Male et al. (1992) and analysis of case studies showed that architects are more likely to gain kudos from peer approval than from the satisfaction of their clients and may ignore the role of the client and behave unilaterally. These are factors which have resulted in clients dissatisfaction and driven them to develop the project brief by changing and modifying its contents.

5.2 Drivers relating to feasibility studies (No. 15)

A Feasibility Study is defined as a study to determine the probability that a specific real estate proposal will meet the objectives of the developer and / or investor (Collins, 1999). De Valence (1999) states that there are numerous examples of projects proceeding to detailed design stage without proper feasibility studies. Improper feasibility studies and the absence of reasonable alternative options including a no-build option lead to the failure of the project and its brief to meet the client objectives and market and business needs.

5.3 Drivers relating to value (No. 30)

Value Engineering is defined as the process of relating the function, the quality and the cost of the project in the determination of optimum solutions for the project (Omigbodun, 2001). Initiating Value Engineering changes contributes to the production of better and smarter designs (Stocks and Singh, 1999). This could be achieved through developing the project brief by improving functionality (AMEC, 1999), eliminating unnecessary costs (Dell'Isola, 1997), simplifying design, using substitute cheaper materials that have the same or better quality, using substitute construction methods and equipment that have greater capacities, higher efficiencies, higher speeds, and lower operating costs, for instance (Tenah, 1985).

5.4 Drivers relating to project users (No. 8 & 10)

An example of this in the case study was a housing project consisting of 400 houses designed by a foreign consultant who did not adequately understand the culture and values of the end users. After the practical completion stage of the project, the users implemented significant changes in order to meet their requirements such as privacy and the ability to add more rooms for future increase in their family sizes. Mustapha and Bintaher (2000) state that the needs of the occupants may change therefore housing can not be considered as a final product but rather a process that needs to be continuously updated. Brief development should highlight to the client organisation the importance of involving project users in the briefing process and understanding their requirements, culture and traditions.

5.5 Drivers relating to co-ordination and accuracy (No. 2)

Changes in the scope or details of construction originate from various sources. One of the main sources is the faulty construction documentation which generates the need for alternative materials or processes (O'Leary, 1992). Uncoordinated and incorrect construction documentation can emerge from the unfamiliarity of the designer with the project, time shortage, misunderstanding, information overload, over manning for example (Wantanakorn et al., 1999). This leads to development of the project brief in order to rectify the incorrect project documentation and resolve the contradictions in them in an endeavour to ensure client requirements are correctly reflected.

5.6 Drivers relating to inadequate provision of information (Nos. 3, 5 & 28)

The case study project was a residential compound in the desert. It consisted of 35 buildings. The project cost was Dirhams (DHS) 53,760,000 and the construction period was 24 months. It was the first project of its kind to be constructed in the area and as a result , brief information was being delivered during late design and into construction. Lack of information for items such as soil nature and electricity load required resulted in changing the structural design from shallow foundation to deep piles and changing the electricity connection cable to suit the project size delaying the project handover for 180 days. In addition, the omission to consider environmental requirements resulted in design changes to suit the area weather and shift the water tanks from exposed to underground water tanks to protect them from heat and sand storming. As a result project brief developed increasing the project cost by DHS 5,692,813 and the design and construction period by 255 days.

5.7 Drivers relating to regulations and technology advancement (Nos. 6, 7, 13 & 21)

One project in the case studies was a commercial complex consisting of basement floor (2 Cinemas), ground and mezzanine floors, 12 typical residential floors, roof, swimming pool, health club, 6 lifts, 4 escalators, central gas system, central water filtration system and central dish antenna. The cost of the project was DHS 76,960,000 and the construction period was 20 months. Changes in government regulations and codes during the course of the project and the failure of the designer to incorporate these changes, meant the basement had to change from cinema to shopping centre. Additionally, the lack of communication and co-ordination between government authorities and design firms over planning and approvals caused extra spaces and equipment for anticipated telecommunication connections meant substantial changes to the brief. These factors resulted in 25 days extra for re-design and approvals and DHS 246,667 as extra design cost. However, in mitigation these changes reduced the construction period by 60 days and the construction cost by DHS 725,000.

5.8 Drivers relating to quality and sustainability (Nos. 11, 24, 27 & 29)

The case study project was a refurbishment and modification of an existing residential complex and the construction of new recreation area, fountains, swimming pool and car parking. The client objective was to upgrade the project facilities and add new services in order to enhance the project performance, increase its rent and attract new tenants. Many of the materials and equipment used in the existing project were proven poor quality and the maintenance cost and the whole project life were not considered. In addition, lack of functional, aesthetic and safety requirements resulted in developing the original brief to meet the client objectives. This development included the re-design of flats and circulation areas, changes to internal and external finishing, the construction of new aesthetic facades, enhanced safety requirements, installation of high quality materials and equipment. In spite of the cost, time and effort spent in developing the original brief, client objectives and

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satisfaction were achieved, the annual income increased, and enhancing the project performance.

5.9 Drivers relating to design cost and time (Nos. 16 & 26)

All members of the design team have target dates by which their documentation must be delivered. Concern about meeting deadlines limits the time available for cost comparisons and value management. An inadequate budget for completing a design properly encourages designers to take shortcuts in the design process and can adversely affect the completed facility (ICE, 1996). These are some factors that may drive the client and the designer to develop the project brief in a later endeavour to achieve maximum value.

5.10 Drivers relating to unforeseen conditions (No. 9)

Unforeseen conditions cause brief development as the conditions of the field do not match the contract document. This most often occurs with regard to under ground conditions, such as uncharted utilities, uncharted existing foundations, rock or other strata at higher elevation than expected, high ground water, and so on (O'Brien, 1998). Such conditions force the client and the designer to change and modify the project brief in an attempt to overcome these obstructions and deal with unexpected circumstances.

5.11 Drivers relating to market conditions and user demands (Nos. 1, 14, 23 & 25)

A case study project was designed to be a commercial building. After the design was completed and the building license issued, the client received an offer to lease the building for 20 years if the design was changed to a medical centre provided with the latest technological equipment and facilities. Because of the shortage of the market demand for commercial buildings and the business opportunity offered, the client decided to change the project design. The development of the project brief, which happened at the end of the pre-construction period, resulted in 100 extra days and additional cost of DHS 298,908 for re-design and approvals. A further 180 days were required to find a funding body to finance the extra DHS 2,104,318 for hospital equipment. The benefits that the client gained however, far outweighed the increases in cost and time. The annual return for the commercial building was DHS 550,000 excluding the maintenance cost, which was the responsibility of the client, whereas the annual return of the medical centre was DHS 1,000,000 excluding the operation and maintenance cost which was the responsibility of the medical centre

5.12 Drivers relating to lack of design expertise (Nos. 4 & 12)

An example from the case study was a luxurious office building. Its facades were covered with curtain walls and most of the specified materials were imported. The rapid material and technology improvement, coupled with the lack of designer experience to follow up these improvements meant many of the specified materials were no longer produced or available in market. As a result, the client had to change the design of the facades and decided to use locally made materials. This development of the project brief enhanced the project performance. Firstly, the re-design of the project facades reduced the air-conditioning cooling capacity required and became more suitable for a country of hot and humid climate. In addition, these developments to the project brief minimised the project duration by eliminating the time required to import material from abroad and reduced the project cost through using locally made materials (Tenah, 1985). The construction period was reduced by 90 days and the cost was reduced by DHS 380,000.

6. Quantification of the brief development drivers

Out of 530 questionnaires issued, a total of 261 completed and returned. The aim of the questionnaire was to quantify the brief development drivers in order to direct the attention of clients and construction professionals to the most influential drivers, so particular attention could be paid to manage them for the benefit of the project. A three-stage approach was adopted for data analysis. The first stage was simply to measure the central tendency and dispersion of the questionnaire responses in order to get an overview of the typical value for each variable by calculating the mean, median and mode. The measure of dispersion was used to assess the homogenous or heterogeneous nature of the collected data by calculating the variance and the standard deviation (Bernard, 2000). Secondly, since not all-brief development drivers have the same influence on brief development, the relative importance index was used to differentiate between drivers (Olomolaiye et. Al, 1987; Shash, 1993). In order to investigate the correlation between the brief development drivers, the third stage established the linear relationship between the drivers using Bivariate analysis. The data was analysed with the aid of Microsoft Excel spreadsheet and the Statistical Package for Social Sciences (SPSS) computer software (Kirkpatrick and Feeney, 2001).

7. Measure of central tendency and dispersion

The analysis of the collected data showed the close values of means, medians and modes that tend to typical central values and showed also the lower values of variances and standard deviation. This ensures the quality and the homogeneity of the collected data as well as the low degree of dispersion of these data, which will result in reliable recommendations for clients and construction professionals. Figure (1) rated drivers according to their means using clustered columns chart on a scale of 5.

8. Relative importance of brief development drivers

The numerical scores from the questionnaire responses provided an indication of the varying degree of influence that each driver has on developing the project brief. To further investigate the data, a relative importance index (RII) was used to rank the drivers according to their influences (Olomolaiye et. al, 1987; Shash, 1993). This was calculated using the following formula: **Relative Importance Index (RII) = $\sum$ w / AN**

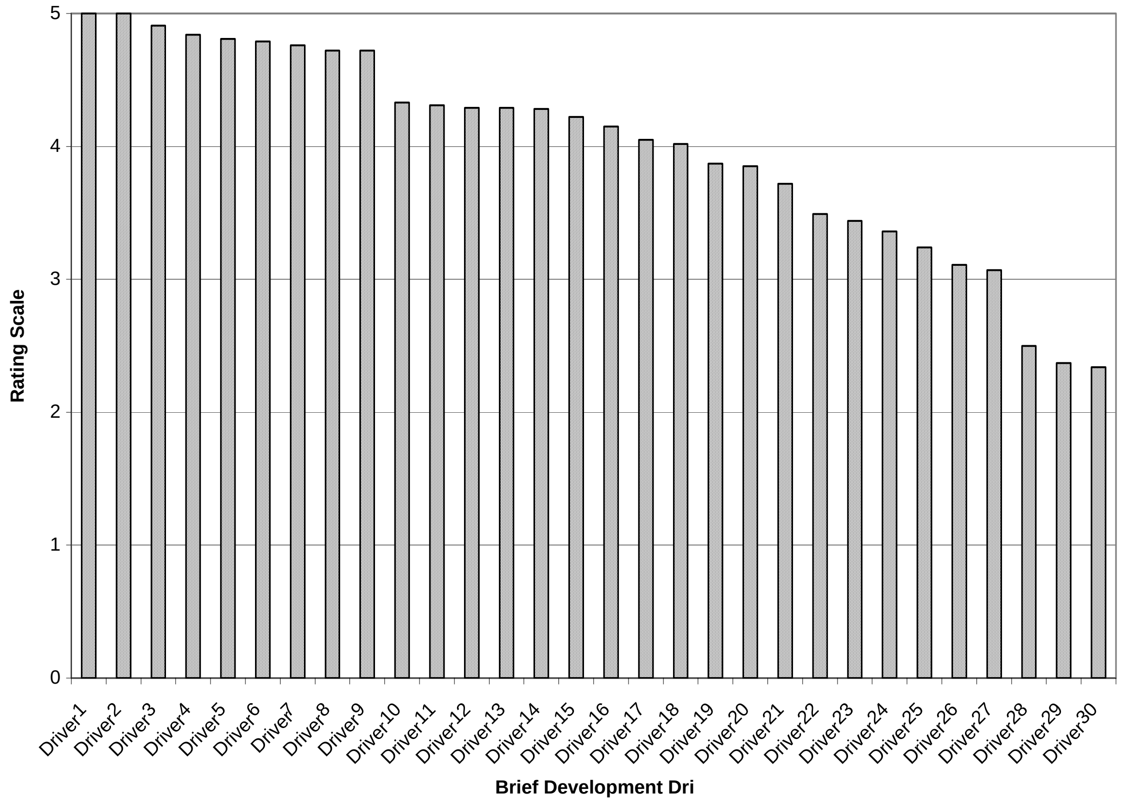

Figure (1) Rating the Brief Development Drivers on a Scale of 5

Where w = weighting given to each driver by the respondents and range from 1 to 5 where 1= very low influence and 5 = very high influence; A = highest weight (5 in our case); and N = total number of sample (Kometa and Olomolaiye, 1997). The RII ranges from zero to one. As would be expected, while some drivers have very high influence on brief development, others do not. Figure (2) shows that the brief development drivers could be classified according to their relative importance into three categories: Firstly, the drivers with very high influence with RII above 0.800, secondly, the drivers with average to high influence, with RIIs lying between 0.600 and 0.800, and finally, the drivers with very low to low influence with RIIs less than 0.600.

