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An Integrated Approach to Value Management and Sustainable Construction during Strategic Briefing in Saudi Construction Projects

By

Ali M. H. Al-Yami, BSc, MSc, AVS

A Doctoral Thesis Submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy of Loughborough University

November 2008

PAGINATION AS IN ORIGINAL
ABSTRACT

There has recently been considerable concern regarding the degradation of the environment caused by depletion of natural resources, air pollution, global warming and the lack of consideration paid to the earth's ecosystem. The principles of sustainable construction are thus being widely adopted by many countries all over the world. This quest towards sustainable development throughout the world has put a spotlight on the construction industry. Sustainable construction is a major concept underlying a variety of efforts to ensure a good quality of life for the present and future generations. Most developing countries have experienced a fast uptake of urbanisation and the acceleration of infrastructure development, all of which fuel the necessity of establishing sustainable construction principles; this is true in Saudi Arabia as in other countries.

This research has carefully investigated the current situation of Value Management (VM) and Sustainable Construction (SC) in the Saudi construction industry in terms of their application, clients' attitudes, barriers to implementation, identification of enablers that could overcome these barriers and improve their implementation, and determination of the level of existent knowledge about both subjects among people who work in the Saudi public sector. It has also defined Sustainable Construction principles in three dimensions, in Saudi Arabia: environmental, economic and social.

The research findings have revealed that SC principles are not a major consideration in the Saudi construction industry and many people who work in the Saudi public sector have little or no experience in sustainable development. On the contrary, VM has been applied in the Saudi construction industry for more than three decades and its application is mandatory in all governmental projects funded by the Saudi government. This enables those people who work in the VM sector to possess great experience, skills and knowledge. However, there are a number of barriers that could impede or affect the VM performance in the Saudi construction industry which were taken into account in this research.

Moreover, this research has developed robust background knowledge of the best practice of VM and SC within the UK construction industry. The knowledge has
developed from discovering exemplary VM and/or SC projects and integrating them as case studies. The information collected has facilitated the development of an integrated approach to VM and SC during strategic briefing for construction projects.

Therefore, the research has concluded that there could be substantial benefits from using VM as a road map for promoting and establishing SC principles, as well as improving awareness of it within the Saudi construction industry. Additionally, the experience and skills of VM practitioners could be exploited and harnessed to accelerate the understanding and implementation of SC principles in construction projects. Meanwhile, the principles and techniques of VM can provide the required quality for the whole life of a project during the project’s development stage, which will provide best value from a whole life perspective.

As a result of this an “Integrated Approach to VM and SC during Strategic Briefing” has been developed in this research. It provides a robust methodology integrating the VM and SC processes. The integrated approach defines the sustainable terms, and establishes its essential elements, principles, drivers and benefits. This integrated approach also guides how to identify stakeholders and clarifies their roles and responsibilities with a view to increasing the value of sustainability application in the project.

In addition, the approach describes the tasks and activities to be undertaken at each stage, as well as the tools and techniques required, to effectively enable clients to obtain a successful strategic briefing. The tools and techniques associated with both subjects are already in use in the industry, thus increasing its applicability and probable adoption. The techniques used were Stakeholder Analysis, Single and Double Loops Learning, Quality Function Deployment, Spider Diagram, Function Analysis and Parametric Paired Comparison and others.

The integrated approach depends on the participation, communication and learning of the key stakeholders of the project and comprises eight stages: Planning; Stakeholders Briefing; Information, Innovation; Evaluation; Development, Decision-Building and Implementation stage. The framework is divided into four phases: Planning stage,
Stakeholders briefing stage, Workshop stage, Decision-Building stage and Implementation stage.

The Integrated Approach to VM and SC during Strategic Briefing was validated through interviews with twelve industry experts possessing significant experience in VM and/or SC practice. The overall feedback was positive and comments provided were considered. Many of the experts contacted considered adopting the framework and mentioned potential benefits from it. In general, the valuation revealed that the developed integrated approach is comprehensive and has clear and detailed foundations underlying its processes and steps.

**Keywords:** Construction industry, Integrated Approach, Saudi Arabia, Sustainable construction, Value Management
DEDICATION

This thesis is dedicated to my parents,
Wife and children
Brothers and sisters
All my family
ACKNOWLEDGEMENTS

The completion of this thesis effort would not have been possible without the assistance of many people. I would like to thank Professor Andrew D. F. Price for his outstanding supervision, positive criticisms, constructive comments, great support and encouragement during undertaking the research stages. My thanks also are extended to the Director of Research Professor Koji Shiono.

I am very grateful for the assistance received from my colleagues, friends and academic staff in Department of Civil and Building Engineering. Additionally, my work would not have been nearly as successful if it were not for the help of the construction industry practitioners either in Saudi Arabia or the United Kingdom.

I would like to thank General Manager of Saudi Border Guard His Excellency Lieutenant General MR Talal M. Al-Angawy, and his Deputy Major General MR Zumeim M. Al-Swat for their guidance and support during undertaking this research.

I owe great attitude toward General Manger Assistant of Border Guard Major General Eng. Saeed M. Mosmar for his spiritual support during my study, whether he was close or far away. He was generous with both his time and resources, sharing his personal visions that sustained me throughout the research process. My thanks are also due to Lieutenant Colonel Eng. Mohsen M. Al-Subeai for his support, assistance and encouragement throughout undertaking my research.

There are many people who are due to thanks. I express my sincerely gratitude to everyone who has helped along the way providing intellectual, physical, or emotional support. I am profoundly grateful to all.

Finally, I am eternally grateful to my parents, wife and children for their patience, support and understanding throughout the entire research process.
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<tr>
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<tr>
<td>APM</td>
<td>Association for Project Management</td>
</tr>
<tr>
<td>AVC</td>
<td>Associate Value Specialist</td>
</tr>
<tr>
<td>BRE</td>
<td>Building Research Establishment</td>
</tr>
<tr>
<td>BREAM</td>
<td>BRE Environment Assessment Method</td>
</tr>
<tr>
<td>BS</td>
<td>British Standard</td>
</tr>
<tr>
<td>BSRIA</td>
<td>Building Services Research and Information Association</td>
</tr>
<tr>
<td>CABE</td>
<td>Commission for Architecture and the built Environment</td>
</tr>
<tr>
<td>CBPP</td>
<td>Construction Best Practice Programme</td>
</tr>
<tr>
<td>CEEQUAL</td>
<td>Civil Engineering Environmental Quality Assessment</td>
</tr>
<tr>
<td>CFC</td>
<td>Chlorofluorocarbons</td>
</tr>
<tr>
<td>CIB</td>
<td>Construction Industry Board</td>
</tr>
<tr>
<td>CIBSE</td>
<td>Chartered Institute of Buildings Service Engineers</td>
</tr>
<tr>
<td>CVS</td>
<td>Certified Value Specialist</td>
</tr>
<tr>
<td>CIOB</td>
<td>Chartered Institute of Building</td>
</tr>
<tr>
<td>CIRIA</td>
<td>Construction Industry Research and Information Association</td>
</tr>
<tr>
<td>DETR</td>
<td>Department of the Environment, Transport and the Regions</td>
</tr>
<tr>
<td>DTI</td>
<td>Department of Trade and Industry</td>
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<tr>
<td>ENVEST</td>
<td>Environmental Estimating Software</td>
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<tr>
<td>ER</td>
<td>Expenditure Request</td>
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<tr>
<td>FAST</td>
<td>Function Analysis System Technique</td>
</tr>
<tr>
<td>GCCP</td>
<td>Government Construction Client’s Panel</td>
</tr>
<tr>
<td>ICE</td>
<td>Institute of Civil Engineers</td>
</tr>
<tr>
<td>ISO</td>
<td>International Standard Organisation</td>
</tr>
<tr>
<td>IVM</td>
<td>Institute of Value Management</td>
</tr>
<tr>
<td>JIC</td>
<td>The Jubail Industrial College</td>
</tr>
<tr>
<td>LEED</td>
<td>Leadership in Energy and Environmental Design</td>
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<tr>
<td>LSK</td>
<td>Lump Sum Turnkey</td>
</tr>
<tr>
<td>MEP</td>
<td>Ministry of Economic and Planning</td>
</tr>
<tr>
<td>MODA</td>
<td>Ministry of Defence and Aviation</td>
</tr>
<tr>
<td>MOMRA</td>
<td>Ministry of Municipality and Rural Affairs</td>
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<tr>
<td>MPM</td>
<td>The Presidency Metrology and Environment</td>
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<td>MWE</td>
<td>Ministry of Water and Electricity</td>
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<tr>
<td>NCWCD</td>
<td>National Commission for Wildlife Conservation and Development</td>
</tr>
<tr>
<td>RCJY</td>
<td>Royal Commission for Jubail and Yanbu</td>
</tr>
<tr>
<td>RIBA</td>
<td>Royal Institute of British Architects</td>
</tr>
<tr>
<td>RICS</td>
<td>Royal Institution of Chartered Surveyors</td>
</tr>
<tr>
<td>SABIC</td>
<td>Saudi Basic Industries Corporation</td>
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<tr>
<td>SAVE</td>
<td>Society of American Value Engineers</td>
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<tr>
<td>SC</td>
<td>Sustainable Construction</td>
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<tr>
<td>SDSF</td>
<td>Sustainable Defined Stakeholder Factors</td>
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<tr>
<td>SMART</td>
<td>Simple Multi Attribute Rating Technique</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>SPeAR</td>
<td>The Sustainable Project Appraisal Routine</td>
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<tr>
<td>SPS</td>
<td>Saudi Public Sector</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>USGBC</td>
<td>United States Green Building Council</td>
</tr>
<tr>
<td>VA</td>
<td>Value Analysis</td>
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<tr>
<td>VE</td>
<td>Value Engineering</td>
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<tr>
<td>AVS</td>
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<tr>
<td>VM</td>
<td>Value Management</td>
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<td>VMB</td>
<td>Value Management Board</td>
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<tr>
<td>VP</td>
<td>Value Planning</td>
</tr>
<tr>
<td>WLCC</td>
<td>Whole Life Cycle Cost</td>
</tr>
<tr>
<td>WLV</td>
<td>Whole Life Value</td>
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8.5.1 Appoint a qualified and experienced facilitator

8.5.2 Clarify objectives of the study

8.5.3 Agree on the total cost of VM and SC Study

8.5.4 Appoint a sustainability advisor

8.5.5 Select appropriate team members

8.5.6 Do Stakeholder analysis

8.5.6.1 Timing of Stakeholder Analysis

8.5.6.2 Reasons behind Stakeholder Analysis

8.5.6.3 Identifying project stakeholders

8.5.6.4 Identify of requirements and expectations

8.5.6.5 Prioritising stakeholders

8.5.6.6 Involve stakeholders

8.5.6.7 Synthesising Information

8.6 STAKEHOLDER BRIEFING STAGE (2)

8.6.1 Building knowledge and understanding

8.6.1.1 Introduce SC and VM principles

8.6.1.2 Introduce benefits and drivers

8.6.1.3 Clarify sustainable value

8.6.1.4 Set up the scope and objectives of a project

8.6.2 Motivate team members

8.7 INFORMATION STAGE (3)

8.7.1 Finalise project objectives

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8.7.2.1 Identify and define functions

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CHAPTER ONE
CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Extreme economic development in the Gulf Cooperation Council (GCC) countries has resulted in a significant consumption of natural resources which increases the demand for economically viable construction projects coupled with the need to maximise the efficient use of natural resources through adoption of establishing and implementing Sustainable Construction (SC) principles in the region. Saudi Arabia, as other GCC countries, is currently experiencing a construction boom due to strong oil prices and progress on reforms in the country. The boom is being spurred on by major government infrastructures and the development of construction projects, as well as a rapidly expanding tourism sector.

The notion of sustainable development has been broadly adopted by many countries all over the world. Sustainability is a major concept underlying a variety of efforts to ensure a good quality of life for present and future generations. Sustainable development was defined as “development that meets the needs of the present generations without compromising the ability of future generations to meet their own needs” (Bruntland 1987). This definition indicates that the environment and social issues are as paramount as economic issues but suggests that human, natural and economic systems are interdependent. It also involves intergenerational justice, highlights the liability of current generation for the wellbeing of millions yet unborn and involves the idea that present generation are borrowing the planet, its resources, and its environmental function and quality from future generations (Kibert 2005).

Ferng and Price (2005) claimed that the attainment of optimal solutions to current difficult infrastructure problems is vitally the consideration of environmental technical, social, political and economic aspects, their synergies and the inevitable balances between them. SC principles in this way express holistic solutions with regard to a
whole system, with an entire combination of outcomes as expressed by a variety of comments and conclusions (ibid).

VM offers a method for stakeholders to achieve a better built environment and improve the adopted construction process. It can be used to ensure the incorporation of the principles of SC into decisions that affect not just new construction projects but also the efficient use of whole resources. This chapter introduces the research background, aim and objectives, justification, contribution, and scope of the research. Moreover, it presents briefly the research methodology adopted, as well as outlining the structure of the thesis.

1.2 BACKGROUND

The construction industry has both positive and negative impacts on the environment and people. Construction constitutes 10-12% of GNP to the economy of the European Union (Sjostrom 1999) and provides jobs for approximately 1.5 million people in the United Kingdom. In Saudi Arabia, the construction industry employs 14.4% of 7.3 million workers and contributes 5.4% of the GDP (Ministry of Economy and Planning 2006). Moreover, the construction industry significantly contributes to the quality of life for humanity through providing dwellings, buildings, factories and infrastructures (DETR 2000).

However, the construction industry and its products, including buildings, bridges, dams and roads etc, contribute to environmental problems on a global scale through: resources depletion; energy consumption; air pollution and waste creation (Ngowi 2000). It is estimated that the construction industry in Europe is responsible for approximately 40% of energy consumption, 30% of CO2 emissions and 40% of total solid production waste (Hajek 2002 and Sjostrom 1999). The construction industry's fragmentation also creates many difficulties for its clients who must procure individual project elements from different sources (Egan 1998).
If the construction industry is to provide the required buildings, infrastructure and reduce environmental degradation, it must adopt more sustainable practice and policies (Ngowi 2000). The concept of SC emerged to capture the role of the construction industry in sustainability development. The objectives of SC include: environmental impact reduction; resources optimisation; cost minimisation through applying Whole Life Cycle Cost (WLCC) in a project; social and cultural improvement; as well as the achievement of quality, affordability and durability in a project.

1.3 AIM AND OBJECTIVES

This section presents the main aim of the research and its objectives. The achievement of the research objectives performs the attainment of the major research aim.

1.3.1 AIM OF THE RESEARCH

The main aim of the research is to develop an Integrated Approach to VM and SC during Strategic Briefing in the construction Industry.

1.3.2 OBJECTIVES OF THE RESEARCH

The following objectives were set in order to achieve the main aim of the research.

- Explore VM and SC concepts by conducting a comprehensive literature review to both topics, in addition to attendance at seminars, conferences and training.

- Establish and integrate conceptual linkages between VM and SC principles.

- Investigate the current situation of VM in the Saudi construction industry in terms of: the application of VM; clients' attitudes towards VM; barriers to implementation; identification of enablers that could overcome the barriers and improve its implementation; and determination of the level of existent knowledge about VM in the Saudi public sector and construction industry.

- Investigate the current situation of SC in the Saudi construction industry in terms of the: application of SC; clients' attitudes towards SC; identification of
barriers implementation; identification of enablers that could overcome the barriers and improve its implementation; and determination of the level of existent knowledge about SC in the Saudi public sector.

- Ascertain the current situation of VM and SC in the Saudi construction industry in terms of strategies, policies associated with its implementation.
- Defining and adapting SC principles for the Saudi construction industry.
- Develop an integrated approach to VM and SC to be used at strategic level of project developments. It aims to accelerate the understanding and implementing the principles of SC in the Saudi construction industry through VM and practitioners’ experience and skills in the Saudi public sector. Moreover, this approach also aims to upgrade VM to continue its competitiveness, enhance its performance and spread its implementation all over the country in delivering value for money. Furthermore, it endeavours to improve and promote the technical knowledge and awareness of VM practitioners about SC aspects.

1.4 JUSTIFICATION FOR THE RESEARCH

Excessive economic development in the Arabian Peninsula countries has caused a significant imbalance of exist natural resources and demand. Kingdom of Saudi Arabia is currently experiencing a construction boom due to strong oil prices and ongoing reforms in the country. The boom is being encouraged by major government infrastructures activities and the development of construction projects, as well as a rapidly expanding tourism sector.

These are being accompanied with increased water, energy and materials consumption and land use which make natural resources becoming scarce. Between 1980 and 1990, water demand was boosted from \(9.95 \times 10^9\) billion to \(22.6 \times 10^9\) billion. If the current situation continues, water demand may reach \(35.4 \times 10^9\) billion by the year 2010 (Abdulrazzak 1995). Furthermore, the consumption of electrical energy in Saudi Arabia has risen significantly over the last two decades. Peak loads reached nearly 24GW in 2001, which is 25 times higher than its level in 1975, and is predicted to reach 60GW by
To meet this demand, the total investment needed exceed $90 billion (Al-Ajlana and Al-Ibrahima et al. 2006).

The in-depth research established the reasons behind the abovementioned problems. The research results indicated that SC principles are not a major consideration among Saudi people and many individuals who work in the Saudi public sector have a little experience in sustainable development. This resulted in a lack of consideration paid to SC issues during the design, construction and operation phases. Moreover, the policies and legislations of SC have not been established yet in the country. Consequently, rapid economic development and the absence of the consideration of SC principles caused huge consumption of materials, energy, water and land use, in addition to negative impacts on environment and people.

The research results found that VM has been used in Saudi Arabia for more than three decades and people are familiar with its technique. It also established that the people who work in the VM sector possess significant experience relating to VM. Moreover, the research findings found that VM is mandatory in all governmental projects funded by the Saudi government. However, there is a number of barriers illustrated in Chapter 5 that could impede or delay VM implementation in the Saudi public sector which were taken into account in the research.

In the light of the above, there could be substantial benefits of using VM as road map for promoting and establishing SC principles, as well as raising its awareness within the Saudi construction industry. Additionally, the experience and skills of VM practitioners could be exploited and can be turned to accelerate the understanding and implementation of SC principles in the Saudi construction industry. These could be executed by developing an integrated approach to VM and SC at strategic level of a project.

The principles and techniques of VM can provide the required quality at optimum whole life during the process of developing a project, which will provide best value from a whole life perspective. Moreover, this approach also aims to upgrade VM to continue its competitiveness, enhance its performance and spread its implementation all
over the country in delivering value for money. Furthermore, it endeavours to improve and promote the technical knowledge and awareness of VM practitioners about SC aspects.

In the beginning of the 1970s, designers deliberated that the capability to achieve a task or function were restricted only to equipment. Designers thought that if one could invent a way to accomplish a goal, the required resources would be available. In today’s economic environment limited resources have again become a problem, consequently, an effective VM approach is needed to be established again as in the shortage of material during World War II (Land 1997).

1.5 THE CONTRIBUTION OF THE RESEARCH

The expected major achievements of this research are; firstly, to define and implement SC principles in the Saudi construction industry; secondly, to overcome challenges associated with the implementation of VM and SC in the Saudi construction industry. The potential gains from the study can be postulated as follows.

- The definition and acceleration of the understanding and implementing the principles of SC in the Saudi construction industry through VM and its practitioners’ experience and skills in the Saudi public sector, which will help establish sustainable development in the country.

- The ability of the key stakeholders to put into action the consideration of SC principles at strategic level of projects. The consideration could be achieved by chasing the following steps: create a good environment; bringing the key stakeholders into one place; educate them about SC principles and VM; introduce to them the benefits and drivers from implementing VM and SC associated with the key stakeholders. This should help shift thinking of stakeholders from short term to long term, from cost to value, from shareholders to stakeholder and from local to national to global.
The integration of the principles of SC into VM will upgrade the approach of VM to continue its competitiveness in delivering its objectives and services, in addition to promote and spread its implementation all over Saudi Arabia. This also should help to improve and promote the technical knowledge and skills of VM practitioners about SC aspects.

- The encouragement of the need to take into account environmental prosperity and social promotion at the earliest stages of projects.

- The implementation of both VM and SC as part of a single exercise can provide a better opportunity for implementing the value for money in the project and save time and money.

- The integration can help constructing new projects that have the most advanced sustainable technology conform to the highest profitability and satisfy the requirements of users and investors.

1.6 LITERATURE REVIEW

A comprehensive literature review was undertaken, in addition to attendance at seminars, conferences and training session. The research started with a literature review on the topics of VM, value engineering, value analysis, value planning, sustainability, SC, whole life value, whole life cost and value for money. Each of these areas was covered in general and especially in terms of relationships between these subjects.

Over 320 citations were reviewed to define the scope of the research and explore the conceptual linkages between VM and SC in order to meet aim and objectives of the research. There is scarcity of available literature review relating to the application of SC dimensions into VM in addition to lack of literature on SC associated with the Saudi construction industry. Most literature review covers SC and VM individually.

However, there have been attempts in construction research were cited towards finding a single framework. Thus, the concept of blending SC principles into VM by identifying the conceptual linkages, underlying logic of well-established an integrated approach to
VM and SC during strategic briefing emerged as the thrust of this research. A literature review is appeared in Chapter 3, 4 and 5.

1.7 RESEARCH METHODOLOGY

The overall research process adopted to develop an integrated approach to VM and SC during strategic briefing and its actions taken to achieve the aim and objectives have been illustrated in Figure 1.1. Chapter 2 discusses the research methodology in detail.

![Figure 1.1: The Research Process Diagram](image)

1.8 SCOPE OF WORK

The integrated approach developed in this research was designed to be used during strategic briefing, particularly in the Saudi construction industry. Figure 1.2 illustrates the key areas studied in this research.
1.9 GUIDE TO THESIS LAYOUT

The thesis is representing into ten chapters, which are shown in Figure 1.3 and summarised below.

Chapter 1 introduces the research background, aims and objectives, justification, scope and contribution of the research. Moreover, it presents briefly the research methodology adopted, as well as the structure of the thesis.

Chapter 2 provides details of the overall research methodology comprising the research approach, design, process, scope, methods and limitations. It introduces an overview of research methods then concentrates on the all processes adopted in achieving the research aim and objectives.

Chapters 3, 4 and 5 reviews related literature and previous work. It illustrates the gaps and novelty of the research in the context of related and previous studies.

Chapter 6 discusses expert interviews and case studies from Saudi Arabia. It also presents the current situation of VM and SC application in the country. Furthermore, it illustrates conclusion derived from the data collection.
Chapter 7 discusses expert interviews and case studies from the UK. It presents the best practice in terms of the implementation of VM and SC. It also includes case studies
on SC and VM implementation. Moreover, it introduces the suitable way to integrate both subjects and develop the integrated approach.

*Chapter 8* illustrates the process derived from the research that is dedicated to the development of an Integrated Approach to VM and SC during strategic briefing of construction projects in Saudi Arabia.

*Chapter 9* discusses the refinement, improvement and validation of an Integrated Approach to VM and SC during strategic by pursuing expert feedback about the developed framework, its process, its components and its steps.

*Chapter 10* presents the recommendations and conclusions of the whole research. It also discusses the limitations of the research and recommends areas for further research.
CHAPTER TWO
CHAPTER 2
RESEARCH METHODOLOGY

2.1 INTRODUCTION

The achievement of research aims and objectives often faces many challenges especially in construction management due to the independent nature of each construction project and the lack of prescribed data collecting procedures within the industry. The design of a good research methodology is thus vital for assuring the validity of this type of research (El-Diraby and O’Conner 2004). Research methodology is defined as ‘the principles and procedures of the logical thought process which are applied to a specific investigation’ (Fellows and Liu 2003). The selection of a methodology is significant in supporting identification of all relevant variables, their mechanisms and the amount of impact (ibid). The primary aim of this chapter is to provide an overview of the research methodology, followed by a description of the research methods adopted to achieve the aim and objectives of this research.

2.2 RESEARCH DEFINITIONS

Research is defined ‘as an organized, systematic, data based, critical, objective, scientific inquiry or investigation into a specific problem’ (Sekaran 2003). Tan (2004) also defined research as a systematic approach to carefully investigate problems in order to find solutions. He classified the type of research as: pure or applied; exploratory, descriptive, interpretive and causal; or qualitative or quantitative. Moreover, Phillips and Pugh (2000) defined research as ‘finding out something you do not know’ and classified it into three basic types: exploratory, testing-out and problem solving, which applies to both qualitative and quantitative research.

The concise Oxford Dictionary defines research as ‘the systematic investigation into and study of materials, sources etc. in order to establish facts and reach new
conclusions' (Fellows and Liu 2003). The crucial characteristic of research for a doctoral degree (PhD) is that the research makes a novel contribution to knowledge (ibid). Research is classified into two types: pure research, which is mostly carried out by academics, and applied research, which is mostly carried out a collaboration by research practitioners and industrialists. Pure research endeavours to develop a "theoretical explanation" or "understanding" of a topic, whereas applied research relates to problems and their solution (ibid). Moore (2000) identified a third type of research namely social research, which is how to measure developments in the world around us in order to better understand what is going on. Four essential factors frequently connect any research: bias, generalisation and particularisation, validity and rigour. Figure 2.1 illustrates the research designs, methods and strategies.

Figure 2.1: Research Design, Method and Strategy (adopted by author from (Bryman 2003))
2.3 RESEARCH DESIGN

Research design is usually introduced after identifying the research questions and before starting to collect data. The function of research design is to ensure that the data obtained enables the researcher to answer the initial questions as completely and clearly as possible. Therefore, a research design is a context that provides a framework within which data are collected to answer research questions. It is also defined as the framework in the course of which the different components of a research project are brought together, such as: literature review, research questions, collection and analysis of data, and findings (Royer and Zarłowski 2001; Tan 2004). Fellows and Liu (2003) concluded that a research design is a framework for the collection and analysis of data.

Yin (2003) defined research design as 'a logical plan for getting from here to there, where here may be defined as the initial set of questions to be answered, and there is some set of conclusions (answer)'. Many writers have argued that there is no unique correct design for a research project, but several designs are possible; however, the quality of research design has a strong relationship with the logic of the research components used and its coherency (Royer and Zarłowski 2001).

2.4 RESEARCH METHODS

There are a variety of research methods associated with the available techniques that are actually used in a research project (Fellows and Liu 2003). A research method is simply a technique for collecting data, which includes a particular instrument, such as self-completion questionnaire or a structured interview schedule, or participant observation whereby a researcher listens to and/or watches others (Bryman 2003). Table 2.1 illustrates the common types of research designs and methods.
Table 2.1: Types of research design and method

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Research designs</td>
<td>Experimental and related designs (i.e. quasi-experiment).</td>
<td>Case studies.</td>
</tr>
<tr>
<td></td>
<td>Cross-sectional design, the most common form of which social survey research.</td>
<td>Surveys.</td>
</tr>
<tr>
<td></td>
<td>Longitudinal design and its various forms, such as the panel study and the cohort study.</td>
<td>Experiments.</td>
</tr>
<tr>
<td></td>
<td>Case study design.</td>
<td>Correlation research.</td>
</tr>
<tr>
<td></td>
<td>Comparative design.</td>
<td>Causal-comparative research.</td>
</tr>
<tr>
<td>Research methods</td>
<td>Questionnaires</td>
<td>Questionnaires</td>
</tr>
<tr>
<td></td>
<td>Interviews</td>
<td>Interviews</td>
</tr>
<tr>
<td></td>
<td>Observation</td>
<td>Observation techniques</td>
</tr>
<tr>
<td></td>
<td>Analysis of documents</td>
<td>Analysis of past documents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simulations</td>
</tr>
</tbody>
</table>

2.5 RESEARCH STRATEGIES

Researchers have to make decisions about what type of strategy they want to follow for data collection and analysis (Fellows and Liu 2003). A research strategy is concerned with the way a piece of research is conducted. Although, the distinction between qualitative and quantitative approaches is not clear (Linn and Erickson 1990; Moore 2000), however, many authors of methodological matters discover it useful to differentiate between them (Bryman 2003). There are three types of research strategies: qualitative, quantitative and a combination usually called the triangulation or hybrid method, as shown in Figure 2.1.

In any research there is a strong relationship between the data collection methods used and the outcomes obtained, consequently, the findings will be affected by the methods employed (Saunders 2000). Rouse and Dick (1994) recommended that qualitative approaches are used to extract holistic real world answers to real-world problems in a way that is not possible in a quantitative context. Therefore, qualitative approaches are
the most appropriate to generate rich data relating to the experience and practice of VM and SC and thereby achieve the research objectives. This section outlines the main features of these research strategies and the tools used to accomplish them. Tables 2.2 and 2.3 demonstrate common contrasts between quantitative and qualitative research.

Table 2.2: Differences between qualitative and quantitative (adapted from Bryman 2003)

<table>
<thead>
<tr>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers</td>
<td>Words</td>
</tr>
<tr>
<td>Point of view of researcher</td>
<td>Point of view of social actors</td>
</tr>
<tr>
<td>Researcher distant</td>
<td>Researcher close</td>
</tr>
<tr>
<td>Theory testing</td>
<td>Theory emergent</td>
</tr>
<tr>
<td>Static</td>
<td>Process</td>
</tr>
<tr>
<td>Structured</td>
<td>Unstructured</td>
</tr>
<tr>
<td>Generalisation</td>
<td>Contextual understanding</td>
</tr>
<tr>
<td>Hard, reliable data</td>
<td>Rich deep data</td>
</tr>
<tr>
<td>Macro</td>
<td>Micro</td>
</tr>
<tr>
<td>Behaviour</td>
<td>Meaning</td>
</tr>
<tr>
<td>Artificial settings</td>
<td>Natural settings</td>
</tr>
</tbody>
</table>

Table 2.3: Difference between qualitative and quantitative strategies (Bryman 2003)

<table>
<thead>
<tr>
<th>Principal orientation to the role of theory in relation to research</th>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deductive; testing of theory</td>
<td>Inductive; generation of theory</td>
</tr>
<tr>
<td>Epistemological orientation</td>
<td>Natural science model, in particular positivism</td>
<td>Interpretivism</td>
</tr>
<tr>
<td>Ontological orientation</td>
<td>Objectivism</td>
<td>Constructionism</td>
</tr>
</tbody>
</table>

2.5.1 QUANTITATIVE RESEARCH

Quantitative research is named ‘realistic’ and is used to collect data about things that are easy to calculate. However, it is also possible to conduct quantitative research on a number of topics that are essentially qualitative in nature (Moore 2000). The
quantitative approach involves making measurements by collecting data and is built upon previous work that has developed principles, law and theories, which help to decide the data requirements of the particular research project. A quantitative approach is used to both collect factual data and study relationships between facts to obtain information on how these facts and relationships agree with theories of previous research results (Fellows and Liu 2003). Quantitative research is connected with the testing of theories (Bryman 2003).

2.5.2 QUALITATIVE RESEARCH

Qualitative research is called ‘idealistic’ and is associated with information about things that are less easily understood by calculation. It is a systematic, empirical strategy for responding to questions about people in special situations. Given any person, group, or locus for interaction, it is a means for describing and attempting to understand the observed in what people do, or in what they report as their experience (Locke et al 2000). It also seeks to understand how people see and interact with ‘the world’ (Fellows and Liu 2003). The objective of using a qualitative approach is to provide an exploration of the research topic, which is attempted without prior formulation to gain understanding and collect information and data (Fellows and Liu 2003).

In addition, qualitative research is connected with the generation of theories (Bryman 2003, Fellows and Liu 2003). Marshall and Rossman (1999) mention three major purposes for research adopting the qualitative approach: to understand, to develop, or to discover. Many qualitative studies are descriptive and exploratory: they find out deep descriptions and understanding of difficult situations that are not discovered in the literature (ibid). The following characteristics distinguish the qualitative research strategy (Locke et al 2000).

- The qualitative research is usually used inductively to produce theories that assist in understanding phenomena.
- Many writers use qualitative research to identify how people interact with their world and then to determine how they experience and understand that world:
how they explain structure and relationships within some fragment for their experience.

- The most common ways of collecting data in qualitative research are interviews and various form of observation, as well as document collection.
- The most common data take the form of words, namely; field notes, interview transcripts, diaries, etc. although quantities, frequencies and graphic representation can be used as well.
- Quantitative research reports should contain exhaustive descriptions of participants, as well as both the physical and social structures of the context within which the study takes place.
- The selection of participants for the sample in qualitative research is more likely to be selective in order to maximise the usefulness of data to meet the research aims and objectives. However, samples are sometimes created by random procedure in special cases.

2.5.3 TRIANGULATION RESEARCH
The triangulation is also termed *hybrid, multi-strategies*, or *comparative*. It refers to the use of corroboration of qualitative research to quantitative research results or vice versa. Triangulation entails researchers using more than just one approach or source of data in order to investigate the research problem in order to enhance confidence in the ensuing findings (Bryman 2003). The use of triangulation to investigate the subject of research has become very significant, as it is very influential for obtaining deep understanding and findings, for assisting in making inferences and in drawing conclusions (Fellows and Liu 2003). The combination provides a multidimensional view of the topic obtained through synergy (ibid). Using evidence from different sources, different methods of collecting data and different investigators, where possible, is all part of the triangulation approach, which improves credibility (Robson 2002).
2.6 EPISTEMOLOGY versus ONTOLOGY

Quantitative and qualitative strategies have many differences in terms of their epistemological and ontological commitments. The connection between research strategies to epistemological and ontological commitments is not deterministic. Epistemology is about the study of knowledge and the acquisition of its valid, nature, value, methods and scope. Ontology is about the study of being (Bryman 2003; Girod-Seville and Perret 2001).

2.7 POSITIVISM versus INTERPRETIVISM

Positive research considers that the subject under analysis should be measured through objective methods instead of being inferred subjectively. It generally attempts to test theory to increase the predictive understanding of phenomena (Remenyi et al. 1998). Positivism investigates by connecting clarification and fundamental rules, and in general diminishes the comprehensive into its simplest possible constituents in order to facilitate analysis (Easterby-Smith 1992; Remenyi et al. 1998). Positivism is defined as an epistemological situation that supports the application of the methods to the natural sciences to the study of social reality and further (Bryman 2003). It has a clearly strong link to the quantitative approach (Fellows and Liu 2003). Yin (2003) have categorised the case study method as a positivist approach within qualitative research.

Interpretivism is a phrase given to describe a contrasting epistemology to positivism. Interpretive research is mainly important for research areas in management by indicating that the researchers are involved in constructing reality. This assumes that reality can only be obtained since human beings interpret it through language, consciousness and shared meanings (Fellows and Liu 2003). Interpretive research attempts to understand and explain a phenomenon, rather than search for the external cause of fundamental laws (Easterby-Smith 1992; Remenyi et al. 1998). Interpretivism is more likely to distinguish the qualitative approach (Fellows and Liu 2003). Table 2.4 explains key features between positivism and interpretivism paradigms.
Table 2.4: Key features of Positivism and Interpretivism (Amaratunga and Baldry 2001)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Positivism</th>
<th>Interpretivism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic beliefs</td>
<td>The world is external and objective</td>
<td>The world is socially constructed and subjective</td>
</tr>
<tr>
<td></td>
<td>Observer is independent</td>
<td>Observer is part of what is observed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Science is driven by human interests</td>
</tr>
<tr>
<td>Researcher should</td>
<td>Focus on facts</td>
<td>Focus on meaning</td>
</tr>
<tr>
<td></td>
<td>Look for causality and fundamental laws</td>
<td>Try to understand what is happening</td>
</tr>
<tr>
<td></td>
<td>Formulate hypotheses and test them</td>
<td>Look at the totality of each situation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Develop ideas through induction from data</td>
</tr>
<tr>
<td>Performed method in</td>
<td>Identifying concepts so they can be measured</td>
<td>Using multiple methods to establish different views of the phenomena</td>
</tr>
<tr>
<td>the research</td>
<td></td>
<td>Small samples investigated in-depth</td>
</tr>
</tbody>
</table>

2.8 DEDUCTION versus INDUCTION

Deduction is defined as the process of reasoning in which a conclusion follows necessarily from the stated premises; inference by reasoning from the general to the specific. This embodies the fact that, if the proposition initially is true, then the conclusion that follows logically from this premise must be true (Charreire and Durieux 2001). Deductive theory depicts the common view of the nature of the relationship between theory and research (Bryman 2003).

Induction logically means to declare the truth of a general proposition by considering particular cases that advocates it. It is defined as 'the operation of discovering and proving general propositions by which we infer that what we know to be true in a particular case or cases, will be true in all cases which resemble the former in certain assignable respects' (Charreire and Durieux 2001,53). Grounded theory is extremely
supported by induction versus deduction methods and focuses on building theory from data collection continuum (Glaser and Strauss 1967).

2.9 RESEARCH PROCESSES ADOPTED

The reported research is aimed at developing an integrated approach to VM and SC during strategic briefing. It will be used at the strategic level of project development to accelerate understanding and implementation of the principles of SC in the Saudi construction industry through VM and its practitioners’ experience and skills in the Saudi Public Sector. Moreover, this approach also aims to upgrade VM to continue its competitiveness, enhance its performance and spread its implementation all over the country in delivering value for money. Furthermore, it endeavours to improve and promote the technical knowledge and awareness of VM practitioners about SC aspects.

A purely quantitative approach is not appropriate for this study, as it aims to obtain the whole picture and investigate in-depth the current situation of VM and SC in Saudi Arabia and gain their best practice in the UK. Rouse and Dick (1994) recommended that qualitative approaches are required to extract holistic real world answers to real-world problems in a way that is not possible in a quantitative context. In addition, many researchers recognise the difficulties of using quantitative approaches to investigate management practice (Tesch 1991 and Neuman 1997).

Therefore, a mixed approach has been undertaken, which is defined as the use of different data collection methods within one study to ensure that the data illustrate what it is thought that they will illustrate (Saunders and Thornhill et al. 2007). The qualitative approach is the most appropriate to generate rich data relating to the experience and practice of VM and SC but coupled with quantitative methods that were used to evaluate, confirm and validate the integrated approach. The methods adopted, in this research, are: literature review, expert semi-structured interviews and questionnaire, as illustrated in Figure 1.1.
2.9.1 FORMULATION OF THE AN INTEGRATED APPROACH
The literature review showed that individual frameworks for SC and VM implementation exist. However, each framework has different objectives and aspects. It was thus logical to develop a new approach to enable the owners to implement VM and SC principles in their projects by one technique. The proposed integrated approach to VM approach will generate many benefits to both the stakeholders and the project. This approach will ease the application of VM and SC principles by one approach in a series of studies, depending on the size and complexity of the project, which can be scheduled during the project developments.