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9. Bivariate analysis of brief development drivers

In order to investigate the correlation between the brief development drivers, Bivariate analysis was carried out to establish the linear relationship using the most common measure of correlation, Pearson's *r* (Clarke and Cooke, 1992). Bivariate analysis is used to reveal the relationship between two variables and to what extent the variation in one variable coincides with the variation in another. Bivariate analysis with the aid of SPSS computer software was used to generate the correlation matrix, an extract of which is shown in table (2). The chief feature of using Pearson's *r* is that the correlation coefficient will almost certainly lie between 0 (no relationship between the two drivers) and 1 (a perfect relationship). The closer the coefficient is to 1, the stronger the relationship, the closer it is to zero, the weaker the relationship. The coefficient will be either positive or negative, this indicates the direction of a relationship (Bryman, 2001). For example, the matrix shows a perfect positive relationship, with a (r = +1) between drivers 10&12, as the lack of understanding of different users' culture and traditions increase, the lack of design experience increases by the same amount. In other words the different user's culture and traditions will only be fully perceived and reflected in design if the designer is experienced and possess the art of questioning, extracting and analysing information from the user. The matrix shows a perfect negative relationship (r = –1) between drivers 23&30. This means that, as project users exaggerate their needs in an effort to enhance the facility function and performance, the initiation of value engineering changes will reduce. Finally, there is no correlation between drivers 15&20 as the correlation is close to zero and there is no apparent pattern in the scatter diagram. This means that the variation in each driver is associated with drivers other than the ones present in this analysis (Bryman, 2001) for instance driver 15 is associated with drivers 20, 29 and 28 and driver 20 is related to drivers 27 and 21. Therefore understanding the correlation between the brief development drivers will help clients achieve their emerging requirements, meet user needs, cope with regulation changes, exploit business opportunities, adapt to technology improvement, add value and manage risks.

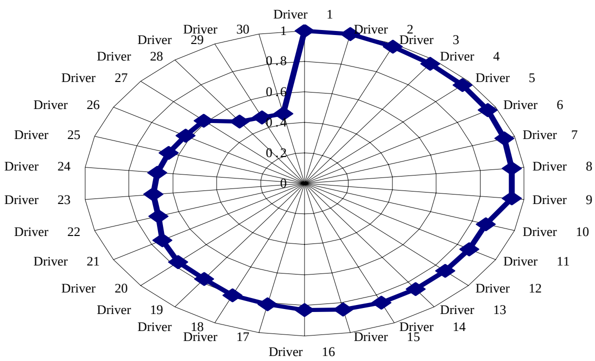

Figure (2) The Relative Importance Indices of the Brief Development Drivers

Table 2 The Correlation Matrix of the Brief Development Drivers

Brief Development Driver	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30
Driver (1)	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (2)	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (3)	-0.44	-0.44	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (4)	-0.38	-0.38	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (5)	-0.34	-0.34	0.99	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (6)	-0.32	-0.32	0.99	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (7)	-0.27	-0.27	0.98	0.99	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (8)	-0.22	-0.22	0.97	0.99	0.99	0.99	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (9)	-0.22	-0.22	0.97	0.99	0.99	0.99	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (10	-0.69	-0.69	-0.35	-0.41	-0.44	-0.46	-0.50	-0.55	-0.55	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (11)	-0.83	-0.83	-0.14	-0.20	-0.24	-0.26	-0.31	-0.36	-0.36	0.98	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (12)	-0.65	-0.65	-0.40	-0.46	-0.50	-0.51	-0.56	-0.60	-0.60	1.00	0.96	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (13)	-0.83	-0.83	-0.15	-0.21	-0.25	-0.27	-0.32	-0.37	-0.37	0.98	1.00	0.97	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (14)	-0.34	-0.34	-0.69	-0.74	-0.77	-0.78	-0.81	-0.84	-0.84	0.92	0.81	0.94	0.81	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (15)	-0.84	-0.84	-0.12	-0.19	-0.23	-0.25	-0.29	-0.34	-0.34	0.97	1.00	0.96	1.00	0.80	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (16)	-0.44	-0.44	-0.62	-0.67	-0.70	-0.71	-0.74	-0.78	-0.78	0.95	0.87	0.97	0.87	0.99	0.86	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (17)	-0.67	-0.67	0.96	0.94	0.92	0.92	0.90	0.87	0.87	-0.07	0.15	-0.13	0.14	-0.46	0.16	-0.37	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (18)	-0.48	-0.48	-0.58	-0.63	-0.67	-0.68	-0.71	-0.75	-0.75	0.96	0.89	0.98	0.89	0.99	0.88	1.00	-0.33	1.00	-	-	-	-	-	-	-	-	-	-	-	-
Driver (19)	-0.45	-0.45	1.00	1.00	0.99	0.99	0.98	0.97	0.97	-0.33	-0.12	-0.39	-0.13	-0.68	-0.11	-0.60	0.96	-0.57	1.00	-	-	-	-	-	-	-	-	-	-	-
Driver (20)	-0.45	-0.45	1.00	1.00	0.99	0.99	0.98	0.97	0.97	-0.33	-0.12	-0.39	-0.13	-0.68	-0.10	-0.60	0.96	-0.57	1.00	1.00	-	-	-	-	-	-	-	-	-	-
Driver (21)	-0.11	-0.11	0.94	0.96	0.97	0.98	0.99	0.99	0.99	-0.64	-0.46	-0.68	-0.47	-0.89	-0.44	-0.84	0.81	-0.82	0.94	0.94	1.00	-	-	-	-	-	-	-	-	-
Driver (22)	-0.42	-0.42	-0.64	-0.68	-0.71	-0.73	-0.76	-0.79	-0.79	0.94	0.85	0.96	0.86	1.00	0.84	1.00	-0.39	1.00	-0.62	-0.62	-0.85	1.00	-	-	-	-	-	-	-	-
Driver (23)	-0.65	-0.65	-0.40	-0.46	-0.49	-0.51	-0.55	-0.60	-0.60	1.00	0.96	1.00	0.97	0.94	0.96	0.97	-0.12	0.98	-0.38	-0.38	-0.68	0.96	1.00	-	-	-	-	-	-	-
Driver (24)	-0.71	-0.71	-0.33	-0.39	-0.43	-0.45	-0.49	-0.54	-0.54	1.00	0.98	1.00	0.98	0.91	0.98	0.95	-0.05	0.96	-0.32	-0.31	-0.62	0.94	1.00	1.00	-	-	-	-	-	-
Driver (25)	-0.69	-0.69	-0.35	-0.41	-0.45	-0.46	-0.51	-0.55	-0.55	1.00	0.98	1.00	0.98	0.92	0.97	0.95	-0.07	0.96	-0.33	-0.33	-0.64	0.95	1.00	1.00	1.00	-	-	-	-	-
Driver (26)	-0.79	-0.79	-0.21	-0.28	-0.32	-0.33	-0.38	-0.43	-0.43	0.99	1.00	0.98	1.00	0.85	1.00	0.90	0.07	0.92	-0.20	-0.20	-0.52	0.89	0.98	0.99	0.99	1.00	-	-	-	-
Driver (27)	-0.75	-0.75	0.92	0.89	0.87	0.86	0.84	0.81	0.81	0.05	0.26	-0.01	0.25	-0.36	0.27	-0.26	0.99	-0.22	0.93	0.93	0.74	-0.28	-0.01	0.06	0.04	0.18	1.00	-	-	-
Driver (28)	-0.76	-0.76	-0.25	-0.31	-0.35	-0.37	-0.41	-0.46	-0.46	0.99	0.99	0.99	0.99	0.87	0.99	0.92	0.03	0.93	-0.23	-0.23	-0.55	0.91	0.99	1.00	0.99	1.00	0.15	1.00	-	-
Driver (29)	-0.73	-0.73	-0.30	-0.37	-0.40	-0.42	-0.46	-0.51	-0.51	1.00	0.99	0.99	0.99	0.90	0.98	0.94	-0.02	0.95	-0.29	-0.29	-0.60	0.93	0.99	1.00	1.00	1.00	0.09	1.00	1.00	-
Driver (30)	0.68	0.68	0.36	0.42	0.46	0.47	0.52	0.56	0.56	-1.00	-0.97	-1.00	-0.98	-0.92	-0.97	-0.96	0.08	-0.97	0.34	0.34	0.65	-0.95	-1.00	-1.00	-1.00	-0.99	-0.03	-0.99	-1.00	1.00

10. Classification of the brief development drivers

Because of the complexity of the construction process and the different brief development drivers that influence its products a holistic approach based on considering the project as an entity that, effects and gets affected by its internal and external factors. The approach classified the brief development drivers to internal, external, and internal and external development drivers. The advantage of classifying brief development drivers is to determine the drivers, which are related through a common characterises and highlights the drivers that appear in several categories which could considered as a common drivers (Zaimi, 1997). The internal project factors were clients, end user, design firm, constructor, and supplier, where the external project factors were: economy, policy, technology, society, and environment.

The Internal Brief Development Drivers are: (Uncoordinated and incorrect construction documents), (Project users are not involved in the briefing process), (Lack of understanding different users' culture and tradition), (Lack of design experience), (Improper feasibility studies), (Lack of understanding of the client organisations), (Inappropriate communication between the client and the designer), (Unclear and incomplete project brief), (Designers ignore the client role and behave unilaterally), (Lack of presentation and visualisation of design), (Users exaggerate their needs), (Upgrade project facilities), (Project users appear at later stages), (Inadequate available design time), and (Lack of functional, aesthetic, safety requirements and constructability)

The External Brief Development Driver is: Changing government regulation and codes
The Internal and External Brief Development Drivers: (Stakeholders change project requirements and have second thought at later stages), (Brief information is still being given

during later design and construction stages), (Materials are no longer available in market and use better substitute materials), (Lack of information provision), (Meeting new technology changes), (Lack of regulatory up-dating), (Eliminate proven poor quality materials and equipment), (Responding to market demand), (Restricted design fees), (Lack of communication and co-ordination between government authorities and design firms over planning and approvals), (Lack of consideration of environmental requirements), (Whole project life not considered), (Initiating value engineering changes).

Since "unforeseen conditions" driver is not initiated by any of the internal or external project factors, this driver was not classified under any of the classified categories.

11. Conclusions

Achieving client satisfaction implies that the final product should match or exceed client expectations and this product should be a reflection of the brief requirements. The current briefing theories confine development of the project brief to a certain stage. This perspective hinders the interaction between the client and the designer and inhibit the exploitation of the different brief development drivers. literature review and case studies showed that changing the project brief better enables client organisations achieve their expectations and enhance the performance of their projects. Because of the importance to build a firm understanding of the drivers that lead to brief development, this paper identified the brief development drivers and quantified them to identify the most influential ones. Finally, a theme to classify these divers was developed.

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VALUE AND RISK MANAGEMENT FOR DYNAMIC BRIEF DEVELOPMENT IN CONSTRUCTION

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Abstract

Client satisfaction is paramount for measuring construction projects success. It is achieved through translating the project brief into a building that is completed on time and at the right cost as well as meets or exceeds client expectations. The current briefing theories confine the development of the project brief to a certain stage, which hinders the interaction between the client and the designer and results in clients dissatisfaction. This paper presents the results of four years Ph.D. research work carried out at the Department of Civil and Building Engineering, Loughborough University, UK. Because of its limitations to achieve client satisfaction, the research aimed to overcome the limitations of the current briefing process through presenting the concept of Dynamic Brief Development. Drivers for brief development were identified, quantified and classified. Since brief development either add value or risk to the project or could add both, Value Management and Risk Management were integrated to formulate an innovative decision making tool to enable clients and construction professionals adopt the proper brief development decision. In order to facilitate the application of the protocol and manage the large amount of information used, the research encapsulated the protocol in a prototype software tool. This tool was validated on real case studies and evaluated by its users who recommended it as an effective IT tool for managing dynamic brief development in construction.

Keywords: Client Satisfaction, Briefing Process, Dynamic Brief Development Concept, Brief Development Drivers, Value and Risk Management.