An integrated approach to VM and SC is intended to be used at the strategic level of project developments in order to accelerate the understanding and implementation of the principles of SC in the Saudi construction industry through VM and its practitioners’ experience and skills in the Saudi Public Sector. In the meantime, this approach aims to upgrade VM to continue its competitiveness, enhance its performance and spread its implementation all over the country in delivering value for money. Furthermore, it endeavours to improve and promote the technical knowledge and awareness of VM practitioners about SC aspects. So, both topics either VM or SC will be promoted by developing an integration approach.

2.9.2 LITERATURE REVIEW
The function of the literature review is to ascertain the existing level of knowledge related to the topics of VM and SC. Literature reviews consolidate the background information of the researcher about their research subjects. It provides gaps, context and thoughts for the investigator to discover and design appropriate solutions. Researchers must have a thorough and up-to-date understanding of the literature; detailed background knowledge associated with relevant subjects, technical skills and experience, and significant time and resources (Robson 2002).

The investigation and search for possibly related theories and literature is essential at the early stage of most research. "The literature must be considered in the context of theory" (Fellows and Liu 2003). Literature reviews are crucial for analysis and
interpretation (Zarlowski and Royer 2001). It is paramount to know the historical knowledge associated with the investigated topics to obtain sufficient information to understand the consequences of preceding research and an appreciation of the context in which the topic area exists. Some of the purposes of reviewing literature are as follows (Hart 1998):

- differentiate what has been done from what needs to be done;
- discover important variables relevant to the topic;
- synthesise and obtain a new perspective;
- identify relationships between ideas and practice;
- establish the context of the topic or problem;
- rationalise the significance of the research problem;
- improve and obtain the subject vocabularies;
- develop an understanding of theory and method;
- communicate ideas and theory to applications;
- identify the main methodologies and research techniques that have been used; and
- place the research in a historical context to show familiarity with state of the art developments.

A comprehensive literature review was undertaken, in addition to attendance at seminars, conferences and training sessions. Databases of journals, textbooks, conference proceedings and internet were investigated. The research started with a literature review on the topics of VM, value engineering, value planning, value analysis, sustainability, SC, whole life cost, whole life value and value for money. Each of the previous topics was covered in general and especially in terms of relationships between these subjects. Over 320 citations were reviewed to define the scope of the research and explore the conceptual linkages between VM and SC in order to meet aims and
objectives of the research. All the collected information was critically appraised. The contribution of other writers' work was critically examined to identify the following:

- similarities in the statements made by previous writers;
- assertions raised by previous writers;
- differences or contradiction of assertions made by previous writers;
- criticism made by previous writers; and
- the above acted as a basis for formulating the proposed approach.

2.9.3 EXPERT INTERVIEWS

Interviews with construction industry practitioners often play a crucial role during all stages of the research project for identifying the real practices of an organisation in the field. Miles and Huberman (1994) identify four aspects for the selection of participants in qualitative approach: the setting where the research will take the place, the actor who will be interviewed (interviewee), the events what the actors will be interviewed doing, and the process which is the evolving nature of events undertaken by the actors within the setting. The idea behind the interviews is to purposefully select participants that will best help the researcher understand VM and SC and satisfy the research aim and objectives. The participants (sampling) were not selected randomly as typically found in quantitative approach because the study required people that have great deal of expertise in VM and/or SC to be able to probe rich and deep information.

An interview is a technique of collecting factual information by face-to-face or voice-to-voice interactive conversation to investigate the opinions and feelings of people on a certain topic or problem (Hussey and Hussey 1997). Interviews differ in their nature: they can be structured, semi-structured or unstructured (Fellows and Liu 2003). Semi-structured interviews were employed

The semi-structured interview was employed in this research as the main data collection method which is the most common one (Robson 2002). It is a powerful research tool, widely used and capable for producing rich and valuable data (Punch 1998). The aim of
these interviews is to focus on perceptions and experiences of participants and the method that they make sense of their lives (Fraenkel and Wallen 1990; Locke et al. 1987; Merrian 1988). It also emphasises on the process how and why things are happening, as well as the product or finding. Researchers are specifically concerned in understanding how things happen (Fraenkel and Wallen 1990; Merrian 1998).

Two stages of interviews were held in Saudi Arabia and the United Kingdom. The goal of the first interview conducted in Saudi Arabia was to explore the current situation of VM and SC in the country. The collection and analysis of data is presented detailed in Chapter 6. Twelve expert interviews were conducted to achieve the aims and objectives of the research stated in Chapter 1 Section 1.3.2. In these interviews, two sections were designed using both open and closed questions associated with the related topics of the research. The first section was designed in a semi-structured format (qualitative approach), whereas the second section was designed to use closed questions (quantitative approach), as shown in Appendix B.

The second stage of interviews took place in the United Kingdom to explore best practice of implementing SC principles and VM in the UK construction industry. They also aimed to obtain case studies of the best practice of VM/or SC implementation. Input from the UK construction industry experts were very focussed on objectivity and applicability. The findings aim to develop, modify and refine an integrated approach to VM and SC during strategic briefing for construction projects, in addition, to assessing the comprehensiveness and other stages of the integrated approach development. The best practice based on interviews and case studies in the UK is illustrated in Chapter 7. The interviews form is illustrated in Appendix C.

2.9.4 CASE STUDIES
The case study approach is preferred when investigating existing event if the pertinent behaviours cannot be influenced. Case study is a qualitative evolution approach involving in-depth contextual analysis of a particular situation or problem (Sekaran 2003). Yin (2003) defined case study as 'an empirical inquiry that investigates a contemporary phenomenon within its real context; when the boundaries between
phenomenon and context are not clearly evident; and in which multiple sources of evidence are used'. Case studies provide an important method for developing theory. It is particularly suitable for answering 'Why?' and 'How?' questions, even though it is less useful in investigating 'What?' and 'How much?' questions.

The main advantage of the case study approach in comparison with other approaches is that it depends on several sources. Evidence for case studies may be obtained from six different sources: interviews, observations, documents, archival records, direct observation, participant observation and physical artefacts (Yin 2003). An interview is an important source of case study information. Semi-structured or focussed interviews are the types of interview that are often used in the case study method. The interviews will emerge as conversation guidance instead of structured enquiries. The actual stream of questions in a case study interview is usually fluid rather than rigid (Rubin and Rubin 1995).

Case study research can pursue pure inductive or combine both inductive and deductive methods. The entirely inductive method is employed for developing theory from beginning as in the case of exploratory research. The case studies used the semi-structured interviews by obtaining in-depth insight (Rowley 2003) supporting in the chronology theory development of the proposed framework (Eisenhardt 1989). The case study method was used in the investigation in-depth of current situation of VM and SC in Saudi Construction industry. It also was used to indentify best practice of VM and SC implementation in the UK construction industry.

2.9.5 QUESTIONNAIRE SURVEY

Questionnaire was defined as 'a pre-formulated written set of questions to which respondents record their answers, usually within rather closely defined alternatives' (Sekaran 2003). It usually comprises two types of questions: open or closed. Open questions permit the person to fully respond while closed questions present a limited number of possible answers, as written by the researcher (Fellows and Liu 2003). The questionnaire was used in this research to investigate contemporary situation of VM and
SC in the Saudi construction industry. It also was used to confirm and validate the developed integrated approach of VM and SC.

2.10 RESEARCH METHODS LIMITATIONS

The selection of research processes manipulates the way in which the researcher collects and interprets data. Therefore, the research methods employed in this research are analysed for limitations and weaknesses so that possible solutions to overcome these problems can be found. These terms are discussed in detail in this section.

2.10.1 QUALITATIVE RESEARCH METHODS LIMITATIONS

This section presents the potential limitations and weakness of qualitative approach in addition to the actions taken to overcome or minimise their negative impacts.

2.10.1.1 Replication

Replication, in research, is defined as the attempt to repeat a study. Results are not considered as sound except when they can be independently replicated on several occasions. A number of qualitative researchers regard replication as impossible because they view each study is essentially unique. A failure to replicate previous results does not convincingly fiddle the assumption (Robson 2002). Nevertheless, the interview procedures were structured in terms of using the interview forms to overcome this weakness.

2.10.1.2 Generalisability

Generalisability refers to the extent to which the findings of the enquiry are more generally applicable outside the specifics of the situation studied (Robson 2002). The limited sample sizes and sampling methods employed in qualitative research decrease generalisability of the research findings. The sample size in this research was increased as much as possible. This involved experts possessing significant experience in the research subjects namely; VM and SC in addition to obtaining several case studies.
Qualitative research seeks an understanding of behaviour, values and beliefs associated with the context in which the research is carried out (Bryman 2003). Hence, the sample was deliberately selected to investigate in-depth and understand all subjects associated with the research in order to obtain more knowledge and see the whole picture.

2.10.1.3 Subjectivity

Qualitative research has sometimes been criticised as being more impressionistic and subjective in nature. It focuses on meanings, experience and description (Naoum 1998). The strength of in-depth investigation and understanding associated with the study produced by qualitative research is sometimes a weakness because it affects confidence in the findings. In order to meet this challenge and increase the confidence in the data collection and analysis of the research study, a structured form for conducting the interviews was employed, though probing was used to explore more aspects; in addition, the interviews were recorded and transcribed. The vast quantity of data of qualitative approach was coded and assembled, in addition, blueprints were sought to structure the analysis of the research data.

2.10.1.4 Transparency

In many qualitative approaches it is difficult to identify what the researcher actually did and how he or she arrived at the findings of the research; data analysis is frequently unclear as well. However, qualitative research is seen to produce rich descriptions, which provides the researcher with a database for making judgments about the possible transferable findings to other environments (Bryman 2003). The qualitative methods employed were clearly addressed in precise detail throughout the research to diminish this limitation. Moreover, transcriptions were sent to experts after the interviews had been taken place to increase the confidence and confirm the findings.

2.10.2 QUANTITATIVE RESEARCH METHODS LIMITATIONS

The major criticisms and limitations of quantitative research methods are sampling, non-response limitation, data collection error and data processing error. Maxwell (1996)
stated that purposeful sampling can be used to deliberately select cases in qualitative research that are critical for the theories that one begins the study with or that one has subsequently developed.

2.11 SUMMARY

In this chapter, basic concepts, principles and methodologies associated with research philosophy have been discussed. The first section of this chapter discussed common research methodologies, whereas the second section addressed the research processes adopted to accomplish the aims and objectives of the research. The research has adopted a triangulation approach, in which an integrated approach is developed and empirically evaluated in order to refine it. The main aim of the research is to develop an integrated approach to VM and SC during strategic briefing of construction projects. The development of the approach adopted the following methods: literature review, conducting semi-structured expert interviews, obtaining case studies and investigating documents. This was confirmed and validated by questionnaire survey. The next chapter presents an overview of VM in terms of history, terminologies, benefits and limitations and applications.
CHAPTER THREE
CHAPTER 3
VALUE MANAGEMENT

3.1 INTRODUCTION

VM is employed to achieve best value for money in construction projects by coping with challenges that might happen in these projects. Thus, value studies should not see as a cost saving exercise or cost reduction. However, it has the fact that a certain amount of unnecessary cost is inevitable in construction projects life cycle due to the complexity and uncertainty of these projects. This chapter aims to introduce the historical imperatives for VM in terms of history, definitions of terminologies, objectives and job plan. It also defined terms and techniques used in the processes of VM and Soft Value Management (SVM).

3.2 HISTORY OF VM

VM evolved within the manufacturing industry during the Second World War due to shortage of materials. In 1947, General Electric Company appointed Mr Lawrence D. Miles to produce a method that would both make changes in manufacturing techniques, or design, which led to substantial cost reduction. He developed a systematic approach called Value Analysis (VA), which aims to realise value for money by meeting the required function with minimising the whole life cost of a project and without detriment to quality and performance of the project (Dell’Isola 1997). The first Value Analysis workshop training was conducted in 1952 (Younker 2003). In 1954, the US Navy Bureau of Ships applied Value Analysis to cost improvement during design, terming it after Value Engineering (VE). Since its inception, it has promptly developed and broadened across many industries and countries (Ashworth and Hogg 2000). In the early 1970s, VE techniques were exported outside the United State of America to many countries such as: Japan, Korea, India, France, UK, Germany, Hungry and Saudi Arabia.
in addition to Canada, South America, Taiwan and South Africa and other countries (Dell'Isola 1997).

3.3 DEFINITIONS OF TERMINOLOGY

The terms Value Planning (VP), Value Engineering (VE), Value Analysis (VA) and VM are used to describe a systematic process of appraisal of the function of a project to ensure that it is delivered in the most effective way. In the construction industry, the terms value family have broad terminologies, which are very important for both readers and practitioners to understand them. The terminologies used are different depending on the situation and context, an aspect that probably puzzles those who are new to the approach of VM. The phrases of VM and VE are commonly used in the literature. Figure 3.1 illustrates these terminologies and the proper stage employed. In addition, a number of definitions of these terminologies have been presented below in this section.

![Figure 3.1: Value terminologies](image)

3.3.1 VALUE ANALYSIS

The term Value Analysis is broadly used in the United States of America (Pasquire and Maruo 2001). VA describes a value study of a project that is already built or designed to see if it can be improved, i.e., its application is after the completion of a project (Zimmerman 1982; Ashworth and Hogg 2000). The Department of Defence (DOD) in the United State defines VA is *an after the fact activity* during production and after finishing the project (Pasquire and Maruo 2001).
3.3.2 VALUE PLANNING
Value Planning (VP) is applied in the earliest stages of a project prior to the decision to build the project or at the concept phase of a project (Kelly and Male 2004; Ashworth and Hogg 2000). Pasquire and Maruo (2001) stated that the ICE (1996) observes that VP is implemented into the concept phase of a project and used during the developing the brief to ensure that value is planning into the whole project from its beginning.

3.3.3 VALUE ENGINEERING
The term Value Engineering is used during the detailed design and construction stages, and it is largely used in the United State (Pasquire and Maruo 2001). Moreover, Zimmerman (1982) stated that VE describes a value study during the project design and construction phase. This is confirmed by the Department of Defence (DOD) in the United State that defines VE is as a before the fact activity during the design stage (Pasquire and Maruo 2001). Whereas, Kelly et al. (2004) claimed that VE is a subset of the VM process, where the concentration is on improving value in the design and construction stages of the technical project and he concluded that VE connects to the principles of quality assurance.

The number of VE definitions presented in Table 3.1 highlight numerous imperative expressions and phrases. It has been recapitulated that VE is a systematic, organised creative, problem-solving, function-oriented approach that implies a sequence of processes. VE uses a multidisciplinary, proactive, creative team approach to achieve best value for money in a project during the design and construction stages. It identifies and removes unnecessary costs without detriment to quality, safety, performance, reliability, maintainability, as well as optimises whole life cycle cost in order to satisfy critical factors that can meet or exceed the customer's and user's requirements and expectations.
Table 3.1: Definitions of Value Engineering

<table>
<thead>
<tr>
<th>Authors</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miles (1972)</td>
<td>A discipline action system, attuned to one specific need: accomplishing the</td>
</tr>
<tr>
<td></td>
<td>functions that the customer needs and wants at the lowest cost.</td>
</tr>
<tr>
<td>Zimmerman (1982)</td>
<td>A proven management technique using a systematised approach to seek out</td>
</tr>
<tr>
<td></td>
<td>the best functional balance between the cost, reliability, and performance</td>
</tr>
<tr>
<td></td>
<td>of a product or project.</td>
</tr>
<tr>
<td>Connaughton and Green (1996)</td>
<td>A systematic approach to delivering the required functions at lowest cost</td>
</tr>
<tr>
<td></td>
<td>without detriment to quality, performance and reliability.</td>
</tr>
<tr>
<td>Dell'Isola (1997)</td>
<td>An organized process with an impressive history of improving value and</td>
</tr>
<tr>
<td></td>
<td>quality.</td>
</tr>
<tr>
<td>Standing (2001)</td>
<td>The systematic and creative process for the provision of the necessary</td>
</tr>
<tr>
<td></td>
<td>functions of a project at the lowest cost by efficient identification and</td>
</tr>
<tr>
<td></td>
<td>the elimination of unnecessary cost without detriment to: safety, quality,</td>
</tr>
<tr>
<td></td>
<td>reliability, performance and delivery.</td>
</tr>
<tr>
<td>Hayles and Simister (2000)</td>
<td>Proactive, creative, team approach to problem-solving in construction projects</td>
</tr>
<tr>
<td></td>
<td>to provide the best value for money.</td>
</tr>
<tr>
<td>Kelly et al. (2004)</td>
<td>The process of identifying and eliminating unnecessary cost during design</td>
</tr>
<tr>
<td></td>
<td>and construction stages.</td>
</tr>
<tr>
<td>JSVE (2005)</td>
<td>A professionally applied, function-oriented, systematic team approach used</td>
</tr>
<tr>
<td></td>
<td>to analyse and improve value in a product, facility design, system or service.</td>
</tr>
</tbody>
</table>

3.3.4 VALUE MANAGEMENT

The term VM was originated by the United State General Service Administration in 1974 (Zimmerman 1982). It is used to explain the whole philosophy and range of methods to describe the application of the processes of value studies at the earliest strategic stages of a project. VM is broadly term used all over the UK and Europe (Pasquire and Maruo 2001). In the UK, VM is generic, for the whole process including Value Engineering, Value Analysis and Value Planning (Ashworth and Hogg 2000). Moreover, Kelly et al. (2004) declared that VM explains the whole framework of maximising the value of a project for a client from the concept phase to operation and commissioning and this was corroborated by Zimmerman (1982) who ascertained that VM is a methodology employed in achieving value into a project.

Furthermore, Kelly et al. (2004) claimed that VM connects well to the principles of total quality management. The number of VM definitions shown in Table 3.2
underlines numerous essential terms and expressions. It has been encapsulated that VM is a means to cope with most difficult aspects associated with achieving the best value for money into a project, by taking into account of both internal and external considerations. The objectives are to enable all stakeholders to accomplish their objectives with the efficient use of resources. VM also concentrates on creation of a suitable environment to bring the key stakeholders and decision makers in one place at the earliest stages of a project to reach consensus in terms of the project objectives and the achievement of value for money in the project.

Table 3.2: Definitions of Value Management

<table>
<thead>
<tr>
<th>Author</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connaughton and Green (1996)</td>
<td>A structured approach to defining what value means to a client in meeting a perceived need by establishing a clear consensus about the project objective and how can be achieved.</td>
</tr>
<tr>
<td>Barton (2000)</td>
<td>A structured, facilitated, process in which decision-makers, stakeholders, technical specialists and others work collaboratively to bring about value-based outcomes in systems, processes, products and services.</td>
</tr>
<tr>
<td>Standing (2001)</td>
<td>A structured approach to the identification and evaluation of project objectives and a mechanism by which these may be achieved in order to provide value for money.</td>
</tr>
<tr>
<td>Kelly and Male (2004)</td>
<td>A service that maximises the functional value of a project by managing its development from concept to use through the audit of all decisions against a value system determined by the client.</td>
</tr>
<tr>
<td>British Standards Institution</td>
<td>A style of management, particularly dedicated to motivating people, developing skills and promoting synergies and motivation, with the aim of maximising the overall performance of an organisation. VM simultaneously addresses management goals, encourages positive human dynamics, respects internal and external environmental conditions, and positively provides the methods and tools for achieving results.</td>
</tr>
<tr>
<td>BS EN 12973 (2000, p.6 and 8)</td>
<td>A structured, systematic, and analytical process, which seeks to achieve value for money by providing all necessary functions at the lowest total cost consistent with required levels of quality and performance. The process may be applied to management decision making at any level of an organisation and specifically may be applied to projects, products, systems, services, or processes.</td>
</tr>
</tbody>
</table>
Several fundamental attributes have been summarised below from the definitions of VM. These are:

- VM is a structured, facilitated, analytical process or approach, a service, conference, meeting and a style of management;
- VM enable the stakeholders to have a dialogue and debate during a rigorous short-term conference;
- VM aims to achieve value-based outcomes, define what value means to a client, meet a perceived need and requirements of owner, maximise the functional value;
- VM identifies and evaluates the project objectives then establishes a clear consensus among stakeholders and plans out how can be achieved;
- VM motivates people, develops skills and promotes synergies and motivation;
- VM maximises the overall performance of an organization;
- VM addresses management goals, encourages positive human dynamics, respects internal and external environmental conditions;
- VM provides the methods and tools for achieving results; and
- VM seeks to achieve value for money by providing all necessary functions at the lowest total cost consistent with required levels of quality and performance.

3.4 WHY DO VM STUDY?

The main objective of VM is to enhance value in addition to reducing time, improving quality, reliability, maintainability and performance. Furthermore, VM can modify human behaviour, for instance, attitudes, creativity and teamwork. VM can also expand the use of financial, labours and material resources by eliminating unnecessary or excessive costs without sacrificing quality and performance (Dell’Isola 1997). Zimmerman (1982) contended that the goal of a VM study is to realise true value for the owner, which may come in the form of removing unnecessary cost from the project, or
it may come in the form of supplying a more workable product that would reduce the costs of possessing and operating the facility.

VM is a very good tool for breaking existing perceptions, to convince stakeholders to adopt advanced problem solving techniques and supporting in setting out tasks and objectives with value for money at the forefront of their thinking (Male et. al 1988). Value is elusively product attempted to accomplish in the design, which is in this context, is realising SC principles into construction projects.

3.5 THE VM WORKSHOPS

The VM workshop, as shown in Table 3.3, is a road map to guarantee successful application of the tools and techniques of VM in the correct manner. It is a systematic technique comprised one or a series of workshops, in which clients seek to achieve better value in the project. It may vary in its duration and difficulty from a short series and a single workshop to an extended sequence in excess of several months with various workshops and other involvements depending on the complexity and size of the project. It outlines specific steps to efficiently analyse a project in order to develop the maximum number of alternatives to satisfy the stakeholders’ needs, requirements and expectations. The practitioners of VM, depending on different background experience, have introduced a number of VM workshops. These VM workshops, which are mentioned in the literature, fluctuate in their number and synthesis of stages. The basic difference lies in synthesising the process or splitting them. Whereas, the VM workshops’ technique and concept remain the same in each one.
### Table 3.3: Comparison of various VM workshops

<table>
<thead>
<tr>
<th>Authors</th>
<th>workshop</th>
<th>Authors</th>
<th>Workshop</th>
<th>Authors</th>
<th>workshop</th>
</tr>
</thead>
</table>

#### 3.5.1 THE AMERICAN VM JOB PLAN

The Society of American Value Engineers (SAVE) international (2006) defined the Value Methodology as a systematic procedure used a multidisciplinary team to achieve the value into a project through the analysis of its function. The main aim of the Value Methodology Job Plan is to direct the VM study team during the process of identification and focus on the key functions of a project to generate new ideas that may result in value enhancements. The Value Methodology is generally applied under terms value analysis, Value Engineer, Value Planning, VM and Value Control (VC) (ibid).
The American Job Plan is based on a 40-hour (five-days, which does not include the Pre-Workshop and Post-Workshop efforts) carried out by an external team at the 35 percent of design phase (Pasquire and Maruo 2001). However, the application and duration of the VM Job Plan depends on a number of factors: the size and complexity of the project, the stage of project development and the estimated cost of the project (SAVE 2006). Figure 3.2 demonstrates the VM Job Plan process flow.

![Figure 3.2: Value Methodology Process Flow Diagram (SAVE International 2006)](image)

3.5.2 THE UK VM JOB PLAN

Male et al. (2007, p.110) defined a study style as ‘the outcome and configuration of the VM process that is required to intervene in a particular sage in a project life cycle; or in an organization, process, product or service delivery’. The generic VM process is summarised in Figure 3.3, which comprises of eight phases (Male and Kelly 1998). The
VM workshop, is part of this generic process and consists of five stages. However, there are varieties of Job Plan, in the UK, applied at different stages of the project developments depending on organisations. Several organisations point out that VM workshop can be implemented at construction phase (Pasquire and Maruo 2001). The VM Job Plan generally takes between two and nine days including one to two days for the application of the VM workshop. However, size and complexity of the project and its sensitivities may affect the duration of the VM job plan (Kelly et al. 2004).

![Diagram of the generic VM process](image)

**Figure 3.3:** The generic VM process (Male et al. 1998)

### 3.6 THE TIMING OF VM STUDY

A VM study can be at any point in the project life cycle (McGeorge and Palmer 2002). However, it has been generally agreed that VM needs to be applied at early stages of a project to avoid unnecessary commitments. Dell'Isola (1997) suggested that VM should be conducted as early as possible if its full potential is to be realised, before commitment of funds, approval of systems, services, or designs. He also stated that
when VM is applied later, two things may increase: the investment required to implement changes; and resistance to change. Assaf and Jannadi et al. (2000) reiterated this viewpoint stating that during planning and design, choices can be made between reasonable estimates of alternative courses of action.

3.6.1 THE OPPORTUNITY POINTS OF APPLYING VM

The timing of VM studies is very essential to its successful. They must be knotted intimately at all stages of project developments. This section introduces the benchmarked intervention points for applying value studies at along stages of the project developments as illustrated in Figures 3.4 and 3.5. Each value study objectives and its durations, as well as the suggested participants of the study and the size range of the team are summarised in Table 3.4. However, all these factors can be influenced by the size and complexity of the project and its sensitivities (Kelly et al. 2004).

![Figure 3.4: Value opportunity points application on a modified RIBA (Male et al. 1998)](image)

![Figure 3.5: Value opportunity points application on AIA (Male et al. 1998)](image)
<table>
<thead>
<tr>
<th>The Study</th>
<th>Study objectives</th>
<th>Duration</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM1</td>
<td>Identifying the scope and purpose of the project and its important parameters. Articulating strategic needs and wants Expressing clearly the mission of the business project.</td>
<td>4-7 days including ½ - 1 day for the workshop.</td>
<td>At senior level for client organisation The size 10 to 20 people.</td>
</tr>
<tr>
<td>VM2</td>
<td>Develop project brief in technical terms (technical project)</td>
<td>4-8 days including 1-2 days for workshop</td>
<td>Senior rep. of client, design and project management team. The size 10 to 20 people</td>
</tr>
<tr>
<td>VM3</td>
<td>Reviewing value in terms of initial plans, elevations, sections, outline specifications and cost plan of the proposed built property.</td>
<td>4-8 days including 1½-3 days for the workshop</td>
<td>Senior rep. of client, design and project management team. The size 10 to 15 people</td>
</tr>
<tr>
<td>VM (C)</td>
<td>Validating the project brief and concept design. Ensuring that the client value system is obviously described and understood.</td>
<td>4-8 days including 2-3 days for the workshop</td>
<td>Senior rep. of client, design and project management team. The size 10 to 15 people</td>
</tr>
<tr>
<td>VM4</td>
<td>Moving from the strategic and client organisation to the technical solution of the concept design and involves value engineering in terms of the element function and whole life performance relationships</td>
<td>4-9 days including 2-5 days for the workshop</td>
<td>Senior rep. of client, design and project management team. The size 10 to 15 people</td>
</tr>
<tr>
<td>VM5</td>
<td>Introducing supply chain and technical development issues. Updating the risk associated with the project. Appraising the proposed action identified earlier.</td>
<td>2-6 days including 1-5 days for the workshop</td>
<td>Rep. of contractor’s production planning, purchasing, project management, suppliers and/or subcontractor. Client, design team, client consultant project managers. The size 6 to 10 people.</td>
</tr>
</tbody>
</table>
Moreover, Connaughton and Green (1996) suggested five opportunity points for VM workshops. These points VM workshops are suggested to be applied at each phase as illustrated below:

<table>
<thead>
<tr>
<th>Phase</th>
<th>VM Aims</th>
</tr>
</thead>
<tbody>
<tr>
<td>The concept phase:</td>
<td>VM1 aims to identify the need for a project, its main objectives and constraints.</td>
</tr>
<tr>
<td>The feasibility phase:</td>
<td>VM2 aims to appraise the broad project approach or outline design.</td>
</tr>
<tr>
<td>The scheme design phase:</td>
<td>VM3 aims to appraise developing design proposal.</td>
</tr>
<tr>
<td>The detailed design:</td>
<td>VM4 aims to appraise detailed design proposal.</td>
</tr>
</tbody>
</table>

### 3.6.2 THE TYPES OF VM WORKSHOPS

Hayles and Simister (2000) contended that there are two types of workshops employed in the project life cycle: strategic and technical. Strategic workshops are illustrated as VM1 and VM2 in Figure 3.6, whereas technical workshops are illustrated as VE1 and VE2 in Figure 3.6. The aim of VM1 and VM2 is to aid the client to identify requirements and develop a number of value objectives to benchmark all upcoming decisions taken associated with the project. The aim of VE1 and VE2 is related to the detailed technical assessment of options suggested by the project team to satisfy the requirements and expectations of the client and user.

![Figure 3.6: Four workshops related to a project (Hayles and Simister 2000)](image)

### 3.7 SOFT VALUE MANAGEMENT

SVM is specifically designed to deal with difficult problems experienced at earliest stages of the project, whereby many stakeholders are involved in the course of action and high-level facilitation skills are vital to its accomplishment (Barton 2000). It derives
from the body of knowledge known as group decision support, which is defined as 'any process that supports a group of people seeking individually to make sense of, and collectively act in, a situation in which they have power' (Bryant 1993). SVM is designed to reach a consensus on a collective statement of needs and values between a set of stakeholders. It is based upon the hypothesis that people will have a variety of views about the real and intended functions that a system, process or item does (Barton 2000).

The identification of function in Hard VM is discovered in a pre-existing fact. While in Soft VM, the task of functions are not inherent in the system, product or service and the identification of function is produced by creating common understanding of the shared and viewpoints of the participants. In other words, the main task of SVM studies is to develop shared understanding of the primary purpose(s) of the system, process or product (ibid).

Dallas (2006) stated that SVM is less appropriate in problem-solving but more efficient in problem-shaping. He mentioned three guiding principles consist of identification that: (1) the situations of decision-making are dynamic, ill-defined and multi-perspective; (2) people are conceptualised as dynamic factors; (3) the perceptions of stakeholders are required in identifying the problem. SVM workshops are usually conducted over two days duration. The first day is a divergence, about transformative learning, creating a new knowledge base and possibilities, and shared understanding. The second day is a convergence, about evaluating ideas and developing proposal to meet to defined study objectives (Barton 2000). Five factors are vital to be considered in the facilitation. These are: openness, willingness to share all valid information, free and informed choice, inclusiveness and individual commitment to decisions and outcomes, in addition to positive attitudes towards learning (ibid).

3.7.1 DEFINING HARD AND SOFT PROBLEM

Barton (2000) evolved VM model from action-research described soft as combination of two factors: from the viewpoint of the nature of the problem situations addressed and from the viewpoint of the facilitation methodology used. He described how the concepts
of softness and hardness were defined by (Checkland 1999; Wilson 1990) and others who observe soft and hard situations at opposite ends of the identical continuum. *Hard* problem are well defined and understood and can be described within a clearly defined system boundary, whereas *soft* problem is not well defined and cannot be described within a clearly defined system boundary.

### 3.7.2 SMART VM METHODOLOGY

SMART (Simple Multi-Attribute Rating Technique) VM methodology was developed by Stuart Green in 1992. The distinction of SMART VM is the way in which it offers a framework to facilitate thought and communication. It is confined to the use of VM throughout the briefing and outline design stages of building projects. The identification of all stakeholders and representation of interested parties are necessary for the successful use of this method. Although the SMART VM approach has its origin in decision analysis, it is mainly focused on decision structuring rather than decision-making (Shen and Chung 2004).

The application of SMART VM usually comprises two one-day workshops. The first workshop (VM1) is conducted at the end of RIBA concept stage (A) when a new building project is first proposed. Its purpose is to make sure whether it is worth proceeding with the project or not. The primary objective is to appraise the building project prior to the client executing financial commitments. The second objective is to guarantee that the objectives of the project are obvious and are understood by the stakeholders. The second workshop (VM2) is conducted at the end of RIBA feasibility stage (C). It aims to satisfy the following objectives: (1) to verify the previous objectives produced earlier is still suitable; (2) to confirm that the selection of outline design proposal is consistently developed to the correct performance criteria; (3) to ensure marginal enhancements in the selected design option (Green 1994). Figure 3.7 illustrates the outline methodology for SMART VM.
3.8 THE DEVELOPMENT OF VM IN SAUDI ARABIA

VM was introduced to Saudi Arabia in 1975 under name of VE. The first application of VM was in the Ministry of Defence and Aviation (MODA); the General Directorate of Military works (GDMW), when a group of engineers were sent to attend training of VM in the United State. VM did not obtain acknowledgment and their flourishing outcomes were not published. These were due to two main reasons: firstly, its first application was in military top-secret projects in the country. Secondly, constructions booming were happened in Saudi Arabia at that time between 1970’s and early 1980s (Al-Yousefi et al. 1999).

The first VM study in Saudi Arabia was conducted in Saudi Aramco in 1978, whereas the first VM training was held in GDMW in 1981. Afterwards, the Saudi Arabia VM chapter was established in 1992, subsequently be converted into the Arabian Gulf Chapter in 1998. Since that, the Saudi government has made good efforts in developing VM technique in the country. In 1999, VM had its recognition in the Saudi Seventh Plan Development (2000-2005) after that approved by the Saudi Supreme Economic
Council. Consequently, the Saudi Ministry of Finance mandated the application of VM in the governmental projects in 2001 (Hannan 2003). The application of VM was optional in the first three years; subsequently it was mandatory for the governmental projects. It should apply on typical repeated projects that their costs exceed $1.33 million (SR5Million), projects exceed $5.33 million and operations and maintenance projects that increase than $1.3 million.

Today, many organisations are applying VM on their projects. These are: Ministry of Defence and Aviation (MODA), Saudi Aramco, Ministry of Municipality and Rural Affairs (MOMRA), Royal Commission for Jubail and Yanbu (RCJY), Saudi Electricity Company, Saudi Basic Industries Corporation (SABIC), High Commission for the Development of Riyadh, and Taiba and Real State and Development Company.

3.9 SUMMARY

This chapter presents the history of VM, terminologies and the VM Job Plan in several countries. It has been concluded that VM is a means to cope with most difficult aspects associated with achieving value for money into a project. It is taken account of both internal and external considerations. VM concentrates on the creation of a suitable environment to bring the key stakeholders and decision makers in one place at the earliest stages of a project to reach consensus in terms of the project objectives and the achievement of value for money in the project. VM enables all stakeholders to accomplish these objectives with the efficient use of resources.

VE is a systematic, organised, creative, problem-solving, function-oriented approach that implies a sequence of processes. It uses a multidisciplinary, proactive, creative team approach to achieve best value for money in a project during the design and construction stages. VE identifies and removes unnecessary costs without detriment to quality, safety, performance, reliability, maintainability, as well as optimises whole life cycle cost in order to satisfy critical factors that can meet or exceed the customer’s and user’s requirements and expectations. The next chapter presents an overview of SC in terms of history, terminologies, benefits and limitations and applications.
CHAPTER FOUR
CHAPTER 4
SUSTAINABLE CONSTRUCTION

4.1 INTRODUCTION

There has recently been considerable concern regarding the degradation of the environment caused by depletion of natural resources, air pollution, global warming and the lack of consideration paid to the earth’s ecosystem. The practices of SC are thus being widely adopted by many countries all over the world. This quest towards sustainable development throughout the world has put a spotlight on the construction industry. Most developing countries have experienced a fast uptake of urbanisation and the acceleration of infrastructure development, all of which fuel the necessity of establishing SC principles practices in the developing world (Du Plessis 2007). According to Ashe (2003), literature on SC can be placed into the three classifications below.

- Key driver documents issued by authoritative agencies: for example, the United Nations and some national governments recommend strategic plans, directions or actions to be taken.

- Tools, data and research documents associated with the life-cycle impacts of a project on the environment; case studies, suggested appraisal tools and suggestions for changes in current practice of the construction industry.

- Implementation documents issued by authoritative agencies, such as, national, state and local governments or national institutions either as compulsory regulation or non-compulsory guidelines or codes of practice.

This chapter highlights the main issues by reviewing SC in terms of development, definitions, principles, challengers, drivers and enablers.
4.2 THE CONCEPT OF SUSTAINABLE DEVELOPMENT

Sustainable development was defined by the United Nations World Commission on Environment and Development (WCED) as 'development that meets the needs of the present generations without compromising the ability of the future generations to meet their own needs' (Brundtland 1987) and is frequently discussed in relation to economic, environmental and social issues. Hill and Bowen (1997) stated that a comprehensive and 'an almost practical step toward sustainability' were suggested by the economist Solow (1993), who argued that development will certainly lead to the depletion of existing stocks of non-renewable resources and sustainability should signify more than just the conservation of natural resources.

Brundtland’s definition is about realising a balance between three issues: economic growth and progress; natural resource conservation; and the promotion of social equality. Sustainable development is thus about minimising the negative impacts whilst improving the environment to ensure a better quality of life for current and future generations. It implies using renewable natural resources in a way that does not eradicate or degrade them. It also implies using non-renewable natural resources at a rate slow enough to ensure an orderly societal transition to new alternatives (Langston and Mackley 1998).

Furthermore, Kibert (2005) commented on Brundtland’s definition by stating that the environment and social issues are as paramount as economic issues, and suggested that the human, natural and economic systems are interdependent. He also claimed that the definition: involves intergenerational justice; highlights the liability of the current generations for the wellbeing of millions yet unborn; and involves the idea that present people are borrowing the planet, its resources, and its environmental function and quality from future generations.

Moreover, Hajek (2002) argued that sustainable development integrates: environmental quality, economic constraints in addition to social equity and cultural aspects. Additionally, Du Plessis (2007) identified seven critical areas of intervention for universal sustainable development, for protecting biodiversity and stimulating a number
of economic equity measures to banish underdevelopment. These areas are: clean water, improved sanitation, energy, satisfactory dwellings, healthcare and food security. She also claimed that the variety of build environment that is constructed in the future and its process of creation will be a crucial factor for realising sustainable development objectives of these influential areas.

There is a shift in focus from the Green Agenda issues of Agenda 21 to the Brown Agenda (as identified by the IIED 2001). The Green Agenda aims to reduce negative impacts on the ecological environment, for instance, deforestation, climate change, pollution and the overuse of non-renewable resources, while the Brown Agenda aims to alleviate the problems of poverty and underdevelopment. Table 4.1 illustrates the difference between the two Agendas (Du Plessis 2007).