1. Background and rationale to the research

Achieving client satisfaction was identified as a key factor to measure construction project success (Parfitt and Sanvido, 1993) and one of the most important challenges facing today's construction industry (Torbica and Stroh, 2001). This perspective stemmed from the pivotal role played by clients as the core of the construction process and the driving force for improvement, hence, necessitated the importance to achieve their satisfaction and get their requirements accomplished (Bennett et al., 1988; Latham, 1994; Egan, 1998; Kamara et al., 2000). Two sets of requirements have to be fulfilled in order to achieve client satisfaction. Firstly, by translating client requirements into a design, which specifies technical characteristics, functional performance criteria and quality standards. Secondly, by completing the project within a specified time and in the most cost effective manner (Bowen et al., 1999). Clients are most likely to be satisfied when the final product matches or exceeds their expectations (Ahmed and Kangari, 1995; Hudson, 1999). Because of its vital role in eliciting and communicating client's requirements to the design and construction teams, the briefing process represents a cornerstone for achieving client

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satisfaction. In addition, an effective client briefing is crucial to the attainment of client objectives with respect to time, cost and quality, where inadequate briefing was highlighted as a key source of client dissatisfaction (Latham, 1994). Furthermore, the inefficiency of the briefing process was defined as the reason why buildings have been wasteful of resources or defective in use (Jenks, 1988). According to Kelly et al. (1992) the most critical factors in determining client satisfaction with a building project are the concept brief and the selection of the project team who will design and construct the building. Smith et al. (1998) stated that the briefing process has to be flexible, well organised, and responsive to client and stakeholder needs and objectives to provide more effective, efficient, innovative and better solutions. What mentioned above is the ideal case, but what happens in reality is relatively different. During the course of this research, formal observations, literature review, analysis of 36 case studies, documentary data and unstructured interviews with projects' architects undertaken by the author showed that very few buildings finished on time or at the right cost and clients often criticise the fact that the finished buildings were not what they expected (Othman et al., 2004a). This view was emphasised by others such as Barrett and Stanley (1999) and Kamara et al. (1999). In addition, there is widespread dissatisfaction within the clients community with the extent to which the construction industry delivers facilities that fully meet their requirements or provides appropriate buildings for its clients (Chinyio et al., 1998; Smith et al., 1998). Furthermore, it was articulated that clients used change orders to achieve their emerging requirements and adapt to the influential internal and external drivers, such as exploiting new business opportunities and installing an improved technological system was not available during the brief and design stages (Burati et al., 1992; Gardiner and Simmons, 1992; Hansen, 1994; Bates, 1996; Chapman, 1997; O'Brien, 1998; PMI, 2000).

This is attributed to the limitations of the current briefing theories, which confine the development of the project brief to a certain stage. This perspective obstructs the interaction and communication between the client and the designer since client’s ideas develop and mature as the design alternatives unfold. In addition, it inhibits the incorporation of the influential internal and external drivers that lead to brief development (Othman et al., 2004a). The rationale and motivation for this research stems from the need to improve the efficiency of the construction industry through improving the briefing process. Because of its pivotal role in achieving client satisfaction, the need for improvement has led to focus on the limitations of the current briefing process and propose the appropriate approaches to enhance its performance. The research obtains its significance from the importance to achieve client satisfaction, the need to utilize value opportunities and manage risk threats associated with brief development drivers, the desire to manage project change orders effectively, and improve the briefing process.

2. The aim and objectives of the research

The aim of this research has emerged from the need to overcome the limitations of the current briefing process. The research established that these limitations could be overcome by permitting and managing the development of the project brief throughout the project life cycle. This approach will enable the construction industry achieve client satisfaction, respond to different brief development drivers, manage change orders effectively, and improve the briefing process. Since brief development either add value or risk to the project or could add both, the two well-established methodologies of value management

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and risk management were integrated within this research to formulate the protocol that will manage brief development. In addition, the benefits of information management and information technology were utilised to support and facilitate the use of the developed protocol.

The aim of this research is summarised as developing an innovative protocol integrating value and risk management to manage dynamic brief development in construction and producing a software tool to facilitate its use. In order to achieve this aim the following objectives were developed.

(1) Building a clear understanding of client satisfaction, the briefing process and managing change orders in construction.
(2) Identifying, validating, quantifying, and classifying brief development drivers.
(3) Investigating the perception of the dynamic brief development concept, the existing approaches to manage brief development and identifying their limitations.
(4) Investigating the originators of brief development, the value sources and risk sources to the project from the client's point of view.
(5) Reviewing the value and risk management methodologies, the existing approaches for their combination and identifying their limitations.
(6) Developing the Value and Risk Management Protocol (VRMP).
(7) Producing the prototype software of Brief Development Manager (BDManager).
(8) Evaluating the Brief Development Manager.

3. Overview of the research methodology

The methodology adopted throughout this research was devoted to achieve the research aim and objectives. Based on the revision and analysis of the research process, the different research approaches, and the factors used for selecting the research methodology, this research was descriptive in nature and adopted the applied research approach. Quantitative and qualitative methods were used for data collection and data analysis. The research methodology adopted consisted of four activities: (1) data collection, (2) data analysis, (3) action required, and (4) reliability and validity, see figure (1). These activities were considered as a concurrent process rather than sequential steps. In an endeavor to ensure that the adopted methodology and methods will achieve the research aim and objectives, the relationship between the research objectives and the research methods were established. Data collection was done using different sources and methods to achieve certain objectives. This concept was known as "triangulation", which increased the reliability and validity of data findings. The methods used for data collection were observation, literature review, survey questionnaire, interview, case study and documentary data. The sampling methodology for case study, survey questionnaire, and interview selected a representative and non-biased sample to escalate the reliability and validity of findings. Representativeness and non-bias were achieved by adequately covering all population categories and applying random

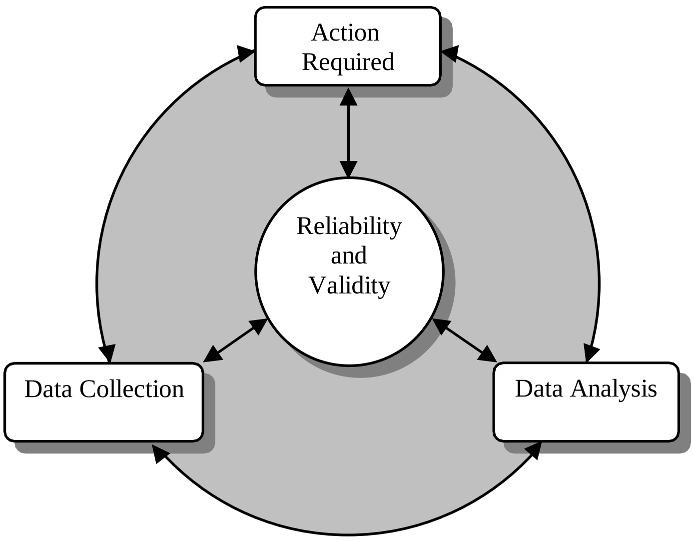

Figure 1 The Research Methodology

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probability sampling methods. Data analysis was carried out quantitatively and qualitatively. For the quantitative analysis approach, measuring the central tendency and dispersion, relative importance index ranking technique, and the linear relationship between drivers using Bivariate analysis were used. For the qualitative approach, the process of preparing and analysing qualitative data was established. During this research many actions were taken in order to meet the research aim and objectives. These actions vary from using other data sources to validate collected data, to selecting an appropriate analysis technique, or designing a questionnaire to quantify the brief development drivers for instance. Reliability and validity was the last activity of the research methodology. Both concepts were built in the heart of the research methodology and had a vital role in making sure that the methods used and the research findings gained were reliable and valid. This was achieved through applying certain course of actions and defined procedures.

4. Overview of the research work done

Throughout this research, the work performed was targeted to achieve the research aim and objectives in the light of the methodology adopted. In order to overcome the limitations and deficiencies of the current briefing process, this research introduced the concept of Dynamic Brief Development (DBD). This concept supports developing the project brief throughout the project life cycle, see figure (2). It was built on four principles:

(1) The briefing process has to be deemed as an ongoing process extending throughout the project life cycle responding in an innovative manner to emerging client requirements, meeting user needs, coping with regulatory changes, exploiting business opportunities, adapting to technology improvement, adding more values, and managing associated risks.

(2) The project brief has to be considered as a live document, which needs to be continually developed throughout the project life cycle.

(3) Feed back to the client organisation and the design and construction teams with comments and learned lessons from the facilities management team and end users will enhance the performance of the briefing process in future projects.

(4) A system to manage the brief development drivers is required. This system must respond to these drivers in a way that adds value and manages associated risk in an endeavor to achieve client satisfaction and enhance project performance.

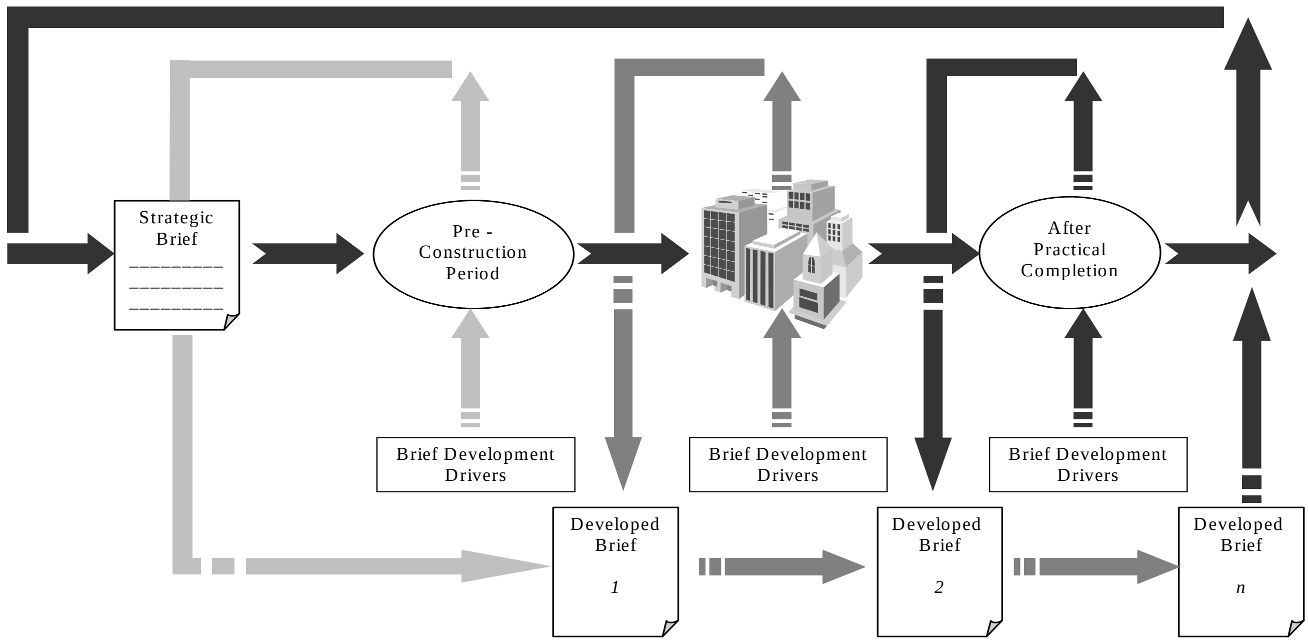

Figure 2 Developing the Brief throughout the Project Life Cycle

In addition, The Dynamic Brief Development concept identifies five milestones to evaluate brief development throughout the project life cycle. These milestones are at: (1) the end of the feasibility stage, (2) the end of the detailed proposals stage, (3) the end of the tender action stage, (4) the end of the construction to practical completion stage, and (5) the practical completion stage (Othman et al., 2004a).

Achieving client satisfaction necessitated the importance to identify the drivers that lead to brief development. Different research methods were used to improve the reliability and validity of the collected data and increase the background knowledge. Formal observations recorded both clients' dissatisfaction with the final product as not meeting their expectation and the increasing number of change orders used throughout the project life cycle. Literature review identified a group of brief development drivers, while analysis of 36 recently completed construction projects confirmed the identified drivers and added new ones. The new drivers reflected the culture and tradition of the surveyed society of the United Arab Emirates. Literature review and case studies identified 47 brief development drivers. These drivers were reviewed and refined on a regular basis to omit repeated drivers and merge similar ones. The end result was a list of 30 brief development drivers. Table (1) lists the identified drivers and indicates whether the driver was identified from literature, case study or both. In order to complete the picture of the brief development drivers throughout the project life cycle, documentary data was investigated to collect information about the project history and the development of project brief at different stages. Moreover, unstructured interviews were undertaken with the projects' architects to investigate the way in which the project brief was developed.