However, a Green or Brown Agenda approach will not independently achieve sustainable development. Although, the Brown Agenda is a crucial factor in the system in the development, the Green Agenda is also essential in making this development sustainable. In other words, the achievement of sustainable development is based on considering both Brown and Green Agendas (ibid).

<table>
<thead>
<tr>
<th>Table 4.1: Distinction between the Brown and Green Agendas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brown</strong></td>
</tr>
<tr>
<td>Key concern</td>
</tr>
<tr>
<td>Timeframe</td>
</tr>
<tr>
<td>Scale</td>
</tr>
<tr>
<td>Concerned about</td>
</tr>
<tr>
<td>View of nature</td>
</tr>
<tr>
<td>Environmental services</td>
</tr>
</tbody>
</table>

4.3 THE CONCEPT OF SUSTAINABLE CONSTRUCTION

SC is generally employed to describe the adaptation and application of sustainable development in the construction industry. This may mean that for the construction
industry to continue its business and growth based on SC principles, it will need to impede its growth in some areas, or grow in different ways (Du Plessis 2002).

‘Construction’ and ‘sustainable’ are very difficult expressions and there has been considerable debate and discussion about their area and meaning. Consequently, the combination of these two words increases the difficulty in understanding (Du Plessis 2007). Construction is defined as ‘the broad process/mechanism for the realisation of human settlements and the creation of infrastructure that support development. This includes the extraction and beneficiation of raw materials, the manufacturing of construction materials and components, the construction project cycle from feasibility to deconstruction, and the management and operation of the built environment’ (Du Plessis et al 2002, p.4)

The earliest definition of the term SC was given by Charles Kibert during the First International Conference on SC in Tampa in 1994: ‘Sustainable construction is the creation and responsible management of a healthy built environment based on resources efficient and ecological principles’ (cited in Bourdeau 1999, p.41). Consequently, the expressions ‘green building’, ‘ecological building’ and ‘sustainable architecture’ have been introduced (Du Plessis 2007). Hill and Bowen (1997) extend the definition of SC to four pillars: social, economic, biophysical and technical as shown in Table 4.2.

The construction industry concentrates on the three aspects of sustainability; environmental, social and economic, in different ways. Environmental issues in construction cover the use of natural resources, waste minimisation, and energy and water efficiency to avoid a harmful effect on the environment. Social factors encompass taking the stakeholders into account which include employees, suppliers and the community, and economic factors include the construction industry’s contribution to economic growth and employment (Adetunji and Price et al. 2003).

Moreover, the International Council for Research and Innovation in Building and Construction (CIB 2004, p.02) defined: SC as ‘the sustainable production, use, maintenance, demolition, and reuse of buildings and constructions or their
components'; sustainable buildings and built environments as 'the contributions by buildings and the built environment to achieving sustainable development'. Du Plessis et al. (2002, p.8) defined SC as a 'holistic process aiming to restore and maintain harmony between the natural and the built environments, and create settlements that affirm human dignity and encourage economic equity'.

Moreover, SC was defined in the Netherlands as 'a way of building which aims at reducing negative health and environment impacts caused by the construction process or by buildings or by the built-up environment' (CIB 1999). These include minimisation of the use of energy and water, and reduction in waste and pollution over the life span of a project, in addition to the use of land and integration with the natural environment. Further approaches include the efficient use of raw materials, meeting users' needs now and in the future and satisfying healthy indoor environment.

Many countries have drawn up strategies and policies in terms of SC implementation. The UK Government published in May 1999 'A better quality of life – a strategy for sustainable development for the UK'. Due to this, SC has become both an essential and well-understood topic in the UK. Furthermore, the UK government has published a series of policy documents to stimulate the application of SC principles in the construction industry, such as 'Building a Better Life: a Strategy for more Sustainable Construction' published in April 2000 (DETR 2000). This is a key policy that illustrates UK strategies for SC. Moreover, the Sustainability Action Group of the Government Construction Clients' Panel (GCCP 2000) produced 'Achieving Sustainability in Construction Procurement'. Different SC principles are collated in Table 4.2 produced by several scholars.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Sustainable construction principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIYATAKE AND CIB (1996)</td>
<td>Minimisation of resources consumption; Maximisation of resource reuse; Use of renewable or recyclable resources; Protection of natural environment; Creation of a healthy and non-toxic environment; Application of whole life-cycle costing; and Pursuit of quality in creating the built environment.</td>
</tr>
<tr>
<td>OGC (2000)</td>
<td>Re-use existing built assets; Design for minimum waste; Target lean construction; Minimise energy in construction; Minimise energy in use; Avoid pollution; Preserve and enhancing bio-diversity; Conserve water resources; Respect people and their local environment; and Set targets.</td>
</tr>
<tr>
<td>GCCP (2000)</td>
<td>Enhance the quality of life and offer customer satisfaction; Offer flexibility and potential to cater for user changes in future; Provide and support desirable natural and social environments; and Maximise efficient use of resources.</td>
</tr>
<tr>
<td>HAJEK (2002)</td>
<td>Decrease use of raw materials and energy; Optimise consumption of renewable resources; Decrease amount of harmful emissions and waste; and Increase serviceability, durability and reliability over entire life of project.</td>
</tr>
<tr>
<td>HILL AND BOWEN (1997)</td>
<td>Improve quality of human life, including poverty alleviation; Make provision for social self determination and cultural diversity in planning; Protect and promote human health through healthy and safe working way; Establish skills training and capacity enhancement of disadvantaged people; Satisfy fair or equitable distribution of social costs of construction; Satisfy equitable distribution of social benefits of construction; and Find intergenerational equity.</td>
</tr>
<tr>
<td></td>
<td>Social sustainability pillar</td>
</tr>
<tr>
<td></td>
<td>Improve quality of human life, including poverty alleviation; Make provision for social self determination and cultural diversity in planning; Protect and promote human health through healthy and safe working way; Establish skills training and capacity enhancement of disadvantaged people; Satisfy fair or equitable distribution of social costs of construction; Satisfy equitable distribution of social benefits of construction; and Find intergenerational equity.</td>
</tr>
<tr>
<td></td>
<td>Economic sustainability pillar</td>
</tr>
<tr>
<td></td>
<td>Enhance competitiveness by adopting policies and practices that advance sustainability; Choose environmentally responsible suppliers and contractors; and Encourage use of non-renewable resources to meet needs of future generations.</td>
</tr>
<tr>
<td></td>
<td>Biophysical sustainability pillar</td>
</tr>
<tr>
<td></td>
<td>Optimise fossil fuels and minerals; Reduce use of energy, water, materials and land; Maximise resource reuse, and/or recycling; Use renewable resources in preference to non-renewable resources; Minimise pollution to air, land and water at universal and local level; Create a healthy (non-toxic) environment; Maintain and restore Earth's vitality and ecological diversity; and Minimise damage to landscapes including scenic, cultural, historical and architectural.</td>
</tr>
<tr>
<td></td>
<td>Technical sustainability pillar</td>
</tr>
<tr>
<td></td>
<td>Construct durable, reliable and functional structures; Pursue quality in creating built environment; Use serviceability to promote SC; Humanise larger buildings; and Infill and revitalise present urban infrastructure by emphasizing rebuilding mixed-use pedestrian neighbourhoods.</td>
</tr>
</tbody>
</table>
These definitions consider SC as more than mitigation of environmental impacts by introducing social and economic aspects associated with current and future generations. They need to pursue the mechanism and interpretation by which these principles of SC can be implemented at all levels of a project. Publicity is also needed to educate people about these principles by introducing their benefits and drivers to the asset. Doing this may help to shift the thinking of key stakeholders from cost to value, from short-term to long-term, from shareholders to stakeholders and from local to national to international.

The implementation of SC principles needs collaborative work from all stakeholders involved in the production and operation of a project. Figure 4.1 illustrates process by which this collaboration can be achieved.

Figure 4.1: Stakeholders involved in SC (adopted from CIB 1999)
Furthermore, the achievement of SC principles needs complete integration and engagement of all stakeholders in the whole process associated with the life cycle of producing the project. These processes start with extraction of natural resources and end with demolition phases. Figure 4.2 illustrates integrated processes for considering the principles of SC throughout the life cycle of a project.

![Diagram of building life cycle and waste production](image)

**Figure 4.2: Elements of building life cycle and waste production (Crowther 2002)**

### 4.4 THE DRIVERS FOR SUSTAINABLE CONSTRUCTION

This section presents a number of important facts showing why changes in thinking and adopting SC principles in construction practice are called for. The changes should
happen in three interdependent and multidimensional issues as follows: environmental, economic and cultural or social (Pitts 2004). According to the United States Green Building Council (USGBC), Leadership in Energy and Environmental Design (LEED), buildings in the USA constitute 36% of total energy use and 65% of electricity consumption, 30% of greenhouse gas emissions, 30% of waste production and 12% of drinkable water consumption (USGBC 2003).

Manoliadis and Tsolas (2006) outlined fifteen drivers for change to implement SC, which are: energy conservation; waste reduction; indoor environmentally quality; environmentally-friendly energy technologies; resource conservation; incentive programmes; performance based on standards; land use regulations and urban planning polices; education and training; re-engineering the design process; SC materials; new cost metrics based on economic and ecological value systems; new kinds of partnerships and project stakeholders; product innovation and/or certification and recognition of commercial buildings as productivity assets. These drivers should stimulate stakeholders to adopt sustainable design in their construction projects.

Adetunji and Price et al. (2003) outlined the following drivers for change in SC: government policy and regulations, business pressures, stakeholder expectations, increased realisation of the importance of the construction image, branding and reputation, and new client procurement policies. The advantages of implementing sustainability principles into the construction industry are associated with the following three main dimensions (Kats and Alevantis 2003):

4.4.1 ENVIRONMENTAL DRIVERS
Global warming mainly arises from increased levels of greenhouse gases in the atmosphere and leads to climate change. These gases, produced from construction activities, result in an increase in the average temperature of the earth. The average universal temperature has slightly increased over the centuries, but during the twentieth century it rose significantly. Thus, the global records have shown that the highest temperature in the previous 1000 years was in the 1990s. Moreover, in the last three decades, there has been a reduction in the snow and ice enveloping the Northern
Hemisphere by 10 per cent. Furthermore, the average sea level increased by between 10 and 20 centimetres and rainfall rose over continental northern latitudes during the period of the twentieth century, whereas it decreased in subtropical zones (Pitts 2004). The impacts of climate change mean that our homes and offices may be subjected to warmer temperatures, extreme winds, extreme temperatures, tropical cyclone, flooding, sea level increase, high intensity rainfall seasons and solar radiation variations (Branz 2004).

The participants in the UN Framework Convention on Climate Change (UNFCCC) at the Rio Earth Summit consented to stabilise greenhouse gas emissions at their 1990 levels by the year 2000 to alleviate the impacts of global warming. Seven years later, the participants to the UNFCCC at the third Conference (COP3) held in Kyoto, Japan, agreed to significantly cut emissions by reducing 5.2% of greenhouse gasses emissions from 1990 levels during the period 2008 to 2012 (Edwards 2005). Moreover, environmental drivers exist in the improvement of air and water quality, minimization of energy and water consumption and reduction of waste disposal (Kats and Alevantis, 2003).

4.4.2 ECONOMIC DRIVERS

The construction industry is a major contributor to the economy through creating millions of employment opportunities and making a considerable contribution to GDP in many countries. The economic aspect is associated with economic performance and human behaviour towards scarce resources. The fundamental economic problem is that goods and services are generally in short supply. Scarcity exists whenever demand exceeds supply. Economic drivers reduce operating and maintenance costs and increase revenue including sale price or rent (Kats and Alevantis 2003). Moreover, it is increasingly difficult for organisations that do not espouse sustainable principles to attract employees, clients and suppliers. Adopting SC is also a business distinguisher and has played a big rule in winning new work in the construction industry (Leiper et al. 2003).

Furthermore, achieving SC principles will produce buildings, with lower embodied energy and harmful emissions that use reusable, renewable, recyclable and repairable
resources, and that use water and energy more efficiently. This will increase the demand for such practitioners including constrictors, designers, consultants and suppliers, in addition to increase marketing and promotional opportunities associated with sustainable building (Ashe 2003). Hayles (2004) stated that the adoption of SC principles delivers better long-term value to the built environment and its occupants.

The main economic drivers of adopting SC principles are the enhancement of property performance and durability as a result of the maintenance and operation costs for the duration of the life cycle of a project. Implementing SC principles can also provide superlative living and working places resulting in increasing the productivity of employees who work in the resulting buildings. However, the misperception of an increase capital cost and shortage of precise market value may discourage both developers and constructors (Zhou 2003).

4.4.3 SOCIETAL DRIVERS

Many strong proofs of economic drivers come from good relationships with clients, the local community and other stakeholders. This enables the creation of sustainable properties and entails these strong factors of robustness. Integrating corporate social responsibility within the strategies of organisation can assist in achieving this robustness and consequently SC (Randles and Price 2004). Robustness elements are: financial strength; competitiveness; employee loyalty and competence; and external recognition (Nattrass and Altomare 2001). The benefits of being socially responsible are recapitulated by Hopkins (2003) as follows: improving reputation among staff and customers; improving productivity through increased innovation and efficiency; increasing shareholder value as social investment funds target the company; expanding the customer base without risking losing existing customers; improving motivation and involvement of staff; enhancing recruitment of fresh young employees; and increasing personal satisfaction of management. Health and community drivers involve enhancing occupant comfort and health, and minimising absenteeism, turnover rate and liabilities (Kats and Alevantis 2003).
4.5 THE ENABLERS FOR SUSTAINABLE CONSTRUCTION

The implementation of SC in developing countries depends upon two important issues: firstly, the creation of a competent and workable construction sector; and secondly, the capability of this sector to meet the demands that sustainable development places on its activities. This can be achieved by the cooperation of all the different stakeholders to implement a patent plan that includes specific duties of all the keys players, in addition to the development of a number of enablers (Du Plessis 2007).

Du Plessis et al. (2002) identify three interdependent enablers, namely, technological, institutional and value-system enablers. These issues depend on local human needs and both local and global environmental limits. The development of a value system is driven by those issues that determine the most appropriate method of dealing with the relationship between meeting human needs and protecting the unity of the earth’s ecosystem. The relationship between these issues is illustrated in Figure 4.3.

Figure 4.3: A strategy for enabling SC (Du Plessis 2007)
4.6 THE CHALLENGES FOR SUSTAINABLE CONSTRUCTION

The construction industry is one of the main users of natural resources especially in developing countries. The challenges for the construction industry in these countries are to deal with the development difficulties of adequate dwellings, rapid urbanisation and shortage of infrastructure and how to do this in an acceptable way in terms of following social and ecological principles (Du Plessis 2007). The following practical challenges are associated with three groups of people (Parkin et al. 2003):

- those who work for the construction industry, using energy and extracted or recycled materials and generating waste while also struggling to set up a green and ethical corporate reputation;
- those who work for owner organisations that are commercial operators or work within budgets, but who also report on their sustainability indicators and triple bottom line (environmental/economic/social) performance; and
- those who work for in-house engineers or consultant firms assisting in producing plans and designs for construction projects while manufacturing clever materials and clean technologies and incorporating life-cycle and risk assessment.

The activities of the above mentioned people cover an extensive area of the construction industry, e.g. from flood alleviation works to water engineering schemes in drier countries. There are also roads, airports and power plants, also planned on environmental principles but sometimes controversial in terms of whether or not they are part of long-term, sustainable strategies such as transport or energy. In the meantime, the responsibilities for engineers are to endeavour to:

- be prepared for new challenges when political constraints are released, for example, to plan how to construct new nuclear power stations on the same site as partially decommissioned ones;
- prove that, in the same example, nuclear waste can be stored and monitored safely and precisely underground;
• convince clients, governments and the general public of the importance of adopting and implementing SC principles; and

• rationalise the misperception that the implementation of SC principles frequently needs additional cost.

Moreover, one major challenge for achieving sustainability is to promote responsible consumption and production approaches and to decrease waste and over-dependence on natural resources (Griffiths et al. 2003). The target of better resource sustainability requires diminution in the life cycle of a project. The following challenges to achieving SC principles are considered influential.

• The lack of a coherent approach to improve resource productivity.

• The lack of a mechanism for producing consistent and robust data on resource use in the industry.

• The culture, fragmented nature of the industry teams forming for short periods, divisions between the trades and diversity of stakeholders, in addition to its rigid specifications and client reluctance to share the burden, financial support and rapidity of construction are all regarded as major obstacles to adopting and achieving SC principles (Adetunji and Price et al. 2003).

4.7 THE HISTORY OF SUSTAINABILITY IN SAUDI ARABIA

There is scarcity of literature addressing sustainable development in general and SC implementation in particular in Saudi Arabia. A few publications highlight environmental policies and their history in the country. Al-Gilani and Filor (1997) reviewed the Saudi government's attempts through policy documents which include the administrative structure and decision making process with regard to environment protection. In a later paper, they also proposed improving the current national framework for environmental policies in Saudi Arabia (Al-Gilani and Filor, 1999). The suggested framework comprises four areas: political culture and the public role; environmental decision-making procedures; environmental policies and laws; and new institutional structure (ibid).
Thereafter, Alshuwaikhat and Aina (2004) suggested a framework for achieving sustainability principles in Saudi Arabia at the municipal level. They also proposed developing Strategic Environment Assessment (SEA) to start from the level of the Ministerial Committee on the Environment (MCE) and the Preparatory Committee for the Ministerial Committee on the Environment (PCMCE). The second level of the framework covers the most important ministries, such as the Ministry of Economy and Planning (MoEP) and Ministry of Municipal and Rural Affairs (MoMRA). The framework at the ministry level should be broadly sectoral, with the exception of MoEP and MoMRA, which have a mandate for regional planning. The final level is the municipal level and the Presidency of Meteorology and Environment (PME) which needs to be more equipped to conduct Environment Impact Assessments (EIA) at the project level in compliance with the SEA process.

Alshuwaikhat and Aina (2005) subsequently appraised the incorporation of environmental assessment into the municipal planning process and planning documents. The study findings were that: the implementation of environmental assessment at the municipal level was minimal; there was a lack of experience in the sustainability assessment of planning documents; and sustainability principles had yet to be entirely integrated into the planning process. Al-Yami and Price (2005) explored the conceptual linkages between VM and SC, concluding that VM could be an effective vehicle for implementing SC principles in the country.