Table 1 The Brief Development Drivers

No.	Brief Development Drivers	Lit. Rev.	Case Study
1	Stakeholders change project requirements and have second thought at later stages (Barrett and Stanley, 1999)	✓	✓
2	Uncoordinated and incorrect construction documents (O'Leary, 1992)	✓	✓
3	Brief information is still being given during later design and construction stages (Barrett and Stanley, 1999)	✓	✓
4	Materials are no longer available in market and use better substitute materials (Tenah, 1985)	✓	✓
5	Lack of information provision (Barrett and Stanley, 1999)	✓	✓
6	Meeting new technology changes (PMI, 2000)	✓	✓
7	*Lack of regulatory up-dating*		✓
8	Project users are not involved in the briefing process (Kernohan et al., 1992)	✓	✓
9	Unforeseen conditions (O'Brien, 1998)	✓	✓
10	*Lack of understanding of different users' culture and traditions*		✓
11	*Eliminate proven poor quality materials and equipment*		✓
12	Lack of design experience (ICE, 1996)	✓	✓
13	Changing government regulation and codes (O'Leary, 1992)	✓	✓
14	Responding to market demand (Smith and Wyatt, 1998)	✓	✓
15	Improper feasibility studies (Valence, 1999)	✓	✓
16	Restricted design fees (ICE, 1996)	✓	✓
17	Lack of understanding of the client organizations (Barrett and Stanley, 1999)	✓	✓
18	Inappropriate communication between the client and the designer (Barrett and Stanley, 1999)	✓	✓
19	Unclear and incomplete project brief (Barrett and Stanley, 1999)	✓	✓
20	Designers ignore the client role and behave unilaterally (Kelly et al., 1992)	✓	✓
21	*Lack of communication and co-ordination between government authorities and design firms over planning and approvals*		✓
22	Lack of presentation and Visualisation of design (Barrett and Stanley, 1999)	✓	✓
23	*Users exaggerate their needs*		✓
24	*Upgrade project facilities*		✓
25	*Project users appear at later stages*		✓
26	Inadequate available design time (ICE, 1996)	✓	✓
27	*Lack of functional, aesthetic, safety requirements and constructability*		✓
28	Lack of consideration of environmental requirements (Best and Valence, 1999)	✓	✓
29	Whole project life not considered (CIB, 1996)	✓	✓
30	Initiating value engineering changes (Stocks and Singh, 1999)	✓	✓

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Because of the importance of quantifying these drivers in order to explore the most influential ones, a survey questionnaire was designed and issued. Then, a three-stage data analysis approach was used to analyse the questionnaire responses. Firstly the measure of central tendency was carried out to get some overall measure of the typical value for each variable, where measure of dispersion was used to know how homogeneous or heterogeneous the collected data is. Secondly, the well-established relative importance index was used to rank drivers according to their importance on developing the project brief on a scale of 5, see figure (3). Finally, the Bivariate analysis was used to investigate the correlation between the different drivers through the creation of a correlation matrix, see table (2).

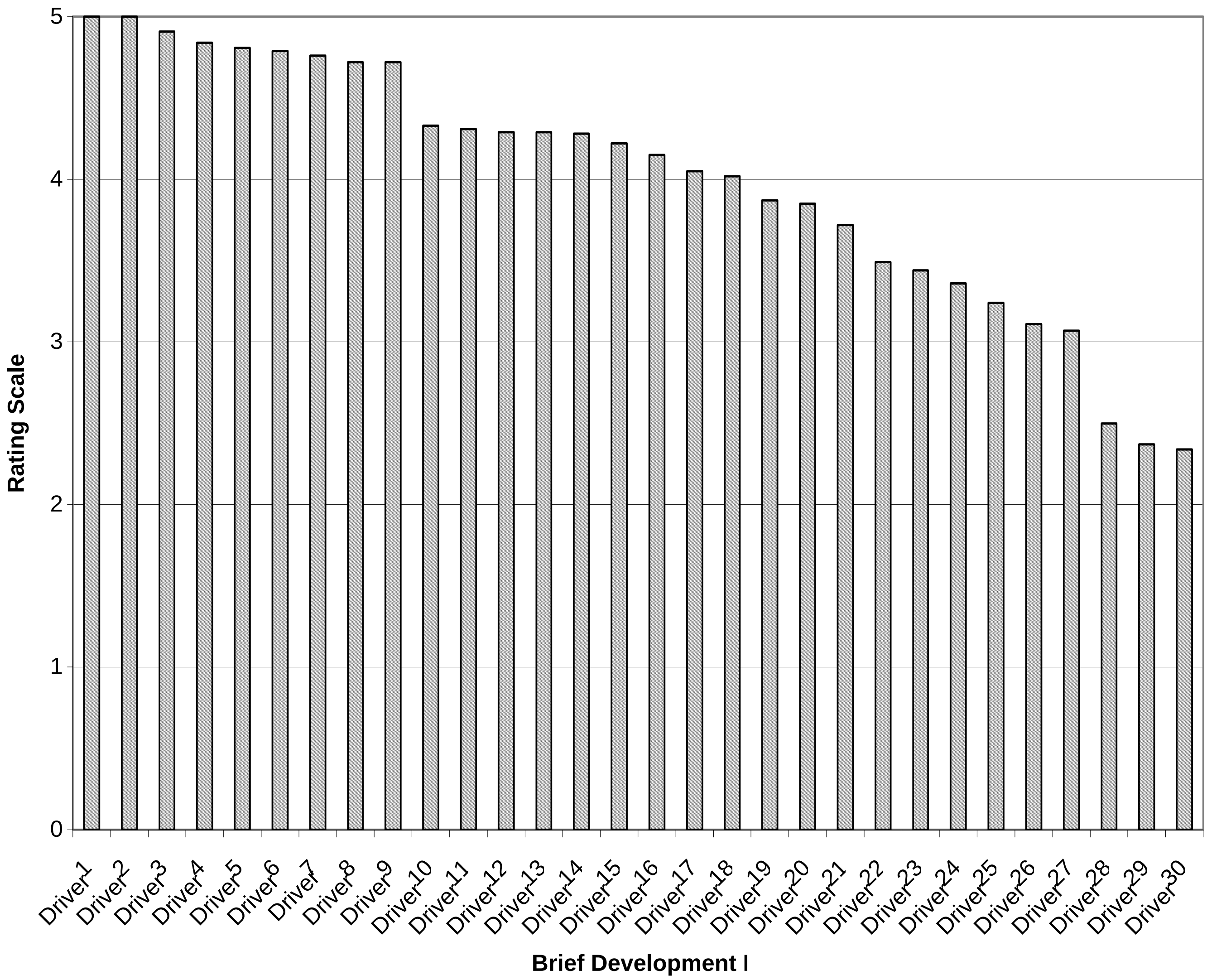

Figure 3 Rating the Brief Development Drivers

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Table 2 The Correlation Matrix Showing the Relationship between the Brief Development Drivers

Brief Development Driver	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30
Driver (1)	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (2)	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (3)	-0.44	-0.44	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (4)	-0.38	-0.38	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (5)	-0.34	-0.34	0.99	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (6)	-0.32	-0.32	0.99	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (7)	-0.27	-0.27	0.98	0.99	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (8)	-0.22	-0.22	0.97	0.99	0.99	0.99	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (9)	-0.22	-0.22	0.97	0.99	0.99	0.99	1.00	1.00	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (10	-0.69	-0.69	-0.35	-0.41	-0.44	-0.46	-0.50	-0.55	-0.55	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (11)	-0.83	-0.83	-0.14	-0.20	-0.24	-0.26	-0.31	-0.36	-0.36	0.98	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (12)	-0.65	-0.65	-0.40	-0.46	-0.50	-0.51	-0.56	-0.60	-0.60	1.00	0.96	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (13)	-0.83	-0.83	-0.15	-0.21	-0.25	-0.27	-0.32	-0.37	-0.37	0.98	1.00	0.97	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (14)	-0.34	-0.34	-0.69	-0.74	-0.77	-0.78	-0.81	-0.84	-0.84	0.92	0.81	0.94	0.81	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (15)	-0.84	-0.84	-0.12	-0.19	-0.23	-0.25	-0.29	-0.34	-0.34	0.97	1.00	0.96	1.00	0.80	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (16)	-0.44	-0.44	-0.62	-0.67	-0.70	-0.71	-0.74	-0.78	-0.78	0.95	0.87	0.97	0.87	0.99	0.86	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (17)	-0.67	-0.67	0.96	0.94	0.92	0.92	0.90	0.87	0.87	-0.07	0.15	-0.13	0.14	-0.46	0.16	-0.37	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
Driver (18)	-0.48	-0.48	-0.58	-0.63	-0.67	-0.68	-0.71	-0.75	-0.75	0.96	0.89	0.98	0.89	0.99	0.88	1.00	-0.33	1.00	-	-	-	-	-	-	-	-	-	-	-	-
Driver (19)	-0.45	-0.45	1.00	1.00	0.99	0.99	0.98	0.97	0.97	-0.33	-0.12	-0.39	-0.13	-0.68	-0.11	-0.60	0.96	-0.57	1.00	-	-	-	-	-	-	-	-	-	-	-
Driver (20)	-0.45	-0.45	1.00	1.00	0.99	0.99	0.98	0.97	0.97	-0.33	-0.12	-0.39	-0.13	-0.68	-0.10	-0.60	0.96	-0.57	1.00	1.00	-	-	-	-	-	-	-	-	-	-
Driver (21)	-0.11	-0.11	0.94	0.96	0.97	0.98	0.99	0.99	0.99	-0.64	-0.46	-0.68	-0.47	-0.89	-0.44	-0.84	0.81	-0.82	0.94	0.94	1.00	-	-	-	-	-	-	-	-	-
Driver (22)	-0.42	-0.42	-0.64	-0.68	-0.71	-0.73	-0.76	-0.79	-0.79	0.94	0.85	0.96	0.86	1.00	0.84	1.00	-0.39	1.00	-0.62	-0.62	-0.85	1.00	-	-	-	-	-	-	-	-
Driver (23)	-0.65	-0.65	-0.40	-0.46	-0.49	-0.51	-0.55	-0.60	-0.60	1.00	0.96	1.00	0.97	0.94	0.96	0.97	-0.12	0.98	-0.38	-0.38	-0.68	0.96	1.00	-	-	-	-	-	-	-
Driver (24)	-0.71	-0.71	-0.33	-0.39	-0.43	-0.45	-0.49	-0.54	-0.54	1.00	0.98	1.00	0.98	0.91	0.98	0.95	-0.05	0.96	-0.32	-0.31	-0.62	0.94	1.00	1.00	-	-	-	-	-	-
Driver (25)	-0.69	-0.69	-0.35	-0.41	-0.45	-0.46	-0.51	-0.55	-0.55	1.00	0.98	1.00	0.98	0.92	0.97	0.95	-0.07	0.96	-0.33	-0.33	-0.64	0.95	1.00	1.00	1.00	-	-	-	-	-
Driver (26)	-0.79	-0.79	-0.21	-0.28	-0.32	-0.33	-0.38	-0.43	-0.43	0.99	1.00	0.98	1.00	0.85	1.00	0.90	0.07	0.92	-0.20	-0.20	-0.52	0.89	0.98	0.99	0.99	1.00	-	-	-	-
Driver (27)	-0.75	-0.75	0.92	0.89	0.87	0.86	0.84	0.81	0.81	0.05	0.26	-0.01	0.25	-0.36	0.27	-0.26	0.99	-0.22	0.93	0.93	0.74	-0.28	-0.01	0.06	0.04	0.18	1.00	-	-	-
Driver (28)	-0.76	-0.76	-0.25	-0.31	-0.35	-0.37	-0.41	-0.46	-0.46	0.99	0.99	0.99	0.99	0.87	0.99	0.92	0.03	0.93	-0.23	-0.23	-0.55	0.91	0.99	1.00	0.99	1.00	0.15	1.00	-	-
Driver (29)	-0.73	-0.73	-0.30	-0.37	-0.40	-0.42	-0.46	-0.51	-0.51	1.00	0.99	0.99	0.99	0.90	0.98	0.94	-0.02	0.95	-0.29	-0.29	-0.60	0.93	0.99	1.00	1.00	1.00	0.09	1.00	1.00	-
Driver (30)	0.68	0.68	0.36	0.42	0.46	0.47	0.52	0.56	0.56	-1.00	-0.97	-1.00	-0.98	-0.92	-0.97	-0.96	0.08	-0.97	0.34	0.34	0.65	-0.95	-1.00	-1.00	-1.00	-0.99	-0.03	-0.99	-1.00	1.00

Data analysis was done by using Microsoft Excel and the Statistical Package for Social Science (SPSS) software (Othman et al., 2004b). A theme to classify the brief development drivers as internal, external and internal and external drivers was developed. Moreover, a brainstorming session with projects' clients was carried out to establish the relationship between the brief development drivers and the project team members in order to identify the originators of brief development, value sources and risk sources to the project from the client's point of view.

Permitting brief development throughout the project life cycle without establishing the procedures and drawing the boundaries which control that development leaves the project brief uncontrolled and jeopardise the achievement of clients objectives and satisfaction. This necessitated the need to develop a system that is capable to manage brief development for the benefit of the client. Since brief development either add values or risks to the project or could add both, the well-established methodologies of value management and risk management were the most appropriate tools that could manage brief development in construction. Because of the obvious benefits of their combination as better value could not be achieved unless associated risk have been managed, both disciplines have been integrated to form the basis of the Value and Risk Management Protocol (VRMP). It consisted of four steps: (1) identifying problem, (2) structuring objectives, (3) scrutinising alternative solutions, and (4) adopting development decision, see table (3). The key principles behind the Value and Risk Management Protocol are: whole project view, dynamism and flexibility, stakeholders involvement, co-ordination and communication, feedback, rational, and creativity. Information management and information technology supported the protocol in terms of collecting, verifying, classifying, storing, retrieving, sharing and updating information. The developed protocol overcame the pitfalls and shortcomings of the existing approaches for both combining value and risk management as well as managing change orders, and it represented a real contribution to the original body of knowledge as an innovative approach to manage brief development in construction projects.