4.8 SUSTAINABILITY AGENCIES IN SAUDI ARABIA

During the last decade, the Saudi government has given significant consideration to protecting the environment, conserving biodiversity and natural resources and providing a better quality of life. It has contributed significantly to sustainable development, through the initiation of a number of regulations, policies and reports by relevant agencies that are playing major roles in achieving sustainability principles in the country (MoEP 2006). These agencies and their roles are shown in Table 4.3.
<table>
<thead>
<tr>
<th>N</th>
<th>Agencies</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The Presidency of Meteorology and Environment (PME)</td>
<td>Protecting environment at the national level: the PME and other relevant agencies are jointly accountable for implementing and monitoring sustainable development.</td>
</tr>
<tr>
<td>2.</td>
<td>The National Commission for Wildlife Conservation and Development (NCWCD)</td>
<td>Preserving both terrestrial and marine wildlife, along with maintaining ecological balance and bio-diversity in addition to conservation of environmental and natural resources</td>
</tr>
<tr>
<td>3.</td>
<td>The Ministry of Agriculture (MoA)</td>
<td>Maintaining pasture, forestry, animal resources and fisheries, as well as the establishment of national parks.</td>
</tr>
<tr>
<td>4.</td>
<td>The Ministry of Water and Electricity (MoWE),</td>
<td>Managing and sustaining water resources, the sewage system and the generation of power.</td>
</tr>
<tr>
<td>5.</td>
<td>The Ministry of Petroleum and Mineral Resources (MoPMR)</td>
<td>Managing and sustaining mineral and oil industries.</td>
</tr>
<tr>
<td>6.</td>
<td>The Ministry of Municipal and Rural Affairs (MoMRA)</td>
<td>Providing urban services with respect to environmental health, waste management, cleaning of cities and landscaping.</td>
</tr>
<tr>
<td>7.</td>
<td>The Ministry of Health (MoH)</td>
<td>Managing and eliminating medical waste.</td>
</tr>
<tr>
<td>8.</td>
<td>The Ministry of Interior (MoI)</td>
<td>Checking and periodically inspecting vehicles to enforce measures with respect to reducing air pollution that results from vehicles exhaust fumes.</td>
</tr>
<tr>
<td>9.</td>
<td>The Ministry of Culture and Information (MoCI)</td>
<td>Raising environmental awareness by conducting campaigns.</td>
</tr>
<tr>
<td>10.</td>
<td>The Saudi Arabian Standards Organization (SASO)</td>
<td>Setting standards and specifications as to environmental protection and elimination of pollution.</td>
</tr>
<tr>
<td>11.</td>
<td>The Royal Commission for Jubail and Yanbu (RCJY)</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>King Abdulaziz City for Science and Technology (KACST)</td>
<td>Sharing specific environmental concerns with other agencies.</td>
</tr>
<tr>
<td>13.</td>
<td>Saudi Aramco</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Saudi Arabian Basic Industry Company (SABIC)</td>
<td></td>
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</table>
4.9 THE SAUDI ACHIEVEMENTS IN SUSTAINABLE DEVELOPMENT

The Saudi Government has taken an active role in initiating sustainable development during the Seventh Five-Year Development Plan (2000-2005). Agenda 21 issued at the 1992 Earth Summit in Rio as the international blueprint for sustainable development, was approved by the Saudi Government in December, 1994. Consequently, a number of environmental targets were accomplished such as reducing the level of pollution, controlling desertification, creating environmental information network, adopting a coastal management plan and conserving national wildlife.

Moreover, the General Environmental Regulations were enacted in October, 2001 and the executive by-law was enacted in September, 2003; this led to the appointment of the Presidency of Meteorology and Environment, the main agency responsible for the enforcement of environmental regulations in coordination with other appropriate agencies. Moreover, Saudi Arabia joined the following international environment conventions during the Seventh Five-Year Development Plan (2000-2005): the United Nations Framework Convention on Climate Change (UNFCCC); the supplement of Kyoto Protocol which was approved in January, 2005; the United Nations Bio-Diversity Convention; and United Nations Desertification Control. The PME is coordinated with related agencies which embark on the implementation and follow up on a number of environment conventions associated with their duties. These include: the Basel Convention on the Control of Transboundary Movement of Hazardous Waste; the Vienna Ozone Layer Protection Convention; and the Montreal Protocol on substances that deplete the ozone layer Agreement (Ministry of Economy and Planning 2006).

Furthermore, the Saudi Government is preparing an outline of the National Strategy for Health and Environment, the National Environment Strategy, the National Action Programme for Desertification Control, the National Strategy for Biodiversity, the National Forestry Strategy and the National Plan for Management of Coastal Regions, all national environment strategies and their related regulations. The Saudi Government has also enacted water resource conservation and consumption rationalisation, and sewage water recycling regulations. In the meantime, the Ministry of Water and
Electricity has been updating its water resource studies as part of the National Water Plan (MoEP 2006).

Accordingly, the Ministry of Municipal and Rural Affairs has issued a circular in terms of water resource conservation to all its branches and consultant firms. It informs them that it is mandatory for all new construction projects and area development planning to be designed to use conservative plumbing equipment in line with the new Technical Saudi Standards and Codes, so as to maximise water-efficient use. Licenses for starting the construction in these projects will not be issued and all services such as water supply and electricity will not be connected for these projects and areas until the relevant standards and requirements have been met (MoMRA 2006).

4.10 SAUDI NATIONAL STRATEGY OF SUSTAINABLE DEVELOPMENT

The Eighth Five-Year Development Plan (2005-2010) was drawn up with a broad strategic vision of the economy and development geared to accomplishing sustainable development. The main objective is to satisfy the material, cultural and spiritual needs of people in addition to their health and quality of life. The objectives of the development strategy are to achieve sustainable development and eliminate any negative impacts on natural resources, the quality of life or public health, while protecting the environment against harmful activities and practices. This section highlights the objectives, policies and targets of environmental operations during the Eighth Five-Year Development Plan (MoEP 2006).

4.10.1 Objectives

The objectives are as follows.

- Protecting the environment against pollution.
- Improving the quality of life and public health.
- Achieving sustainable development through a closer harmony between human activities and the protection of natural resources; this involves the conservation
of non-renewal natural resources in addition to searching for alternative resources.

- Developing and protecting wildlife to ensure their sustainability.

4.10.2 Policies
The policies are as follows.

- Enhancing the efficiency of protective mechanisms to protect the environment and conserve natural resources.
- Reassessing and updating environmental standards.
- Enhancing databases of the weather, climate and the environment.
- Enhancing the role of the private sector in the protection of the environment, natural resources and wildlife conservation, and especially the adoption of "green" materials and environmentally friendly processes in industry.
- Developing the institutional capacities of the environmental agencies.
- Introducing sustainability awareness issues into school curricula and the media.

4.10.3 Targets
The targets are as follows.

- Conducting studies on the environmental effects of new factories as part of licensing requirements.
- Updating air, soil and groundwater databases as well as surface and coastal water pollution standards.
- Spreading environmental awareness programmes.
- Stimulating the formation of environmental protection societies in all regions of the country.
- Strengthening inspection of the environmental status of existing industrial establishments to ensure compliance of new industries with environment protection requirements.
• Broadening the meteorological monitoring network to cover the entire Saudi territories.

• Reassessing and modifying school curricula to cover environmental and awareness issues starting from primary schools.

• Coordinating with the Ministry of Culture and Information for preparing shows, programmes and TV serials that focus on environmental issues, as well as providing coverage to regional and international environment news and issues programmes.

4.11 SUMMARY

SC is about realising a balance between three issues: economic growth and progress, natural resource conservation and social equality promotion. Sustainable development is thus about minimising the negative impacts whilst improving the environment to ensure a better quality of life for the current and future generations. It implies using renewable natural resources in a way which does not eradicate or degrade them. It also implies using non-renewable natural resources at a rate slow enough to ensure an orderly societal transition to new alternatives.

The Saudi government has made significant efforts towards protecting the environment by introducing a number of regulations and policies and by participating in a number of global conventions over the past few years: general environmental regulations and rules for implementation have been issued and approved; climatic research and reports have been produced; meteorological, environmental and air pollution measurements are being conducted; and the implementation of sustainable development is handled by collaboration between a number of ministries and agencies in the public and private sector. The Saudi government has also signed a number of international environmental protection conventions. The next chapter presents conceptual linkages between VM and SC. It attempts to connect both subjects to each other in terms of achieving whole life value or the best value in the project. It also highlights the capability of VM to implement SC principles at strategic level of construction projects.
CHAPTER FIVE
CHAPTER 5
CONCEPTUAL LINKAGES BETWEEN VALUE MANAGEMENT AND SUSTAINABLE CONSTRUCTION

5.1 INTRODUCTION

The adoption of SC principles and Value VM is both nationally and internationally requested all over the world, and its adoption keeps the users and/or occupants more healthy, productive and happy. It can also encourage retention and reduce absenteeism. Moreover, sustainable projects tend to be more efficient with resources and use better quality and environmentally friendly materials; they can foster crime prevention, natural resources and energy conservation, and waste minimisation. They also produce better interior spaces, better natural lighting and ventilation and greater flexibility in space layouts. All these attributes have a positive impact on occupant performance and satisfaction; in addition they tend to have less impact on the environment. As SC brings these values to projects, VM can be used to maximise the values (Addis and Talbot 2001).

This chapter aims to highlight the conceptual linkages between VM and SC. It also aims to cover previous research which incorporates both subjects. It has been established that VM and SC have strong linkages and relationships in terms of their application and aims in construction projects. The literature review generally revealed that there was scarcity of materials that deal with the combination of VM and SC, with the exception of a number of publications presented at a number of conferences held by the Institute of VM in Australia and Hong Kong, in addition to SAVE International and few journal papers. These publications generally address the importance of VM in enhancing SC value and promoting VM (Barton 2002; Schneider 1999) and the intrinsic value of VM to spread and implement SC principles (Yeomans 2002; Barton et al. 1999). Furthermore, some of these publications state that the incorporation of VM and SC
would enhance their reputation and consequently increase their demand (Fong 2003; Schneider 1999).

5.2 APPLICATION OF VM AND SC DURING BRIEFING

It has been established from the study findings that the best time for applying VM and SC is at the earliest stages of a project. The strategic objectives are attained by thinking of SC as making design decisions and technical alternatives. A multidisciplinary approach is necessary to integrate all the analytical appearances in these objectives (Maffei and Boccaccini 2007). The Federal Facilities Council (FFC) strongly advocates using VM and WLCC analyses in the conceptual planning, design and construction phases to achieve SC principles. The FFC further encourages clients to pay significant attention during the conceptual planning and design phases where the capability to influence the considerable cost of the project is the greatest; this can be translated into the application of value methods earlier in the planning and design process (Kirt and Dell'Isola 2004).

The development of the brief is a substantial activity in the project development process. In the UK construction industry, there is a strong concern that the briefing continues as a weakness in the construction process (Barrett et al. 1999). Latham (1994) stated that the brief needed improvement as well as strong intervention and great care from the key stakeholders to meet the client and user satisfaction and requirements. The briefing process splits into two main stages: strategic briefing and project briefing. Strategic briefing sets out the client’s vision and overall objectives of the project, and provides an opportunity to test them against the SC criteria (CIRIA 2001). The project brief translates the strategic brief into construction terms and alternatives in terms of SC principles, environmental performance, social impact of the project and economic affordability (Halliday 2007). The design brief, technical brief, etc. can form further sub-sets of the project brief (CIRIA 2001).

Kao (2003) stated that “an alternative perspective is needed to introduce and cover social and innovative matters into the briefing process in order to achieve a full
understanding of client requirements"). It is understood that briefing has moved on from compiling data and information associated with the client's requirements to understanding the client's requirements and needs through a social learning process.

The VM service, tools and techniques may address each of the variables identified provided the method is used properly and by an accredited facilitator. In terms of projects, VM is a project orientated service which relies on clear objectives being set for the workshop to allow for an agenda to be set which will improve project performance. VM is most effective when applied to a project with clearly defined goals and start and completion dates. It also relies on a project team getting together for a workshop to discuss the project and add value in any way possible to the project. How this team performs will depend on the dynamics of the team and their ability to share and transfer knowledge. In addition, VM can improve communication and understanding of the client, consultants and stakeholders; this is the essence of briefing (Yu and Shen 2005).

5.3 DEVELOPMENT OF A DYNAMIC BRIEF DEVELOPMENT

Othman et al. (2004) stated that limiting the development of the project brief to a certain stage decreases the ability of the interaction between the client and the designer. It also hinders the incorporation of the influential internal and external factors that may have an effect on the project. Although the repeatedly adverse impact of change orders on project cost, time and quality, literature review and case studies confirmed that client organisations continue using change orders to realise their expectations and augment their projects' performance mainly because existing construction management procedure in stills an expectation that, change after a specified point is in some way outside the project brief rather than part of the incomplete development of that brief. The authors introduced the concept of dynamic brief development (DBD), a method that meets client satisfaction by adapting the brief developing factors for the benefit of the project and meeting the desire to manage project change orders. This concept of DBD would facilitate the incorporation of these variable demands and relies on the following four essential principles.
The briefing process can be deemed as an ongoing process throughout the project life cycle.

The project brief can be considered as in progress document continually developing and adapting in an innovative manner to the powerful internal and external drivers for the benefit of the project.

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.

It is very important to develop a system to manage the brief developing drivers as early as possible.

They also investigated the current theory on briefing development to produce a system to overcome all the current deficiencies and problems. They identified the factors that drive the need to change to develop an innovative brief. They identified 30 drivers for brief development and categorised them to 13 groups. They emphasised on the necessity for the client organisations and construction professionals to pay attention to these drivers during the project life cycle to satisfy client satisfaction and expectation.

Othman et al. (2005) examined these drivers in-depth through 261 survey questionnaires, 47 structured interviews and a brainstorming session with 12 clients. The main results concluded from the data analysis are as follows:

- There was a need to continue developing the project brief throughout the project life cycle.
- The dynamic brief development should concentrate on accomplishing client satisfaction, responding in an innovative manner to the different brief developing drivers and managing project change orders.
- There is a need to identify specific points through project life cycle (milestones) where the brief development processes carried out that can be evaluated and performance feedback undertaken.
- The interview feedbacks confirmed that there was no broadly 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 improve the project performance.

- The brainstorming exercise found 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.

They concluded that there is a need to embark on a detailed brief development management system that includes both value management and risk management. The proposed system should enable the suitable project participant make informed decisions at the correct time for the benefit of the client. The system must ease feedback to both client organisations and construction professionals to facilitate lessons to be learned in order to improve the briefing process for future projects.

Othman et al. (2006) developed Value and Risk Management Protocol (VRMP) as innovative decision making tool to manage dynamic brief development in construction projects. They applied the protocol on real case studies showed that it consumes time and has a large amount of information that needs to be managed. They overcame these limitations, and facilitated the use of the protocol and raise its efficiency. They presented it as a computerised version of the VRMP called the Brief Development Manager (BDManager) prototype software.

5.4 CAPABILITY OF VM TO IMPLEMENT SC

VM can be a vigorous and effective analytical methodology with a flexible and multidisciplinary team, which can be applied in a great variety of situations. VM can also leverage, accelerate and amplify efforts to implement SC principles into the construction projects. It does not leverage SC efforts only, but also identifies the weak areas that need improvement and monitoring. SC, on the other hand, while not specifically an analytical approach, brings to bear a group of fundamental sustainable principles and practices that, in the right context, can significantly transform a project’s nature, people productivity, organisation profitability, and client relations.

Yeomans (2002) stated that VM can be used as a vehicle for achieving SC during its application at early stages of a project. He continued that VM is a reliable means for creating visions of a new direction and obtaining objectives towards a base of desired
output including formulating policy. He also maintained that the application of VM principles into strategic planning is paramount to create a vision, establish measurable goals and put strategies in place. Moreover, he emphasised the significance of Function Analysis which distinguishes needs from wants and helps to very quickly and collaboratively shape fundamental objectives.

Austin and Thomson (1999) stated that the integration of VM might facilitate collaboration between organisations throughout project design and construction, especially where VM is considered as a familiar technique in the construction industry. VM can be used to realise SC through VM in the construction industry (Schneider 1999; Barton et al 2000; ZainulAbidin and Pasquire 2005). The nature of the VM workshop can significantly help to spread the knowledge of SC among the team members and other stakeholders through the facilitator or sustainability advisor/consultant; or through sharing the experiences between the participants (ZinulAbidin and Pasquire 2003).

Yeomans (2002) declared that VM is a dependable approach for creating visions of a new way and purifying objectives towards a platform of desired findings, including formulating policy. Function Analysis is the most important tool to refine needs from wants. It also helps to identify very quickly and cooperatively fundamental objectives of the project. The same VM methodology can be applied to similar themes and needs within SC initiative. The findings of the research study concluded that VM is a powerful tool for delivering and promoting sustainable issues in a project.

VM possesses a number of techniques and characteristics that can support the implementation of SC such as multidisciplinary teamwork, forums for all stakeholders to exchange ideas and thoughts, Systematic Job Plan to adopt SC schema, and specific tools and techniques to facilitate decisions-making. In addition, it can identify and solve problems through its strategic timing application during the early stages of a project and its aptitude to eliminate unnecessary costs. However, VM has certain weaknesses such as: time limitation, cost, and the team need to have knowledge and experience in both subjects and high level skills. Although VM has few limitations, its strengths can not be
ignored. ZainulAbidin and Pasquire (2003) stated that VM can be a good vehicle to deliver sustainability and stimulate wider attention to this field in the future.

The use of both soft and hard VM tools and techniques in the structured job plan will consider the impact of new and current buildings in terms of achieving SC principles which will immediately influence the inputs, development and outputs to ensure achieving 'best value' solutions in the project (Hayles 2004). Soft VM (SVM) techniques are most highly used in the early project stages when the project is not completely defined to reach consensus with stakeholders (Dallas 2006).

SVM is specifically designed to deal with difficult 'unstructured' problems experienced in project initiation, whereby many stakeholders are involved in the course of action and high-level facilitation skills are vital to its accomplishment (Barton 2000). It derives from the body of knowledge known as 'group decision support' which is defined as 'any process that supports a group of people seeking individually to make sense of, and collectively act in, a situation in which they have power' (Bryant 1993).

Integrating themes early in the VM Job Plan, all processes such as Function Analysis, ideas evaluation and development are considered as powerful tools and can be used to help meet the objectives of the project. Table 6.1 illustrates the strengths and limitations of VM as a means to accomplish and incorporate SC principles within its process (ZinulAbidin and Pasquire 2003).
Table 5.1: Strengths and limitations of VM to integrate SC (ZinulAbidin and Pasquire 2003).

<table>
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<tr>
<th>Strengths</th>
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<tr>
<td>Multidisciplinary teams;</td>
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<td>Different skills and techniques to build knowledge of SC;</td>
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<tr>
<td>Structured and systematic Job Plan to deliver SC;</td>
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<td>Creativity phase generates sustainable options and avoid initial idea that springs to mind;</td>
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<tr>
<td>Function analysis can be used to identify &amp; understand the project and use sustainable dimensions as project functions;</td>
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<tr>
<td>The VM tools and techniques help decision-makers to take correct and suitable actions;</td>
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<tr>
<td>The critical timing of VM provides significant positive effects on whole project delivery;</td>
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<tr>
<td>VM is applied in a successive manner which enhances and monitors SC process;</td>
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<tr>
<td>VM can be used as quality assurance to monitor sustainable principles;</td>
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<tr>
<td>VM proposals are based on cost-effectiveness and considered sustainability dimensions could be used to persuade clients’ attitude in future;</td>
</tr>
<tr>
<td>Potential to reduce the project whole life-cycle cost, even if it contains sustainable principles, through eliminating unnecessary cost; and</td>
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<tr>
<td>Facilitator helps to guide the process and its members.</td>
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<th>Limitation</th>
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<tr>
<td>Time restriction;</td>
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<td>Client commitment is a necessary to promote SC;</td>
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<tr>
<td>VM fees implementation for each workshop may decrease the number of workshop in projects;</td>
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<tr>
<td>It needs the team members to have knowledge on both topics, VM and SC.</td>
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5.5 VALUE PERSPECTIVE

The application of VM and SC aims to achieve value for money in a construction project. SC is associated with delivering better long-term value for clients, users and other stakeholders. It means balancing value, risk and waste within project parameters, taking into account factors such as land use, materials selection, construction methods, regeneration and community needs.

The consideration of sustainable principles in construction projects requires a shift away from tradition standpoints: from short term to long term; from shareholders to stakeholders; from product to service; from local to global; and from cost to value.
In BS EN 12973 (2000) value is portrayed as the relationship between the satisfaction of need and the resources used in achieving that satisfaction, therefore, higher value is achieved with lower resource use and/or higher satisfaction of needs.

The sustainable decision making involves professional judgment and vision to distinguish between capital and operational expenditure. The vital objective is to maximise value for all capital invested for the client. VM plays a significant role in managing value to meet its goals. It can provide the networking required for improving coordination and communication. In other words, VM facilitates management of both value and costs (Dell'Isola 1997). The derivation of a measurable statement of quality to achieve client value system can be represented by environment, exchange, politics/community/popularity, esteem, flexibility and comfort (Male and Kelly 2006).

VM is effective in many areas of the construction industry and can be used at different stages in the life of a building project. VM can also be applied with flexibility, and creativity to indicate areas of potential saving and value enhancement that have not been revealed or readily discovered. Often, VM can generate significant funds in initial installation and operating costs (Dell'Isola 1997). It is not only a management approach for the construction industry in the 90s; it is also one of the best techniques for producing best results in achieving value for money for the client (Fong 1996).

Using VM can result in improved profit and will continue to pay increased dividends to shareholders for years to come (Dell'Isola 1997). Isaacs and Kurtz (2004) stated that 'VM is a process that can be used to evaluate the functionality of any project, process or system. If you choose to apply it to first cost, it works great. If you choose to apply it to the sustainability elements of a project, it also works great. Choose the goals and let the VM process and the facilitator do the rest'.

5.6 TRIPLE BOTTOM LINE (TBL)

Yeomans (2002) mentioned that VM has an essential role in realising the Triple Bottom Line (TBL) and moving: from theoretical to practical; from clarification to consensus;
and from machinations to mechanisms. The accomplishment of the TBL is very important to enhance economic living standards whilst increasing the overall quality of life for present and future generations. The only principle that continues consistent, in business and government dynamic changes, is the bottom line. The concern of value practitioners is the adaptation of the value methodology to satisfy these ever-changing requirements, particularly during integrating perceived “premium” factors such as sustainable or “green” techniques into design and construction (Koga and Lehman 2005).

Yeomans also stated that VM is possibly the most robust mechanism to accomplish the Triple Bottom Line in terms of defining social, environmental and economic values in any given project context, and ultimately delivering the equity of society, environment and economics. He deemed VM much "softer" in its application and capable of being applied to virtually any product, project or process; he also suggests that it may be less money-driven than its predecessors.

Kirt and Dell'Isola (2004) showed that value specialists have an outstanding chance to positively participate in greening the United State of America. They are already responsible for considerable cost savings to government and corporate America. Nowadays many clients request the provision of sustainable solutions that are not only cost-effective but mitigate negative impacts generated by these projects to the environment and people through saving water, energy, land, money and materials.

The focal point of value specialists can be “green within the green” by looking for environmentally friendly sustainable solutions that are cost-effective and which enable the clients to gain a green solution throughout the cost effective Whole Life Cycle Cost of a building. Value specialists need to build their knowledge and experience to become familiar with sustainability, Whole Life Cycle Cost, and checklists such as “LEED” to identify sustainable options for project consideration. Function Analysis assists in defining the drivers which can be consequently prioritised and rationalised to enable all of the TBL ingredients to be placed into the mix and to ensure a balanced outcome for each different stage (Yeomans 2002).
5.7 DIFFERENT PERCEPTION TOWARDS VM AND SC

VM has been a crucial technique for architects and designers to implement most design projects within specified budgets, however, some practitioners perceive that VM has been used in opposition to achieving sustainable design principles. They contend that VM studies just take into account initial costs and avoid consideration of SC principles such as minimised Whole Life Cycle Cost, environment impacts and social aspects including community incorporation (Grahl 2007).

This practice may happen in some projects where VM has been applied incorrectly by inexperienced people who are not trained or certified, according to Mike Doleac, who is technology VM director at CH2M Hill in Seattle and has facilitated more than 200 VM studies in the last 30 years. He possesses significant experience in applying the VM process to satisfy a variety of objectives including sustainability goals. He claimed that “VM can be used for any number of goals: for focus, including first costs, Whole Life Cycle Costs, environmental impact concerns and occupant productivity”.

In actual fact, using VM principles in a sustainable design project can essentially increase maximisation of both the sustainability and functionality of the project (Grahl 2007). Moreover, the VM process fosters an environment of teamwork among the team members, helps them to understand the difficult interactions between building elements, and supports obtaining consensus decisions to come up with the best building components to include in the overall design (Grahl 2007). ZainulAbidin and Pasquire (2003) confirmed that the consideration of SC is already inbuilt in the VM workshops but the level of consideration differs from one workshop to another. They also identified the potential barriers for the integration of VM and SC and suggested suitable solutions that might overcome these obstacles. In addition, they confirmed that the implementation of sustainability during VM is viable and advisable.

Isaacs and Kurtz (2004) claimed that VM involves financial modelling using Whole Life-Cycle Cost and any tax incentives available. In essence, the VM workshop is supported by direct involvement of the clients, which results in the generation and agreement of evaluation criteria of the project elements. Moreover, the use of VM
toward sustainability provides a brand new spotlight on this premise. It is also obvious that VM techniques and the multidisciplinary approach are constructive in managing every difficult segment, but the value index, in particular, could be a momentous method for achieving sustainability issues (Maffei and Boccaccini 2007).

5.8 THEORETICAL CONCEPT FOR INTEGRATING SC INTO VM

Zainulabidin and Pasquire (2007) developed a theoretical concept for the integration of sustainability issues into VM to encourage clients to consider the sustainability principles in their projects. They stated that VM is a well-known technique conducted to assist in decision-making, which seizes strategic characteristics to integrate sustainability dimensions into construction projects. They also mentioned that though VM has many fundamental aptitudes, which amplify its prospects as an instrument to deliver sustainability, the integration has not yet been entirely exploited by the practitioners.

The authors illustrated the synchronisation of required activities in a VM workshop to support sustainability needs in Figure 5.1. They also portrayed the essential tasks at pre-workshop and post-workshop in Figures 5.2 and 5.3, which are adapted from the VM procedure presented by Male et al (1996). Figure 5.1 illustrates the three stages of VM workshop: input of sustainability at the pre-workshop stage, processing sustainability at the workshop stage and output of sustainability at the post-workshop stage. Figure 5.2 illustrates the mechanisms that should be followed to improve the awareness of sustainability at the pre-workshop stage. Figure 5.4 illustrates sustainability processing at the workshop stage by showing the required tasks associated with sustainability consideration in the VM process.
Figure 5.1: Three effects of sustainability integration in VM (ZainulAbidin and Pasquire 2007)

Figure 5.2: Improving sustainability awareness at pre-workshop stage of VM (ZainulAbidin and Pasquire 2007)
5.9 PROPOSED STRUCTURAL MODEL OF INTEGRATION

Zainul-Abidin and Pasquire (2007) developed a structured model for integrating sustainability dimensions into VM, as illustrated in Figure 5.4. They demonstrated the suitable stages of raising sustainability principles to be considered in a project within VM. This model proposes that sustainability issues should be introduced to the clients at the pre-workshop stage and should be discussed in combination with the clients’ value drivers. They claimed that the aspects that have gained client’s interests will be treated as part of the client’s needs and then brought into the VM workshop to be integrated into the Function Analysis. The model delineates a suitable way for bringing sustainability aspects to the attention of the clients and VM participants. The model proposed when the decision is made on sustainability, before the workshop takes place and at early stages of design, will influence the rest of the VM process in the project design and affect the extent of sustainability principles considered in VM.
Figure 5.4: The structure model for integrating sustainability into VM (ZainulAbidin and Pasquire 2007)
5.10 SUMMARY

This chapter has explored conceptual linkages between VM and SC. It has also reviewed previous work that has been done for the incorporation of both topics for achieving best value in construction projects. This chapter has concluded that there were a number of studies and publications that have been done in the two areas. They confirm that the two topics can be integrated as a hybrid framework to produce mutual benefits and promotions to VM and SC. On the one hand, VM will spread SC knowledge among the study and design team as well as other stakeholders which will enable them to consider SC principles implementation in their construction projects; on the other hand, the integration will also promote VM, and enhance the skills and knowledge of value specialists and their practitioners. It will also increase the demand for the application of VM in the construction industry.

A number of studies have stimulated this integration and have confirmed that VM can be used a useful vehicle to accomplish SC implementation into the construction industry. However, there is no a comprehensive methodology or framework showing in detail how this integration can be achieved and illustrating the useful and suitable techniques that could be used to incorporate both subjects in creating a sustainable design. Therefore, further research needs to be done to bridge the gaps discovered in the study. An inclusive and facilitated integrated approach to VM and SC is needed to achieve multiple sustainable values in projects. The next chapter aims to investigate in-depth the current situations and practice of VM and SC in Saudi Arabia. It also aims to indentify any barriers that could hinder its implementation, and to establish solutions to overcome the challenges.
CHAPTER SIX
CHAPTER 6
EXPERTS INTERVIEWS AND CASE STUDIES IN SAUDI ARABIA

6.1 INTRODUCTION

This chapter aims to investigate in-depth the current situation relating to VM and SC in the Saudi construction industry to satisfy the following objectives.

- Investigate VM in the Saudi construction industry in terms of: the application of VM; clients' attitudes towards VM; barriers to implementation; identification of enablers that could overcome the barriers and improve its implementation; and determination of the level of existent knowledge about VM the Saudi construction public sector.

- Investigate SC in the Saudi construction industry in terms of: the application of SC; clients’ attitudes towards SC; identification of barriers to implementation; identification of enablers that could overcome the barriers and improve its implementation; and determination of the level of existing knowledge about SC in the Saudi public sector.

-Ascertain the current situation of VM and SC in the Saudi public sector in terms of procurement methods strategies, policies associated with its implementation.

- Define and adapt valid SC principles to be applied within the Saudi construction industry.

6.1.1 DATA COLLECTION AND ANALYSIS

The data used in this chapter were obtained through semi-structured interviews with twelve experts working in or possessing significant experience in the Saudi construction public sector. The interviews each lasted between 55 minutes and 2:32 hrs. Table 6.1 illustrates the log of each interview respectively. The interviews combined qualitative and qualitative approaches. The form used in interviews comprised three sections: expert information, VM assessment and SC exploration. It was designed to obtain a
complete picture of current practice and the situation of VM and SC, to satisfy the objectives of the research mentioned in Section 6.1. This form is illustrated in Appendix B.

Table 6.1: Interview log (hrs)

<table>
<thead>
<tr>
<th>Interview No</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (hr)</td>
<td>1:04</td>
<td>1:08</td>
<td>0:55</td>
<td>0:51</td>
<td>2:32</td>
<td>1:18</td>
<td>1:03</td>
<td>1:30</td>
<td>1:23</td>
<td>1:21</td>
<td>0:50</td>
<td>1:12</td>
</tr>
</tbody>
</table>

6.1.2 INFORMATION OF EXPERTS
The experts interviewed possessed significant experience in the Saudi construction industry. Their experience was, on average, 14 years. The qualifications of interviewees are as follows: five of them hold a PhD; four hold an MSc; and three hold a BSc. Tables 6.2 and 6.3 illustrate the information of interviewees respectively.

Table 6.2: Summary of interviewee information

<table>
<thead>
<tr>
<th>Academic Qualification</th>
<th>Professional qualification</th>
<th>Experience (Av. years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PhD</td>
<td>MSc</td>
<td>BSc</td>
</tr>
<tr>
<td>CVS</td>
<td>AVS</td>
<td>Others</td>
</tr>
<tr>
<td>SPS</td>
<td>VM</td>
<td>SC</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>13.7</td>
<td>10.6</td>
<td>2.7</td>
</tr>
</tbody>
</table>

6.2 QUANTITATIVE FEEDBACK
In this section, only the quantitative data are reported and analysed. Whereas quantitative research has already been explained and justified in Chapter 2. The figures and explanation below are findings of closed ended questions analysed by Statistical Package for the Social Sciences (SPSS).
<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Experience</th>
<th>Qualification</th>
<th>Tasks</th>
<th>Organisations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Expert A</td>
<td>9</td>
<td>SPS 4 VM 7 SC</td>
<td>Supervision, design, management</td>
<td>Dammam Municipality</td>
</tr>
<tr>
<td>2</td>
<td>Expert B</td>
<td>19</td>
<td>SPS 3 VM 1 SC</td>
<td>Supervision, design, management</td>
<td>Ministry of Defence</td>
</tr>
<tr>
<td>3</td>
<td>Expert C</td>
<td>6</td>
<td>SPS 12 VM 1 SC</td>
<td>Consulting, design</td>
<td>MOMRA</td>
</tr>
<tr>
<td>5</td>
<td>Expert E</td>
<td>12</td>
<td>MSc, CSV-Life PMP</td>
<td>Construction projects, design, management, lead VM studies, deliver VM courses</td>
<td>Saudi Commission En</td>
</tr>
<tr>
<td>6</td>
<td>Expert F</td>
<td>20</td>
<td>SPS 3 VM 3 SC</td>
<td>Design, management, deliver VM training and studies</td>
<td>Ministry of Municipality</td>
</tr>
<tr>
<td>7</td>
<td>Expert G</td>
<td>12</td>
<td>SPS 19 VM 3 SC</td>
<td>Delivering VM Studies, consulting, design</td>
<td>Ministry of Municipality</td>
</tr>
<tr>
<td>8</td>
<td>Expert H</td>
<td>5</td>
<td>SPS 3 VM 3 SC</td>
<td>Project Management, VM leader, deliver VM training</td>
<td>Saudi ARABCO</td>
</tr>
<tr>
<td>9</td>
<td>Expert I</td>
<td>25</td>
<td>SPS 17 VM 3 SC</td>
<td>Construction project, design team, deliver VM training and studies</td>
<td>Saudi Royal commission</td>
</tr>
<tr>
<td>10</td>
<td>Expert J</td>
<td>10</td>
<td>SPS 17 VM 3 SC</td>
<td>Work in private sector, deliver VM training and studies. Participate as design member</td>
<td>Saudi Royal Commission</td>
</tr>
<tr>
<td>11</td>
<td>Expert K</td>
<td>20</td>
<td>SPS 5 VM 15 SC</td>
<td>Head of design department, supervision, construction project, participate in VM studies</td>
<td>Ministry of Defence</td>
</tr>
<tr>
<td>12</td>
<td>Expert L</td>
<td>13</td>
<td>SPS 10 VM 8 SC</td>
<td>Work in academia and industry. Participate in design and supervision.</td>
<td>King Saud University</td>
</tr>
</tbody>
</table>
6.2.1 Current application of VM and SC

The graphs below provide indications about the existing situation of VM and SC in the Saudi public sector. Figure 6.1 shows that the implementation of VM in the Saudi public sector is relatively frequent ("always"= 15%; "often"= 33%), whereas that of SC is infrequent ("occasionally"= 24%; "rarely"= 48%). It is thus concluded that the application of VM is significantly higher than the application of SC in the Saudi Public Sector.

![Bar chart showing VM and SC application comparison.](chart)

**Figure 6.1: VM application comparison with SC**

6.2.2 Barriers to application of VM and SC

Figure 6.2 elucidates the major barriers that could impede the application of VM and SC in the Saudi public sector. The barriers are ranked according to the interviewees' perception of their potential impact on the application of VM and SC. Five possible choices written could be selected by the interviewee: "very high=5", "high=4", "moderate=3", "low=2", "very low=1". SPSS software was used to analyse the data by calculating the descriptive variables in quantitative data.

The five major obstacles that could hinder the application of VM, as they appear in Figure 6.2, are: lack of information (4.08); lack of leadership (3.83); lack of time (3.75);
lack of awareness (3.75); and client commitment (3.67). Whereas, the five major barriers that could impede the implementation of SC are; lack of awareness (4.9); lack of leadership (4.5); client commitment (4.5); lack of information (4.4); and lack of training (4.3). The mean of all SC barriers is considerably higher than that of VM barriers; in other words, the people who work in the Saudi public sector are more familiar with VM than SC.

![Figure 6.2: Barriers to application of VM and SC](image)

6.2.3 Importance of VM and SC

Figure 6.3 shows the importance of VM and SC from the perspective of interviewees for the Saudi public sector in particular and the construction project in general. It is clear that the implementation of both VM and SC is seen as “very important” and “important” in the Saudi construction industry.
6.2.4 Knowledge of and Satisfaction with VM and SC

Figures 6.4 and 6.5 demonstrate the knowledge and satisfaction of people, who work in the Saudi public sector, regarding VM and SC. Figure 6.4 shows that respondents' knowledge of VM was "very good" or "good", while that of SC was "poor" or "very poor". Figure 6.5 shows that the majority of experts were "very satisfied" or "satisfied" with VM, but "dissatisfied" or "very dissatisfied" with SC.

Although there was extensive VM knowledge and experience, the knowledge of SC within the construction industry would appear to be a problem across people who work in the Saudi Arabia. Many who work in the Saudi public sector appear to have less experience of Sustainable Development, and SC is all too often not a major consideration. This can be explained by the fact that VM was introduced to Saudi Arabia as early as 1975 (Al-Yousefi et al 1999), whereas SC has not yet had the required consideration within the Saudi public sector. For this reason, it would be beneficial to be able to exploit the VM experience and skills to accelerate the understanding and implementation of sustainable development in the Saudi construction sector.
6.3 QUALITATIVE FEEDBACK

Qualitative research has been explained and justified in Section 2.5.2. The objective of expert interviews in this research was to: explore, explain and describe SC and VM associated with the objectives of the research as stated in Section 1.3.2. A qualitative
approach was employed to elicit holistic data associated with SC and VM in Saudi Public Sector to answer the research questions. Qualitative approach is the most appropriate to generate rich data relating to the experience and practice of both VM and SC to achieve research objectives, but coupled with quantitative methods that were used to evaluate, confirm and validate the findings.

6.3.1 SUSTAINABLE CONSTRUCTION

In this section, the qualitative data obtained through semi-structured interviews with experts are analysed and reported. The interview sessions were taped, transcribed and coded. The qualitative data aims to investigate in-depth the situation of SC implementation in the Saudi public sector. The questions posed in interviews focused on the following issues:

- the identification of barriers that could impede the implementation of SC in the Saudi public sector in particular and the construction sector in general;
- the identification of reasons behind the requisite implementation of SC principles in the Saudi construction industry;
- the definition of the principles of SC that could be used in Saudi Arabia as perceived by the experts; and
- the identification of enablers and solutions to help people who work in the Saudi public sector to understand the principles of SC, and consequently accelerate its implementation in the country.