Table 3 Node Index for The Value and Risk Management Protocol

Diagram Reference		**Description**		
VRMP/A0		**Managing Construction Brief Development**		
	VRMP/A1	**Identifying Problem**		
		A11	Assembling and Empowering the team	
			A111	Orientation Meeting
			A112	Identifying and Selecting the team members
			A113	Deciding on study date, time, duration & location
		A12	Investigating Brief Development Data	
			A121	Collecting Brief Development Data
			A122	Defining Development Data Resources
			A123	Classifying Development Data
		A13	Defining Brief Development	
			A131	Describing Brief Development
			A132	Defining Development Driver
			A133	Defining Development Stage
			A134	Defining Development Initiator
			A135	Defining Value & Risk Sources to Client
	VRMP/A2	**Structuring Objectives**		
		A21	Defining Objectives	
		A22	Developing Objectives Value Hierarchy	
		A23	Allocating Importance Weights	
		A24	Defining Associated Risks	
	VRMP/A3	**Scrutinising Alternative Solutions**		
		A31	Generating Alternatives	
		A32	Evaluating Alternatives	
			A321	Developing Decision Matrix
			A322	Assessing Associated Risks
			A323	Comparing Alternatives
			A324	Performing Sensitivity Analysis
			A325	Reconciling Value and Risk
	VRMP/A4	**Adopting Development Decision**		
		A41	Presenting Alternatives	
		A42	Selecting the Best Alternative	
		A43	Implementing the Selected Alternative	
		A44	Monitoring and Feeding back	

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Because of the time consuming experienced during the workshops carried out to apply and test the protocol on a real case study and the need to manage large amount of information used, the Value and Risk Management Protocol was encapsulated in computer based prototype software called Brief Development Manager (BDManager), see figure (4). Microsoft Access was used to produce the prototype software. The produced prototype was applied on case studies and was evaluated by its users. Analysis of evaluation was encouraging and recommended the use of the prototype software as an IT tool for managing dynamic brief development in construction.

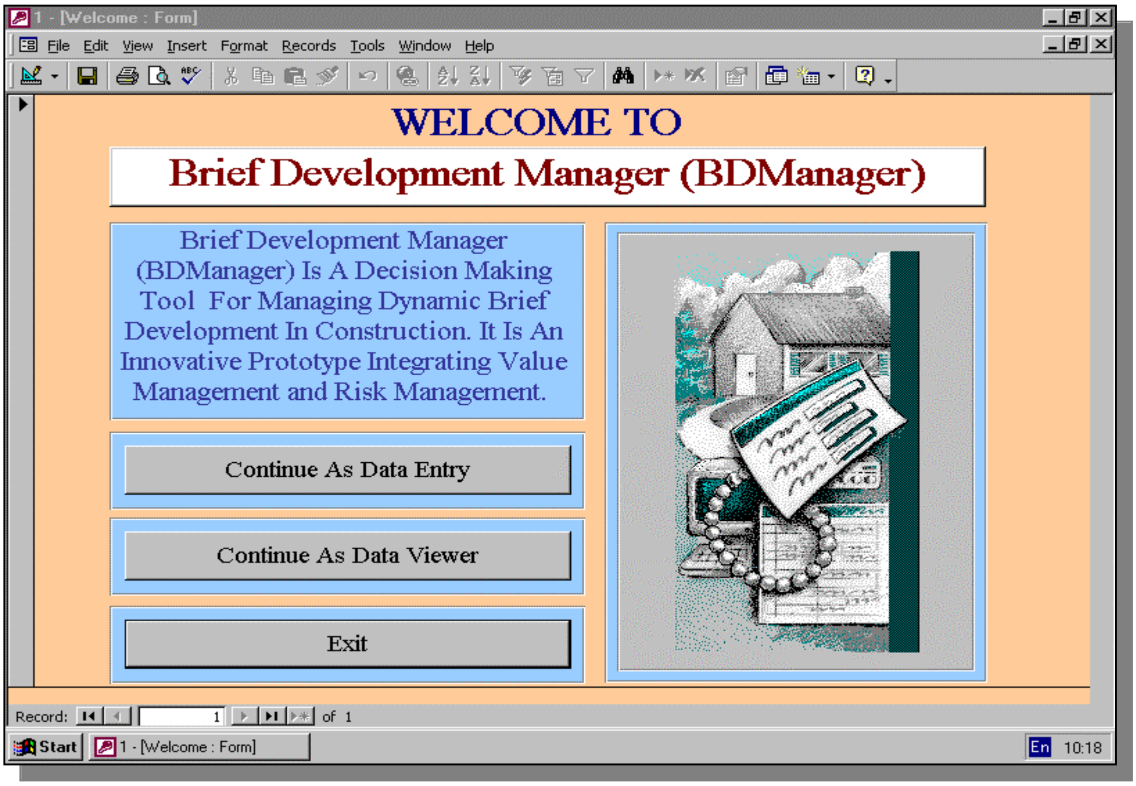

Figure 4 The Welcome Screen of the Brief Development Manager

5. Research originality and achievements

The originality and achievement of this research could be summarised as:

(1) Adding new contribution to the original body of knowledge could not be achieved unless the state of the art has been reviewed and the pitfalls of the prevalent perceptions and shortcomings of the current practices were identified. For this reason, selection of the research subject and identification of the research question were derived initially from the researcher observations and practical experience. Then, in-depth literature review supported by the use of different research methods resulted in formulating the research problem, which could be identified as managing dynamic brief development in construction.

(2) Accordingly, the research aim and objectives were defined and the research methodology and methods adopted to achieve this aim and accomplish these objectives were designed.

(3) The research was innovative in introducing the Dynamic Brief Development concept with its objectives, underlying principles and milestones to the construction industry for the first time. The new concept developed by this research encouraged developing the project brief throughout the project life cycle in order to achieve client satisfaction and enhance the project performance. In spite of, the existing ideas which called for allowing the briefing process to be ongoing process, the subject was not covered in the literature review in a comprehensive perspective as done by this research.

(4) The research identified a complete list of 30 brief development drivers. Analysis of 36 case studies validated the drivers extracted from literature review and added new drivers. These drivers were not covered by literature review and reflected the culture and tradition of the surveyed society. Quantitative and qualitative analysis of these drivers were carried out to quantify their impacts on developing the project brief and investigate the correlation between each others. A holistic approach to classify the brief development drivers was developed by this research.

(5) Because of the increasing awareness of its role as a key factor to measure construction project success, the research focused on client satisfaction as one of the important areas that was not covered well in the construction literature and highlighted the importance to learn from other disciplines that are more focused on client satisfaction during its products development. The research emphasised that client satisfaction could be achieved through delivering an attractive quality products or services that meet or exceed clients' expectations within a specified time and at the most cost effective manner. In addition, the research developed a relationship matrix between the brief development drivers and the project team members. This new matrix will enable clients and construction professionals identify the brief development originators, value sources and risk sources form the client's point of view.

(6) Contrary to the existing perception of the construction industry, the research adopted a new interpretation that change orders do not always have negative impacts on project's cost, time and quality. Literature review and analysis of case studies showed that change orders may have positive impacts on construction projects in terms of responding to emerging client requirements, meeting user needs, coping with regulatory changes, exploiting business opportunities, adapting to technology improvement, adding more value, and managing associated risks. The research sustained and supported the idea that change orders are useful to the project and their positive impacts should be utilised. Extensive review of the existing approaches for managing change orders was carried out and their limitations were identified.

(7) The research supported the integration of value management and risk management as two complementary disciplines since best value could not be achieved unless associated risks have been managed. Literature review showed little progress in developing an integrated approach of value management and risk management. Critical examination of the existing approaches for their combination was undertaken and their limitations were identified.

(8) Although, the two disciplines used to formulate the value and risk management protocol are well established, value management and risk management were used for the first time to develop an innovative protocol integrating the two disciplines to manage dynamic brief development in construction. The research moved a step ahead from the theoretical discussion of their combination toward applying the integrated tool to solve real construction problems. The benefits of information management and information technology were used to support to the designed

protocol. This protocol avoided the pitfalls and shortcomings of the different approaches used for managing change orders and combining value and risk management and answered questions suggested by them.

(9) In order to facilitate the application of the value and risk management protocol, save the time required for its implementation, and manage the large amount of information used, the research produced an innovative, reliable and validated prototype software named the Brief Development Manager (BDManager). The Brief Development Manager is a powerful tool that helped construct a live database for the project brief developments and facilitated archiving, classifying, sharing, storing, retrieving, and updating brief development information.

(10) The research resulted in producing a number of publications in academic journals and proposed areas for further research as well as recommendation for the constriction industry.

6. Conclusions

The rationale and motivation for this research stemmed from the need to overcome the limitations of the current briefing process that confine the development of the project brief to a certain stage. This perspective hinders the achievement of client satisfaction due to the lack of interaction between the client and designer. In addition, it impedes exploiting value opportunities and managing risk threats derived by brief development drivers. The research presented the Dynamic Brief Development concept as an approach to overcome the limitations of the current briefing process. This concept supports developing the project brief throughout the project life cycle. So, emerging client requirements could be achieved and the performance of the project could be enhanced. Since brief development either add value or risk to the project or could add both, the well-established methodologies of value management and risk management were integrated to formulate the Value and Risk Management Protocol (VRMP) to manage dynamic brief development. Furthermore, because of the time consumption experienced during the application of the protocol and the large amount of information used, it was necessary to utilise the benefits of information management and information technology. The developed protocol was encapsulated in a computer-based application called the Brief Development Manager prototype software. The produced prototype facilitated the implementation of the VRMP in a computer based environment and facilitated collecting, verifying, organising, storing, retrieving, sharing and updating live project information database. The prototype software was applied on real case studies and then evaluated by its users. Results of the evaluation are encouraging and end users recommended the use and adoption of the produced software.

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BRIEF DEVELOPMENT ORIGINATORS, VALUE AND RISK SOURCES TO THE PROJECT FROM THE CLIENT'S PERSPECTIVE.

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ABSTRACT: Achieving client satisfaction as a key measure for construction projects success necessitated the importance to build clear understanding of the drivers that lead to brief development. 30 brief development drivers were identified, quantified and classified. In order to complete the picture of these drivers and understand how could the project team members affect or get affected by the brief development drivers, this paper presents the results of a group interview undertake with clients' organizations, that responded to the quantifying questionnaire, to investigate the relationship between the brief development drivers and the project team members. Definitions of the originators of brief development, value sources and risk sources to the project form the client's perspective will be presented. New interpretations of the role of different project team members will be explained. This will enable clients' organizations and construction professionals utilize these relationships for better management of dynamic brief development in construction.

Keywords: Originators of brief development, Value sources, Risk sources, Relationship matrix.

1. INTRODUCTION

The increasing awareness to achieve client satisfaction as an important measure for construction projects success (Parfitt and Sanvido, 1993) necessitated the importance to understand the drivers that lead to brief development. This was accomplished through focusing on four important issues. They were identifying, quantifying and classifying the brief development drivers as well as identifying the originators of brief development, value sources and risk sources to the project from the client's perspective. For the first issue, lterature review and analysis of 36 case studies identified 47 brief development drivers. These drivers were reviewed on regular basis to omit repeated ones and merge similar drivers. The result was a list of 30 brief development drivers (Othman et al., 2004). Secondly, quantifying questionnaire, measure of central tendency and relative importance index were used to explore the most influential drivers. Thirdly, a holistic approach based on considering the project as an entity that effects and gets affected by its internal and external factors was developed. The approach classified the brief development drivers to internal, external, and internal and external development drivers. The advantage of classifying these drivers is to determine the drivers, which are related through a common characterises and highlights the drivers that appear in several categories which could considered as a common drivers (Othman et al., 2004&2005; Zaimi, 1997).

This paper focuses on the fourth issue, which aims to investigate the relationship between the brief development drivers and the project team members to identify the originators of brief development, the value sources and the risk sources to the project brief from the client's perspective. The project team members used to create this relationship were (1) Client Organisation, (2) End User, (3) Design Firm, (4) Constructor, (5) Supplier, (6) Government Authority, and (7) Funding Bodies. Table (2) summarises the results of the brainstorming session in a matrix form. This table consists of two main components: the brief development drivers and the project team members, which were classified to originators, value sources and risk sources to the client. Within this research invitations were directed to the clients' organisations that responded to the quantifying questionnaire. Out of 38 invitations issued a total number of 12 clients organisations agreed to attend the session.

2. METHODOLOGY

The research methodology adopted to achieve the above outlined aim focused on accessing clients perceptions, getting their views and understanding their values in order to enable design and construction teams achieve client satisfaction at the most cost effective manner. This will be accomplished through selecting a research method that could create interactive dialogue between the author and selected clients' organisations. Interview is one of the main data collection methods in research. It is a very good way of accessing people's meanings, definitions of situations, and construction of reality. It was defined as a piece of social interaction with one person asking another a number of questions and the other person is giving answers (Punch, 1998). One of the real methodological difference between the use of questionnaire and interview is the interaction, which takes place between the researcher and the interviewee (Baker, 1994).

During the course of this research, group interview was undertaken with clients' organisations to identify the originators of brief development, the value sources and risk source to the project from the client point of view (Othman et al., 2004&2005). As an approach to generate ideas that could help achieve the above aim, Brainstorming technique was employed. This enabled produce new interpretations of the role played by the project team members.

3. DEFINITIONS

Brief development originator is defined as the person or authority that begins, initiates or be the cause of brief development either by modification, omission, or addition to the brief document contents (Merriam-Webster Dictionary, 2000) that will affect the final product and hence affect the achievement of the client objectives, needs and satisfaction. The Institute of Civil Engineers (ICE) referred that value can be considered as the ration of function achieved to its life cycle cost. Value = Function / Cost (LCC) (ICE, 1996). Dell'Isola (1997) stated that three basic elements that provide a measure of value to the user: function, quality, and cost. These elements can be interpreted by adding quality to the numerator of the above equation to form the following relationship: Value = (Function + Quality) / Cost (LCC). Hence, Value is defined as the most cost-effective way to accomplish a function that will meet the user's needs, desires, and expectations (ECOMAN, 2001). Risk is defined as any unexpected events that may occur during the process of building procurement, and can cause losses to the client or other interested parties (Shen, 1999). Based on the above definitions of value and risk, value source to the client could be defined as the person or authority that could improve the function of the project at no extra cost or by maintaining the function and removing the unnecessary cost in away that achieve client requirements and enhance the performance of the project. Risk source to the client could be defined as the person, authority or event that either threats the achievement of the client objectives or loses an opportunity to improve the project performance.

4. THE BRIEF DEVELOPMENT DRIVERS

Literature review and analysis of 36 case studies identified 47 brief development drivers. These drivers were reviewed on regular basis to omit repeated ones and merge similar drivers. The result was a list of 30 brief development drivers, see table (1).

Table (1) The Brief Development Drivers

No.	Brief Development Drivers	Lit. Rev.	Case Study
1	Stakeholders change project requirements and have second thought at later stages (Barrett and Stanley, 1999)	✓	✓
2	Uncoordinated and incorrect construction documents (O'Leary, 1992)	✓	✓
3	Brief information is still being given during later design and construction stages (Barrett and Stanley, 1999)	✓	✓
4	Materials are no longer available in market and use better substitute materials (Tenah, 1985)	✓	✓
5	Lack of information provision (Barrett and Stanley, 1999)	✓	✓
6	Meeting new technology changes (PMI, 2000)	✓	✓
7	Lack of regulatory up-dating		✓
8	Project users are not involved in the briefing process (Kernohan et al., 1992)	✓	✓
9	Unforeseen conditions (O'Brien, 1998)		
10	*Lack of understanding of different users' culture and traditions*		✓
11	*Eliminate proven poor quality materials and equipment*		✓
12	Lack of design experience (ICE, 1996)	✓	✓
13	Changing government regulation and codes (O'Leary, 1992)	✓	✓
14	Responding to market demand (Smith and Wyatt, 1998)	✓	✓
15	Improper feasibility studies (Valence, 1999)	✓	✓
16	Restricted design fees (ICE, 1996)	✓	✓
17	Lack of understanding of the client organizations (Barrett and Stanley, 1999)	✓	✓
18	Inappropriate communication between the client and the designer (Barrett and Stanley, 1999)	✓	✓
19	Unclear and incomplete project brief (Barrett and Stanley, 1999)	✓	✓
20	Designers ignore the client role and behave unilaterally (Kelly et al., 1992)	✓	✓

21	*Lack of communication and co-ordination between government authorities and design firms over planning and approvals*		✓
22	Lack of presentation and Visualisation of design (Barrett and Stanley, 1999)	✓	✓
23	*Users exaggerate their needs*		✓
24	*Upgrade project facilities*		✓
25	*Project users appear at later stages*		✓
26	Inadequate available design time (ICE, 1996)	✓	✓
27	*Lack of functional, aesthetic, safety requirements and constructability*		✓
28	Lack of consideration of environmental requirements (Best and Valence, 1999)	✓	✓
29	Whole project life not considered (CIB, 1996)	✓	✓
30	Initiating value engineering changes (Stocks and Singh, 1999)	✓	✓

5 QUANTIFICATION OF THE BRIEF DEVELOPMENT DRIVERS

Out of 530 questionnaires issued, a total of 261 completed and returned. The aim of the questionnaire was to quantify the brief development drivers in order to direct the attention of clients and construction professionals to the most influential drivers, so particular attention could be paid to manage them for the benefit of the project. The measure of the central tendency and dispersion of the questionnaire responses were used to get an overview of the typical value for each variable by calculating the mean, median and mode. The measure of dispersion was used to assess the homogenous or heterogeneous nature of the collected data by calculating the variance and the standard deviation (Bernard, 2000). Since not all-brief development drivers have the same influence on brief development, the relative importance index was used to differentiate between drivers (Olomolaiye et. Al, 1987; Shash, 1993). The data was analysed with the aid of Microsoft Excel spreadsheet and the Statistical Package for Social Sciences (SPSS) computer software (Kirkpatrick and Feeney, 2001).

5.1 Measure of Central Tendency and Dispersion

The analysis of the collected data showed the close values of means, medians and modes that tend to typical central values and showed also the lower values of variances and standard deviation. This ensures the quality and the homogeneity of the collected data as well as the low degree of dispersion of these data, which will result in reliable recommendations for clients and construction professionals. Figure (1) rated drivers according to their means using clustered columns chart on a scale of 5.

5.2 Relative Importance of Brief Development Drivers

The numerical scores from the questionnaire responses provided an indication of the varying degree of influence that each driver has on developing the project brief. To further investigate the data, a relative importance index (RII) was used to rank the drivers according to their influences (Olomolaiye et. al, 1987; Shash, 1993). This was calculated using the following formula: **Relative Importance Index (RII) = ? w / AN**

Where w = weighting given to each driver by the respondents and range from 1 to 5 where 1= very low influence and 5 = very high influence; A = highest weight (5 in our case); and N = total number of sample (Kometa and Olomolaiye, 1997). The RII ranges from zero to one. As would be expected, while some drivers have very high influence on brief development, others do not. Figure (2) shows that the brief development drivers could be classified according to their relative importance into three categories: Firstly, the drivers with very high influence with RII above 0.800, secondly, the drivers with average to high influence, with RIIs lying between 0.600 and 0.800, and finally, the drivers with very low to low influence with RIIs less than 0.600.

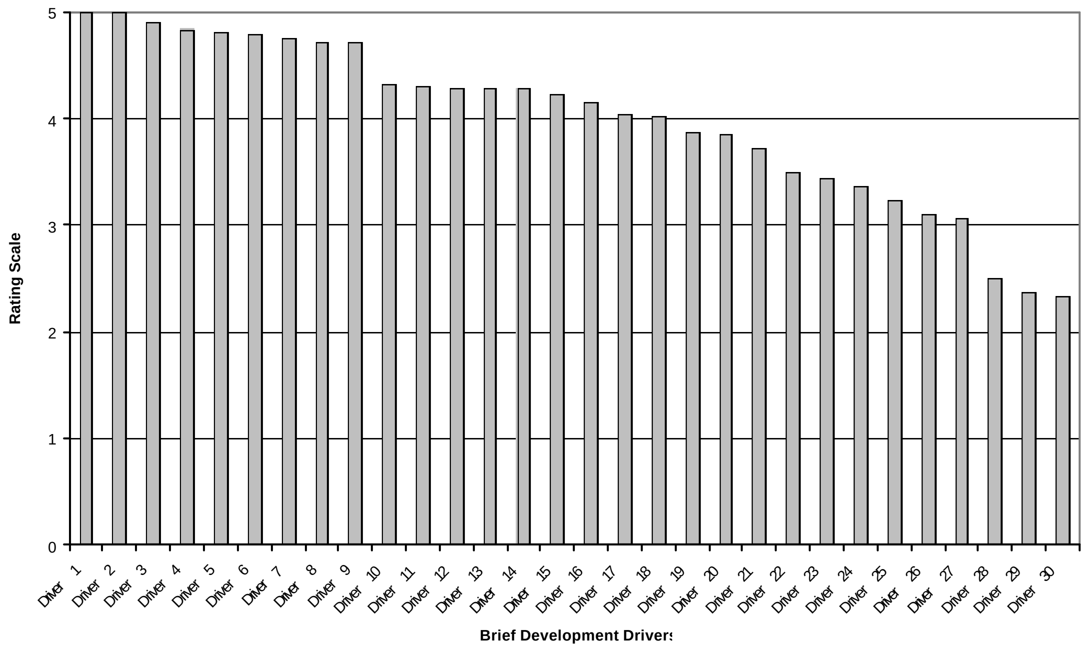

Figure (1) Rating the Brief Development Drivers on a Scale of 5

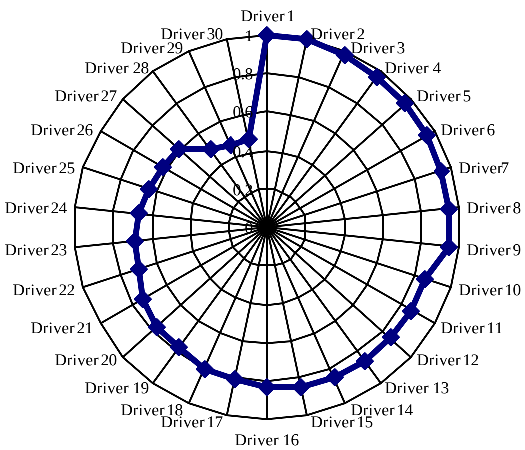

Figure (2) Relative Importance Index of the Brief Development Drivers

6. PROJECT TEAM MEMBERS AS ORIGINATORS OF BRIEF DEVELOPMENT

Analysis of table (2) and feedback from the discussion in the brainstorming session showed that clients' organisations were the key originators of brief development as they may change their requirements and have second thoughts at later stages as well as provide brief information at later design and construction stages. End users were considered as brief development originators when they modify the facility design to meet their requirements, traditions and culture particularly if they were not involved in the briefing process or they appear at later stage. A case study showed that the client organisation changed the project design from a commercial building to a medical centre equipped with all technological equipment in order to respond to market demand and exploit the business opportunity offered to lease the building for 20 years.

Design firms were deemed as brief development originators when they do not have the art of questioning and eliciting clients' requirements, which generates incomplete brief. In addition, their lack of experience may result in producing uncoordinated and incorrect construction documents, non producible materials or technologies. Constructors may be regarded as brief development originators when they provide the design firm with information were not available during the briefing and design stages such as unforeseen conditions or environmental requirements which forces the design firm to modify the design to adapt to these situations. Suppliers play their role in developing the project brief by providing the client organisation and design firms with information related to materials unavailability and poor quality materials as they are closer to manufactures than other parties. The role of government authorities and funding bodies as brief development originators appear when the project design violates building regulations and codes as well as the design is over budget (Othman et. al, 2005).

7. PROJECT TEAM MEMBERS AS VALUE SOURCES

Clients considered themselves as value sources as they modify the project brief to meet their emerging requirements, enhance their project performance, respond to market demand, upgrade project facilities, and include new information, which were not available during the design stage. End users were regarded as value sources to the client when they continue renting the building and enhancing its performance as well. Design firms and constructors could be deemed as value sources to the client when they use their design experience and construction knowledge to advice the client to choose better solutions that achieve his objectives, select better materials, and use effective construction methods that facilitate the construction process and reduce life cycle costing of the project. Suppliers play their role as value sources to the client when they provide information of better substitute materials and recently produced equipments. Government authorities and funding bodies were regarded as value sources to the client by guiding the design firms and construction companies to comply with regulations and codes such as (safety codes and environmental requirements) which enhance the performance of the building and escalate its demand as well as keeping the project within the allocated budget. Feedback from projects executed under the supervision of government authorities and funding bodies enable them to advise design firms to select proper materials and equipments (Othman et. al, 2005).

8. PROJECT TEAM MEMBERS AS RISK SOURCES

Analysis of Table (2) showed that the risk that could be originated by clients' organisations, particularly naïve ones who does not possess enough construction knowledge, emerged from their inability to describe their requirements and business objectives to the designer. In addition, inadequate available design time due to the client hastiness to complete the project as fast as possible inhibits the designer from presenting thorough alternatives and results in producing uncoordinated and incorrect construction documents. End users were considered as risk source to the client when they were not involved in the briefing process and their requirements were not reflected in the facility design. This will tend either to change the produced facility to match their needs or the building will suffer from being vacant if it does not fulfil users requirements. Projects' clients blame design firms for not playing their role as clients' advisors.

Clients viewed design firms as risk sources because they are the cause of the production of uncoordinated and incorrect construction documents, specifying building materials or technologies, which either not produced anymore or not up to date as well as ignoring the role of the client and behave unilaterally. This could result in hindering the construction process in terms of contradictions between the construction documents, time delay due to selecting and importing substitute material and modern technologies as well as future changes as a consequence of adopting decisions which do not reflect the client's perspective. Analysis of the matrix showed that the risk that could be originated by constructors may arise from their lack of experience in reviewing construction documents which may lead to delay due to time required for documents corrections and rework. In addition, constructors' lack of organising construction items as early as possible such as ordering materials that may not produced anymore may result in additional time for selecting and importing alternative materials. Material suppliers were considered as risk sources when they can not provide the project with suitable materials or equipment which commensurate with the project budget, time of delivery and matches with project design. Finally, government authorities and funding bodies were considered as risk sources to the client due to their lack of regulatory updating, communication and co-ordination with design firms over planning and approvals, improper feasibility study and lack of responding to market demand (Othman et. al, 2005).

9. CONCLUSIONS

The importance of achieving client satisfaction as an important measure for construction projects success called for building a clear and firm understanding of the brief development drivers. This was accomplished through focusing on four important issues. They were identifying, quantifying and classifying the brief development drivers as well as identifying the originators of brief development, value sources and risk sources to the project from the client's perspective. Literature review and analysis of 36 case studies identified 47 brief development drivers. All the identified drivers were reviewed on regular basis in order to omit repeated ones and merge similar drivers to produce a list of 30 brief development drivers. A quantifying questionnaire, measure of central tendency and relative importance index were used to identify the most influential drivers. Based on considering the project as an entity that effects and gets affected by its surrounding factors, a holistic approach was developed. This approach classified the brief development drivers to internal, external, and internal and external development drivers.

This paper aimed to investigate the relationship between the brief development drivers and the project team members in order to identify the originators of brief development, value sources and risk sources to the project from the client perspective. Group interview supported by the brainstorming technique was the research method used to achieve this aim. Definitions of the originators of brief development, value sources and risk sources to the project form the client's perspective were presented. New interpretations of the role of different project team members were explained. Results of the interview will enable clients' organizations and construction professionals utilize these relationships for better management of dynamic brief development in construction.

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Table 2 Originators of Brief Development, Value Sources and Risk Sources to the Project from the Client's Perspective

Project Team Members / Brief Development Drivers	Development Originator							Value Source to Client							Risk Source to Client						
	Client Organisation	End User	Design Firm	Constructor	Supplier	Govern. Authority	Funding Body	Client Organisation	End User	Design Firm	Constructor	Supplier	Govern. Authority	Funding Body	Client Organisation	End User	Design Firm	Constructor	Supplier	Govern. Authority	Funding Body
Stakeholders change project requirements and have second thought at later stages	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Uncoordinated and incorrect construction documents			X													X	X	X	X	X	X
Brief information is still being given during later design and construction stages	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Materials are no longer available in market and use better substitute materials	X		X		X							X					X	X	X		
Lack of information provision	X	X	X	X	X	X	X								X	X	X	X	X	X	X
Meeting new technology changes	X	X			X	X											X	X	X	X	
Lack of regulatory up-dating			X			X										X	X	X		X	
Project users are not involved in the briefing process	X		X												X	X	X				
Unforeseen conditions															X	X	X	X	X	X	X
Lack of understanding different users' culture and tradition		X	X													X	X				
Eliminate proven poor quality materials and equipment	X	X			X	X			X			X	X				X	X	X		
Lack of design experience			X												X	X	X	X	X	X	X
Changing government regulation and codes						X										X	X	X	X	X	
Responding to market demand	X	X							X								X	X	X		X
Improper feasibility studies			X														X				X
Restricted design fees	X					X										X	X	X	X	X	X
Lack of understanding of the client organisations	X		X												X		X				
Inappropriate communication between the client and the designer	X		X												X		X				
Unclear and incomplete project brief	X	X	X												X	X	X				
Designers ignore the client role and behave unilaterally			X														X				
Lack of communication and co-ordination between government authorities and design firms over planning and approvals			X			X											X			X	
Lack of presentation and visualisation of design			X													X	X	X	X		X
Users exaggerate their needs		X							X							X	X	X	X		
Upgrade project facilities	X	X						X	X							X	X	X	X		
Project users appear at later stages		X							X							X	X	X	X		
Inadequate available design time	X		X													X	X	X	X	X	X
Lack of functional, aesthetic, safety requirements and constructability			X													X	X	X	X	X	
Lack of consideration of environmental requirements	X	X	X	X		X										X	X	X		X	
Whole project life not considered	X		X													X	X	X	X		X
Initiating value engineering changes																					

DYNAMIC BRIEF DEVELOPMENT FOR BETTER CONSTRUCTION BRIEFING

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ABSTRACT: Limitations of the current briefing process to achieve client satisfaction are attributed to confining the development of the project brief to a certain stage. This perspective hinders the interaction between the client and the designer since clients' ideas develop and mature as the design alternatives unfold. In addition, it inhibits the incorporation of the influences that may affect the project brief. In spite of the impact of change orders on project's cost, time and quality, literature review and case studies showed that clients used change orders to achieve their expectations and enhance the performance of their projects. The concept of Dynamic Brief Development (DBD) is introduced as an approach to overcome the limitations of the current briefing process. Within this paper, revision of the current briefing theories is presented, the need, aims, principles and milestones of the DBD are explained and the case study sampling is described.

Keywords: Brief, Change orders, Client satisfaction, Dynamic Brief Development.

1. INTRODUCTION

The increasing recognition of the role played by clients as the core of the construction process and the driving force for improvement necessitated the importance of achieving their satisfaction (Latham, 1994; Egan, 1998; Kamara et al., 2000). This could be achieved by translating the client needs into a design that specifies technical characteristics, functional performance criteria and quality standards and by completing the project within a specified time and in the most cost effective manner (Bowen et al., 1999). Clients are most likely to be satisfied when the final product matches or exceeds their expectations (Ahmed and Kangari, 1995). Because of its vital role in eliciting and communicating clients' requirements to the design and construction teams, the briefing process represents a cornerstone for achieving client satisfaction. In addition, an effective client briefing is crucial to the attainment of client objectives with respect to time, cost and quality, where inadequate briefing was highlighted as a key source of client dissatisfaction (Latham, 1994). Furthermore, the inefficiency of the briefing process was defined as the reason why buildings have been wasteful of resources or defective in use (Jenks, 1988). According to Kelly et al. (1992) the most critical factors in determining client satisfaction with a building project are the concept brief and the selection of the project team who will design and construct the building. Smith et al. (1998) stated that the briefing process has to be flexible, well organised, and responsive to client's needs and requirements to provide more effective, efficient, innovative and better solutions.

Formal observations, literature review, analysis of 36 case studies, documentary data and unstructured interviews with projects' architects undertaken by the author showed that very few buildings finished on time or at the right cost and clients often criticise the fact that the finished buildings were not what they expected (Othman et al., 2004). This view was emphasised by others such as Barrett and Stanley (1999) and Kamara, (1999). In addition, there is widespread dissatisfaction within the clients' community with the extent to which the construction industry delivers facilities that fully meet their requirements or provides appropriate buildings for its clients (Smith et al., 1998). Furthermore, it was articulated that clients used change orders to achieve their emerging requirements and adapt to the influential internal and external brief development drivers, such as exploiting new business opportunities and installing an improved technological system was not available during the brief and design stages (Burati et al., 1992; Gardiner and Simmons, 1992; Hansen, 1994; Chapman, 1997; O'Brien, 1998; PMI, 2000).

This is attributed to the limitations of the current briefing theories, which confine the development of the project brief to a certain stage. This perspective obstructs the interaction and communication between the client and the designer since client's ideas develop and mature as the design alternatives unfold. In addition, it inhibits the incorporation of the influential internal and external drivers that lead to brief development (Othman et al., 2004). Because of the importance to overcome the limitations of the current briefing theories and propose the appropriate approaches to enhance its performance as an approach to achieve client satisfaction and enhance the performance of the construction industry, this paper will review the current briefing theories and define their limitations, establish the principles of dynamic brief development, and define its time frames. Within this paper the case study sampling is described.

2. METHODOLOGY

The aim and objectives outlined above called for a research strategy that could collect sufficient data to identify the limitations of the current briefing process and perceive the presented concept of Dynamic Brief Development (DBD). Two approaches were employed, namely literature review and case studies. Literature review was used to review the current theories relating to brief development where case studies were used to investigate the project history, the development of the project brief throughout the project life cycle, and identify the drivers that lead to brief development (Othman et al., 2004). Literature review resources were textbooks, professional journal and magazines, conference and seminar proceedings, dissertations and theses, organisations and government publications as well as Internet and related websites. Where the case studies were recently completed construction projects and the information obtained was classified into two main types: the first being project information (e.g. project type, components, cost, duration, contract type and project quality). The second type concerned the development of the project brief (e.g. development type, driver, stage, effects on time, cost, quality and the steps adopted to manage brief development). Particular attention was paid to gathering information from the correspondence between the related parties, minutes of meetings, internal memos, drawings and specifications. In addition, unstructured interviews were held with the projects' architects to investigate the way in which the project brief was developed. By using more than one source of evidence (project documentation, and the recollection of the projects' architects) it was possible to improve the validity of the collected data and increase background knowledge. In an effort to ensure the reliability of the data, data collection and questioning concentrated on facts and events with the support of subjective interpretations (Yin, 1989; MacPherson et al., 1993).

3. CASE STUDY SAMPLING

Selecting a representative and non-biased sample of construction projects to investigate dynamic brief development throughout the project life cycle was the aim of case study sampling. The survey was undertaken in Abu Dhabi, United Arab Emirates and information about distribution of the districts surveyed was collected from the Department of Social Services and Commercial Buildings, UAE. The city was divided into 87 districts (DSSCB, 2000). Random number tables were used to select 45 districts, which represented 51.72% of the total. 10 districts were excluded because of the difficulty in obtaining information about the projects due to national security matters. Buildings in each district were counted up and each building was given a unique number to form a table of 900 buildings. A systematic sample of 36 buildings (1:25) was used to select the case study sample of 36 buildings. The adopted sampling methodology effectively covered the surveyed city, so the identified brief development drivers and the Dynamic Brief Development concept were based on different projects constructed in different districts, with different regulations, types, clients' organisations, cost, time and quality, all of which enhanced the reliability and validity of collected data.

4. CURRENT THEORY RELATING TO BRIEF DEVELOPMENT

Briefing in construction has become the focus of considerable attention in the post-Latham era both within the research community and amongst industry professionals (Hassanen and Bouchlaghem, 1999). The following section defines the terms used within this paper and presents the different approaches to brief development throughout the project life cycle.

4.1 Definitions

The 'brief' is a formal document which is the medium for expressing or communicating the objectives and needs of the client (Goodacre et al., 1982; CIB, 1997). The brief contains information for project implementation and should include: (1) the background, purpose, content and desired outcomes of the project; (2) the functions of the intended facility and the relationship between them; (3) cost and time target, (4) instructions on procurement and organisation of the project; (5) site and environmental conditions, safety, interested third parties and other factors which are likely to influence the design and construction of the facility (Kamara, 1999). To 'develop' is defined as to unfold gradually, or in detail; to change from one state into another by modification, omission, or addition to a project document, design, process, or method previously approved or accepted. 'Development' is defined as an unfolding, growth, or progress (Webster's Dictionary, 2000; Gardiner and Simmons, 1992). Therefore for the purposes of this paper, 'brief development' is defined as a "detailed, gradual unfolding, growth, progress or change either by modification, omission, or addition to the brief document contents that will affect the final product and hence affect the achievement of the client objectives, needs and satisfaction. In addition, "drivers of brief development" is defined as the drivers that lead to unfolding, growth, progress or change of the project brief.

There appears to be a split in the approach to brief development. One approach considers the brief as an entity in itself, which should be frozen after a critical period. Decisions tend to be taken as early as possible, and briefing becomes a stage or stages in the design and construction process. The other approach considers the brief as a live and dynamic document that develops iteratively from an initial global brief in a series of stages. Briefing is deemed an ongoing activity that evolves during the design process (Barrett et al., 1996; Kamara, 1999). This approach is emphasised by Barrett and Stanley (1999) who defines the 'briefing process' as the process running throughout the construction project by which means the client's requirements are progressively captured and translated into effect. These schools are illustrated below:

4.2 The RIBA Plan of Work

The Royal Institute of British Architects (RIBA) Plan of Work states that the brief is developed in three phases. In the first phase, the client establishes the need for the project. In the second phase, which is the most effective if carried out after completion of feasibility studies and/or option appraisals, the strategic brief is developed from the initial statement to provide sufficient information for the consultants to commence the design process. In the third phase the project brief is developed from the strategic brief in parallel with the design process during the outline proposals and detailed proposal stages. The project brief is frozen at the end of the detailed proposal stage (RIBA, 2000). The RIBA plan of work emphasises the need to produce an early, explicit and detailed brief and then to work to it as closely as possible (Barrett et al., 1996).

4.3 The Generic Design and Construction Process Protocol (GDCPP)

The Generic Design and Construction Process Protocol was funded by the Engineering and Physical Science Research Council (EPSRC) under the Innovative Manufacturing Initiative (IMI) and undertook by the University of Salford and Loughborough University, UK with a leading number of industrial partners. It is a common set of definitions, documentation and procedures that provide the basis for the wide range of organisations involved in a construction project to work together seamlessly using manufacturing experience as a reference. The protocol presents a map for the construction process where the project brief is finalised at the production information stage and places a soft gate between the production information stage and the construction stage. All solutions and various options and requirements are fixed for construction with extending the process beyond the practical completion to meet dynamic market conditions and improve the product through learned lessons and feedback (Kagioglou et al., 1998).

4.4 The Netherlands Approach

In the Netherlands, the brief is seen as a process not an event. It is a process that not only starts early, but also continues to inform all the technical work throughout the project. The brief is explicitly managed to evolve through various stages in parallel with the technical information till specification stage and could be extended through the construction stage. Continued interaction with the client is essential to this process, the underlying principle is to make as few decisions as possible at each stage. This means identify the critical decisions and leave flexibility on other issues for later consideration as more information becomes available (Barrett and Stanley, 1999).

4.5 Learning from Experience: Applying Systematic Feedback to improve the briefing process in construction (Acronym: LEAF)

LEAF is the title of two years research led by the University of Sheffield, UK with the collaboration of many partners. The theme of the project is the improvement of the client briefing and evaluation process by systematising the gathering and application of feedback to improve the industry productivity and user satisfaction. It states that the failure to learn from the accumulated wealth of experience from completed construction projects is both costly and unproductive (Phiri and Haddon, 2000).

5 THE NEED AND AIMS OF THE DYNAMIC BRIEF DEVELOPMENT CONCEPT

The importance of the Dynamic Brief Development concept arises from two significant flaws in current practice, which are discussed below.

5.1 Deficiencies of the current briefing process in achieving client satisfaction

The RIBA plan of work limits brief development to the detailed proposal stage. Barrett et al. (1996) state that this approach has a number of problems. Clients' ideas develop as the possibilities of a design unfold and a beneficial creative dialogue with the design team can occur. An insistence on adhering to a detailed early brief will inhibit such a dialogue occurring. Many clients are in a state of dynamic development; hence, their requirements may change during the course of the project. A static brief will prevent these changes from being accommodated. Rezgui et al. (2001) state that clients prefer to consider the briefing process as extended until almost the final stage of construction to ensure that the final product meets and fulfils their requirements and objectives. On the other hand, consultants tend to consider the briefing as a limited process with a well-defined start and end to be able to claim fees for any extra work. In spite of, the Process Protocol and the Netherlands approach fix all solutions, options and requirements for construction and utilising learned lessons and feedback collected beyond the practical completion stage, clients continue blaming the construction industry for providing facilities that do not meet their expectations and fulfil their requirements.

5.2 Managing project change orders and adapting to the influential internal and external drivers

Very few projects are implemented without any change to the original scope of work (Hansen, 1994). Change orders are an indicator of someone's failure to fulfil his or her functions in the construction process. It is argued that no one benefits from change orders during the construction period. They are generally disruptive of the orderly progress of the work and are usually an economic burden on both the client and the contractor (O'Leary, 1992). Change orders are seen as a major cause of project delay and a source of many disputes in today's construction industry, (Mezher and Tawil, 1998; Al-Khalil and Al-Ghafly, 1999; Hanna et al., 1999). On the other hand, (O'Brien, 1998; PMI, 2000) stated that clients use change orders to achieve their emerging requirements and adapt to influential internal and external drivers, such as exploiting new business opportunities and installing an improved technological systems not available during the brief and design stages. Smith and Wyatt (1998) state that external forces may drive changes and clients respond to these forces by demanding more effective and efficient design. (Chapman, 1997) emphasises that effective clients are those who adapt and change in response to their environment and markets. In addition, successful design practices are those who manage changes successfully. As a result, the more influential the internal and external drivers, the greater the use of change orders in particular during the construction and after practical completion stages. There is a need to decide on how to react to these drivers for the benefit of the project. This decision process should include the consideration of potential value and associated risk.

The inability of the current briefing process in achieving client satisfaction and adapting to influential internal and external drivers for the benefit of the project as well as the need to manage project change orders, dictate the need for Dynamic Brief Development. This concept will (1) enable clients achieve their expectations, (2) facilitate an innovative response to the drivers that lead to brief development, and (3) manage project change orders effectively.

6 PRINCIPLES BEHIND THE CONCEPT OF DYNAMIC BRIEF DEVELOPMENT

The following principles of the Dynamic Briefing Development concept have been identified within this research and represent the basis to facilitate the achievement of the concept aims.

(1) The briefing process has to be deemed an ongoing process extending throughout the project life cycle responding in an innovative manner to emerging client requirements, meeting user needs, coping with regulatory changes, exploiting business opportunities, adapting to technology improvement, adding more value, and managing associated risks. This flexible approach will contribute to the achievement of client expectations, adapt to the influential internal and external drivers for the benefit of the project and hence avoid the consequences of change orders as a result of not considering these drivers.

(2) The project brief has to be considered as a live document, which needs to be continually developed throughout the project life cycle.

(3) Feed back to the client organisation as well as the design and construction team of the lessons learned and comments from the facilities management team and end users will enhance the performance of the briefing process in future projects.

(4) A system to manage the brief developing drivers is required. This system must respond to these drivers in a way that adds value and eliminates associated risk in an endeavour to achieve client satisfaction and manage project change orders.

Figure (1) and Figure (2) show the concept of Dynamic Brief Development and the milestones for evaluating the brief development respectively.

7. TIME FRAME / PROCESS STAGES

According to the RIBA Plan of Work, the work stages into which the process of designing building projects and administrating building contracts is divided into three main stages, namely feasibility, pre-construction period and construction period (RIBA, 2000). The Dynamic Brief Development Concept identifies five milestones to evaluate brief development throughout the project life cycle. The rationale behind selecting these milestones is attributed to the following:

Milestone (1) comes at the end of one of the most important stages, the feasibility stage, where the client requirements are identified, studies that enable the client decide whether to proceed and select the probable procurement method are prepared and the strategic brief is identified. Evaluating the project brief at this milestone represents the basis to compare subsequent developed versions.

Milestone (2) evaluates the brief development at the end of the detailed proposals stage where the information becomes more concrete and the pace of change is reduced as the detailed proposals are prepared. This milestone should reflect the influence of internal and external drivers on design since clients' ideas develop as the design alternatives unfold.

Milestone (3) comes at the end of the tender action stage, which represents the end of the pre-construction period and the beginning of the construction period, and potential contractors and / or specialists for the construction of the project are identified and evaluated. In addition, tenders are obtained, appraised and recommendations are submitted to client. Evaluating brief development takes a particular importance because the cost of change or modification after this stage is expensive.

Milestone (4) This milestone evaluates the brief development at the end of the construction to practical completion stage. Implications of the drivers that affected the project brief during construction in terms of cost, time and quality should be reflected in the developed brief. Case studies show that the construction stage represents the stage that witnesses most development of the project brief. This can be attributed to the industry's fragmented nature, long investment term, risk exposure, time consumption, and myriad other internal and external influences.

Milestone (5) comes at the practical completion stage where the final inspections and settlement of the final account occur. Evaluating brief development at this milestone provides the client organisation, design team and construction professionals with learned lessons and feedback from the end users and facilities management team which play an important role in improving the briefing process for future projects.

8. SUMMARY OF FINDINGS AND CONCLUSION

Achieving client satisfaction implies that the final product should match or exceed client expectations and reflect his / her requirements. Since changing the project brief has impacts on the project cost, time and quality, the current briefing theories confine the development of the project brief to certain stages. In spite of these impacts, literature review and case studies showed that changing the project brief enables clients to achieve their expectations and enhance the performance of their projects. The failure of the current briefing theories to achieve client satisfaction, coupled with the need to manage project change orders effectively, and the desire to adapt to the influential brief development drivers, dictates the need to adopt the concept of Dynamic Brief Development with its four underlying principles. First, the briefing process has to be deemed as an ongoing process extending throughout the project life cycle. Second, the project brief has to be considered as a live document continually developing and adapting in an innovative manner to the influential brief development drivers. Third, feeding back the client organisation and the design and construction teams with the lessons learned and comments of the facilities management team and end users will enhance the performance of the briefing process in future projects. Finally, a system to manage the drivers of brief development has to be set out as early as possible. 5 milestones for evaluating brief development throughout the project life cycle were identified and the rationale behind them was explained.

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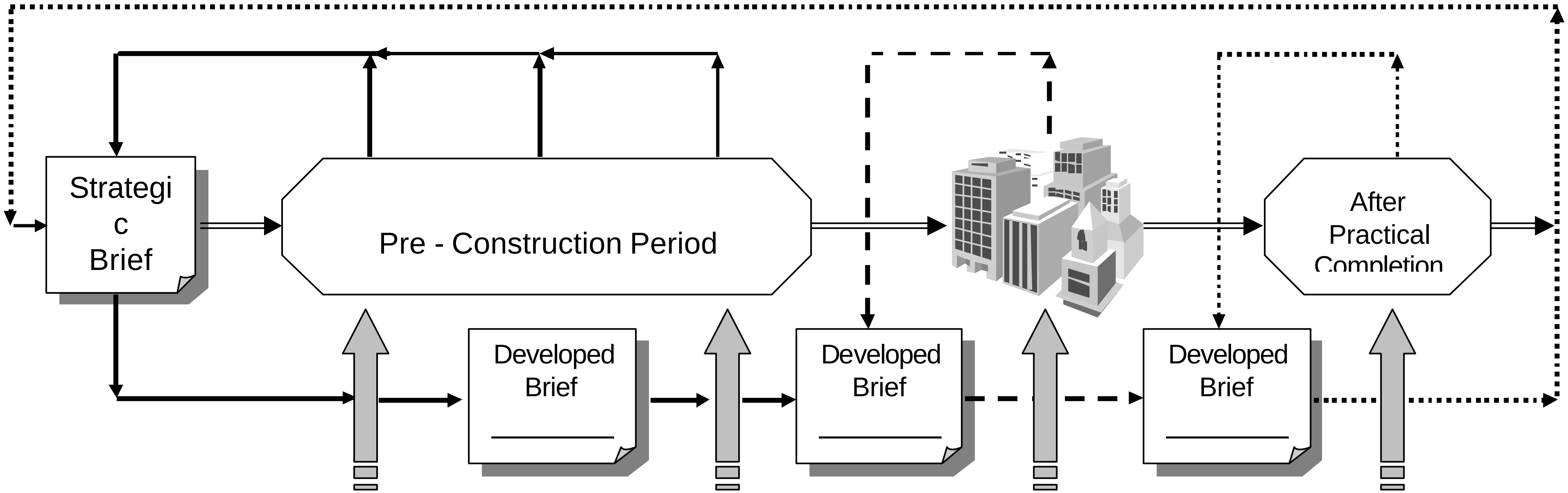

Figure (1) The Dynamic Brief Development Concept

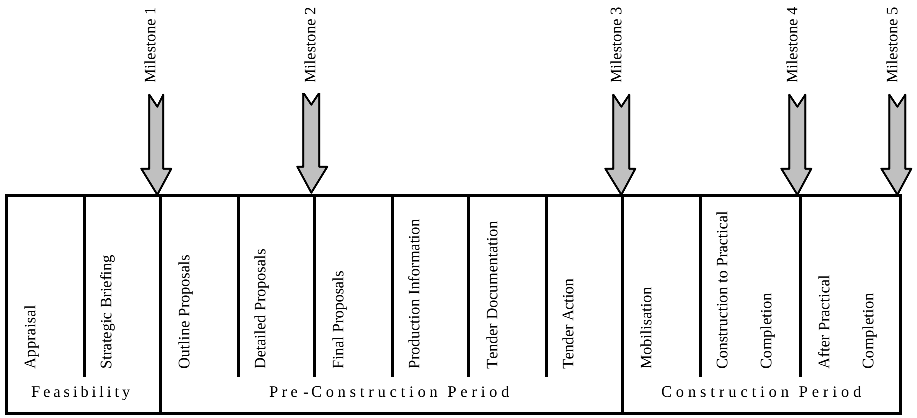

Figure (2) Brief Development Evaluation Milestones against Revised RIBA Plan of Work