6.3.1.1 Barriers to SC in Saudi Arabia

This section aims to identify the barriers that could hinder the implementation of SC in the Saudi public sector by asking the experts "What are the barriers that could impede the implementation of sustainable construction in the Saudi Public Sector? Table 6.3 illustrates the responses to the question, where \( n \) denotes the number of interviewees mentioning a particular barrier.
Table 6.4: Barriers to SC implementation in Saudi Arabia

<table>
<thead>
<tr>
<th>The barriers</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of information</td>
<td>4</td>
</tr>
<tr>
<td>Lack of awareness</td>
<td>10</td>
</tr>
<tr>
<td>Lack of government support</td>
<td>3</td>
</tr>
<tr>
<td>Lack of regulations and policies in terms of SC implementation</td>
<td>5</td>
</tr>
<tr>
<td>Lack of guidance for SC to clients, designers and contractors</td>
<td>3</td>
</tr>
<tr>
<td>Lack of penalties and inspection to violation works</td>
<td>2</td>
</tr>
<tr>
<td>Lack of collaboration and coordination between governmental agencies</td>
<td>2</td>
</tr>
<tr>
<td>Shortage of sustainable materials, equipment and appliances in the Saudi market</td>
<td>3</td>
</tr>
<tr>
<td>Shortage of practitioners, expertise and knowledge of SC</td>
<td>4</td>
</tr>
<tr>
<td>Misperception of high initial cost to implement sustainable design</td>
<td>2</td>
</tr>
<tr>
<td>Complexity of agencies’ legislation, rules and bureaucracy</td>
<td>1</td>
</tr>
</tbody>
</table>

6.3.1.2 Rationale behind SC implementation in Saudi Arabia

The implementation of SC is undoubtedly crucial all over the world; however, each country has its own needs, agenda and circumstances. This section aims to identify the important reasons behind the request of consideration of SC principles in Saudi construction projects by asking the interviewees, "Why are sustainable construction principles important to be implemented in the Saudi construction projects?" Table 6.4 shows answers to the above question, where n denote the number of interviewees mentioning a reason.
Table 6.5: Reasons behind SC implementation in Saudi Arabia

<table>
<thead>
<tr>
<th>Rationale behind sustainable construction implementation</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Elimination of green area; deterioration of environment and scarcity of resources</td>
<td>3</td>
</tr>
<tr>
<td>2 Seventy per cent of energy goes to buildings</td>
<td>1</td>
</tr>
<tr>
<td>3 Sick buildings that includes harmful paints, furniture, ducts, IT, air and materials</td>
<td>1</td>
</tr>
<tr>
<td>4 Forty five per cent of overall waste comes from construction</td>
<td>1</td>
</tr>
<tr>
<td>5 Landfills are quickly filled by construction waste</td>
<td>3</td>
</tr>
<tr>
<td>6 Sea and ground water are being polluted</td>
<td>3</td>
</tr>
<tr>
<td>7 Shortages of dwellings especially in Riyadh, Jeddah, Eastern province</td>
<td>3</td>
</tr>
<tr>
<td>8 Shortage of water and energy, in addition to their high demand</td>
<td>4</td>
</tr>
<tr>
<td>9 Dwellings and land price have dramatically increased over the few past years</td>
<td>3</td>
</tr>
<tr>
<td>10 Demolition of old buildings result in negative impacts to environment and people</td>
<td>2</td>
</tr>
<tr>
<td>11 Distortion of large areas where materials are taken for construction</td>
<td>1</td>
</tr>
<tr>
<td>12 Neighbourhoods’ relationships have increasingly abated</td>
<td>2</td>
</tr>
</tbody>
</table>

6.3.1.3 Defining SC dimensions in Saudi Arabia

Having discovered the barriers to and reasons behind the need for implementing SC principles in Saudi construction sector, this section identifies the most suitable SC principles that could be used beneficially in the Saudi construction industry by asking the experts the following question, “What are the SC principles that are important to be taken into account in the Saudi construction projects? All principles mentioned by experts are analysed and categorised in three dimensions, namely, environmental, economic and social, as seen in Table 6.5 below. Here again, n denote the number of interviewees mentioning an element.

6.3.1.4 Solutions to barriers to SC in Saudi Arabia

The interviewees were asked two questions regarding how to overcome existing barriers and establish SC principles in Saudi construction projects. The first question was “What
are the enablers and solutions that can/do encourage SC implementation in Saudi Arabia?" The second question was "What steps should the government or Saudi agencies take to establish or improve SC performance in Saudi Arabia?" Table 6.6 illustrates the enablers and solutions that could provide a catalyst for establishing and accelerating the implementation of SC in the Saudi Public Sector.

Table 6.6: Principles of SC in Saudi Arabia

<table>
<thead>
<tr>
<th>Sustainable Construction Principles</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycle and reuse water and materials</td>
<td>6</td>
</tr>
<tr>
<td>Maximise efficient use of land</td>
<td>4</td>
</tr>
<tr>
<td>Minimise water and energy use consumption</td>
<td>7</td>
</tr>
<tr>
<td>Maximise efficient use of non-renewable resources</td>
<td>2</td>
</tr>
<tr>
<td>Encourage renewable resources use (solar energy)</td>
<td>4</td>
</tr>
<tr>
<td>Reduce material waste in construction and use</td>
<td>4</td>
</tr>
<tr>
<td>Stop desertification</td>
<td>2</td>
</tr>
<tr>
<td>Stop depleting ozone</td>
<td>1</td>
</tr>
<tr>
<td>Conserve and develop coastal regions</td>
<td>1</td>
</tr>
<tr>
<td>Stop pollution to sea, groundwater, air and land</td>
<td>4</td>
</tr>
<tr>
<td>Protect biodiversity, and flora and fauna</td>
<td>1</td>
</tr>
<tr>
<td>Satisfy good indoor and outdoor environment</td>
<td>5</td>
</tr>
<tr>
<td>Minimise CO2 and other green gases emissions</td>
<td>1</td>
</tr>
<tr>
<td>Provide evacuation area for safety and security</td>
<td>1</td>
</tr>
<tr>
<td>Construct secure and safe property to prevent crime</td>
<td>2</td>
</tr>
<tr>
<td>Consider neighbourhood relationships in design</td>
<td>3</td>
</tr>
<tr>
<td>Consider smoking in design and stop it inside buildings and public places</td>
<td>1</td>
</tr>
<tr>
<td>Consider earthquake, geotechnical and weather aspects in design</td>
<td>2</td>
</tr>
<tr>
<td>Eliminate using toxic materials and sick buildings</td>
<td>2</td>
</tr>
<tr>
<td>Respect culture of people</td>
<td>4</td>
</tr>
<tr>
<td>Involve society in decision making</td>
<td>2</td>
</tr>
<tr>
<td>Satisfy user’s needs and requirements</td>
<td>5</td>
</tr>
<tr>
<td>Respect disabled and satisfy their requirements and needs</td>
<td>2</td>
</tr>
<tr>
<td>Provide public amenities</td>
<td>3</td>
</tr>
<tr>
<td>Satisfy privacy</td>
<td>4</td>
</tr>
<tr>
<td>Apply whole life cycle cost</td>
<td>5</td>
</tr>
<tr>
<td>Deliver affordability</td>
<td>3</td>
</tr>
<tr>
<td>Ensure durability</td>
<td>2</td>
</tr>
<tr>
<td>Enable adaptability</td>
<td>3</td>
</tr>
<tr>
<td>Ensure quality</td>
<td>4</td>
</tr>
<tr>
<td>Satisfy equity</td>
<td>5</td>
</tr>
<tr>
<td>Create jobs</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 6.7: Solutions to accelerate the implementation of SC

<table>
<thead>
<tr>
<th>Solutions to the implementation of Sustainable Construction</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demonstration</strong></td>
<td>5</td>
</tr>
<tr>
<td>Achieve SC principles in governmental projects and demonstrate a good example, i.e. green buildings or sustainable buildings.</td>
<td></td>
</tr>
<tr>
<td>The Government as major client and sponsor of the industry should act as a leader and strongly advocate SC implementation.</td>
<td>3</td>
</tr>
<tr>
<td><strong>Regulations/policies</strong></td>
<td>7</td>
</tr>
<tr>
<td>Enact regulations and policies for SC implementation.</td>
<td></td>
</tr>
<tr>
<td>Establish guidance on sustainable design, construction, operations and maintenance to clients, contractors and designers.</td>
<td>2</td>
</tr>
<tr>
<td>Establish Saudi Council of Engineers System to certify practitioners</td>
<td>2</td>
</tr>
<tr>
<td>Mandate Saudi Building Code and SC Principle implementation in new projects.</td>
<td>3</td>
</tr>
<tr>
<td>Establish ranking of consultant and designer firms in Saudi Arabia.</td>
<td>1</td>
</tr>
<tr>
<td>Train and certify people who work in SC</td>
<td>2</td>
</tr>
<tr>
<td><strong>Incentives</strong></td>
<td>5</td>
</tr>
<tr>
<td>Establish monetary incentives and awards for designers, consultants and contractors who implement SC principles and give them priorities to construct new projects.</td>
<td></td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>2</td>
</tr>
<tr>
<td>Provide sustainable, environmentally friendly materials, suitable appliances and equipment to conserve energy and water in the Saudi market at an affordable price.</td>
<td></td>
</tr>
<tr>
<td><strong>Awareness</strong></td>
<td>3</td>
</tr>
<tr>
<td>Bring key stakeholders together in one place and introduce them the principles of SC, its benefits and drivers at early stages of projects.</td>
<td></td>
</tr>
<tr>
<td>Teach people benefits and drivers of SC and involve them in decision making.</td>
<td>4</td>
</tr>
<tr>
<td>Start teaching sustainability principles at schools and institutions.</td>
<td>3</td>
</tr>
<tr>
<td>Train engineers, architects and labours and raise awareness of top management and affected stakeholders.</td>
<td>4</td>
</tr>
<tr>
<td>Find sponsor to adopt SC by introducing its benefits to the society.</td>
<td>2</td>
</tr>
<tr>
<td><strong>Process</strong></td>
<td>2</td>
</tr>
<tr>
<td>Make competitions for designers and consultants to produce sustainable design.</td>
<td></td>
</tr>
<tr>
<td>Consider SC at early stages of a project consequently evaluate and monitor its performance during design, construction stage and after completion.</td>
<td>1</td>
</tr>
<tr>
<td>Work together with relevant agencies (MOMRA, PEM, MWE, MPM, and NCWCD) to establish regulations and policies, and assign duties and tasks for each one to avoid conflicts.</td>
<td>4</td>
</tr>
</tbody>
</table>
6.3.2 VALUE MANAGEMENT
This section illustrates evolving VM in Saudi Arabia. It also introduces the current situation in terms of its application, its barriers and potential solutions to promote its practice in the country.

6.3.2.1 The Application of VM in Saudi Arabia
The history of VM in Saudi Arabia has been mentioned in Section 3.8. However, it has been broadly agreed that VM should be applied in a design as early as possible so as to significantly benefit from its advantages and avoid the re-design process and its obligations (Dell’Isola 1997; Kelly and Male et al 2004; Zimmerman 1982). In spite of this, the implementation of VM in some organisations mainly depends on the initiative of owners when a project faces impediments to construction. The dominant causes of these are when the cost of a project exceeds its budget or when an owner needs to make a balance between qualities, cost and performance in the project. In this study, it has been discovered that most VM studies implemented by Saudi governmental organisations were applied at the end of designs or in pre-final stages. One interviewee has said that ‘the application of VM at final stages of design is considered as peer review of design and exclusive to changes materials of project’.

However, organisations that employ professional people, such as Saudi Aramco Company and the Royal Commission for Jubail and Yanbu (RCJY), also apply VM techniques at concept and planning stages. Saudi Aramco has a dedicated VM unit and division for estimating. It has the capability to make estimations for a project at different stages, such as the conceptual and preliminary stages of design. This enables the VM team to achieve successful VM studies at any stage of the project. Several VM studies implemented by the RCJY were done between conceptual design and schematic design.

The following organisations are considered good examples for implementing VM in Saudi Arabia: Saudi Aramco, High Commission for the Development of Riyadh, Ministry of Municipality and Rural Affairs (MOMRA), Ministry of Defence and Aviation (MODA), Royal Commission for Jubail and Yanbu (RCJY), Saudi Basic
Industries Corporation (SABIC), Saudi Electricity Company, and Taiba and Real State and Development Company.

6.3.2.2 Benefits from VM to Saudi Construction Sector

The perceptions of interviewees with regard to benefits gained from the application of VM in Saudi Arabia mention in a number of enhancements and potential savings. These are as follows.

- Meet clients’ and/or users’ needs and requirements in a project.
- Improve quality, performance and reliability of a project.
- Enhance aesthetic value of a project.
- Remove unnecessary costs, accordingly minimise whole life cost of a project by 5-30%.
- Saving more than SR 5 billions (US$1.33 billion) in the Saudi Public Sector since VM was introduced to Saudi Arabia.
- Saving time in project design and construction
- Promote behaviours, attributes and skills of people who work in VM Sector
- Produce good and innovative ideas and recommendations; add more value, simplify construction, decrease expenditure, fancy, nice looking and landmark.
- Finally, the benefits of VM have not been widely recognised by some clients and organisations in Saudi Arabia, therefore, the positive proposal of VM study cannot be effortlessly implemented without strong support from clients or top management in the organisation.

6.3.2.3 VM Method used in Saudi Arabia

The process of VM, in Saudi Arabia, is different from one project to another in its synthesis but the Job Plan is approximately the same. A VM study is usually conducted within a week (40 hrs). Most people in Saudi Arabia follow the Society of American Value Engineers (SAVE) International Job Plan, but some of them do not do a good job.
in the Function Analysis because it looks to them tricky due to Function Analysis System Technique (FAST) diagram application.

Sometimes, if the project is in hurry, it may summarise some process, such as function analysis which is done as implicit if the team are familiar with it and they feel they understand it clearly: thereafter they move immediately to brainstorming - Verb-noun technique used to name an individual function. The verb answers the question, "What action is to be done?" The verb defines the action required. The noun answers the question, "to what is the action being applied"? The noun tells us what object is being acted on (Kaufman and Woodhead 2006). In some organisations, Whole Life Cycle Cost (WLCC) is rarely done in VM studies because it needs more expertise and knowledge. The rationale behind this is that the VM team has not obtained the required training, learning and information.

6.3.2.4 Composition of VM Team

The perception of twelve experts interviewed in Saudi Arabia associated with forming a VM team has to achieve any particular study faces several challenges which often includes the following:

- a shortage of qualified and certified practitioners;
- difficulty in finding practitioners of VM due to shortages and lack of records and contact details of those certified in Saudi Arabia;
- a shortage of dedicated, quantity surveyors practitioners or cost estimators;
- a shortage of professional engineers in some specific areas; and
- a lack of VM culture at most contractors and consultant firms.

Furthermore, they mentioned the following desirable characteristics and attributes that should be available in the value manager/facilitator/ leader and study team.

- The leader of a VM study, in Saudi Arabia, should be a Certified Value Specialist (CVS) or an Associated Value Specialist (AVS) who has experience
in VM and participated at least in two workshops to guarantee quality of outcomes.

- The leader of a VM study should have a good leadership style and interpersonal skills, in addition to being a motivational and enthusiastic person.

- The VM team who participate in the study must be highly qualified and experienced to come up with appropriate findings.

With regards to the divisions and practice of VM in a number of Saudi agencies, the experts mentioned the following points:

- Some organisations/agencies have VM sections but they do not have the required expertise and knowledge to enable them to effectively conduct a VM study.

- In other organisations, the design teams do the VM study for the same project, however, it is argued that these will come up with similar productions. Besides, the findings of VM study might be influenced by the decision makers or the design team. Furthermore, this practice is not compliance with SAVE International principles that say the VM team must be completely different from the design team of the project.

- A number of interviewees also mentioned that the team should differ from one study to another, and they justified this by saying that the same team might end up with the same results in all conducted studies. They also recommended that clients or agencies to bring external expertise and ask attendance of people from operation and maintenance to participate in a VM workshop. Additionally, they mentioned that a VM study team, in building projects, should consist of a civil/structure, a mechanic engineer, an architect, an estimator or quantity surveyor in addition to the facilitator; the size of the VM team should be about 5-6 people for the period of one week, eight hours a day (40 hrs).

- Some organisations also tend to appoint a consultant or architect/engineer firms to do both design works and VM study as a full package which was considered by the interviews as bad practice because the VM study done by the same team
will not give a second opinion and any bias may be repeated and covered up again.

- Most VM practitioners interviewed recommended that the hybrid team consisting of local practitioners and an external facilitator, in addition to invited technical experts is considered more appropriate for the current practice of VM in the Saudi Public Sector.

6.3.2.5 Accessibility of Information

One major challenge that has confronted VM practitioners is the lack of information, such as specifications, standards, building code, specs sources, credible and cost estimation manual, and historical data for calculation WLCC. This was considered as an influential barrier to implementing a successful VM study. Some organisations attempt to estimate themselves, which results in serious variations between different organisations and what is done in private sector with A/E or consultant firms. All of these could lead to using misleading information and unsuitable standards and specifications.

6.3.2.6 Solutions and incentives to promote the practice of VM

The interviewees suggested a number of actions that could enhance the practice of VM in Saudi Arabia. They declared that promotion of VM practice needs the following actions.

- Motivation for people who work in the sector of VM, such as VM team, contractor and designer by making incentives and rewards.

- Compensation of A/E and consultant firms or contractors for paying them for any changes made in the design of a project according to the VM study recommendations. This lead sometime to conflict because it is not mentioned in a contract and the changes amendment can cost a firm extra time and money.

- A clearer understanding that the VM technique does not aim to criticise Architect/Engineer and consultant firms’ faults and mistakes, but rather aims to
improve the value of a project by enhancing quality and performance, as well as minimising whole life cost of a project.

- Establishment of a competition and award for all people and organisations that apply VM technique in their projects.

- Obtain support of decision makers/top management because VM can not work and be promoted well without their advocacy. Their involvement is crucial for implementing successful VM studies.

- Free symposiums and seminars to raising awareness of senior and junior people who work in the government organisations about VM technique and its benefits and achievements. One interviewee stated that 'If people understood clearly what the benefits of VM were, they would go for it without needing to mandate or regulate'.

- Dealings with all parties should be based on trust and understanding.

- Establishment of good communication between public sector organisations to exchange and share easily knowledge, experience and information; another interviewees said 'It is not known what everyone is doing in different ministries; it is necessary to share the experience, knowledge, and hopefully in the future, it can be shared even resources. It can be called any engineer who is specialist in any certain area in any ministry to participate in VM study in any organisation'. This method will certainly help each organisation to learn from others in different areas and will open a pool of ideas that all organisations can benefit from.

- To provide contractors with opportunity to do VM and grant them incentives or a percentage of the amount saved.

- To give funds and priorities as incentives for the organisations that apply VM studies in their projects according to the circular of the Saudi Ministry of Finance. This will encourage positively all organisations to adopt and implement VM study in their projects.
• The implementation of VM studies should not be monopolised by specific people or consultant firms, but the opportunity should be given to all.

• It is very important to follow up VM findings and implementation after issuing a decision and recommendations.

• The lack of a practical guidance and a practical framework for implementing VM in Saudi Arabia is a major key factor blocking the wide application of it in the country. Therefore, the development of guidance and a framework for applying VM in Saudi Arabia would be very beneficial in promoting it across the country.

• Publicity about VM and its achievements and benefits would be a very significant way to diffuse and promote it amongst people and organisations in Saudi Arabia.

• To guarantee a successful VM study, key stakeholders should be involved in a study depending on the scale, type and complexity of a project. The suggested people are: value manager, owner, sponsor, consultant firm or designer and contractor. The design team should be multidisciplinary, e.g. an architect, a civil, a structure, an electrical, a mechanical engineer and an estimator or quantity surveyor, in addition to participants from operation and maintenance or facilities management. It is preferred that people who participate in a workshop have some background in VM, at least having attended Module I approved by SAVE International. This helps the team leader to facilitate a study. Additionally, support of top management is very crucial to implement the recommendations of a VM study and come up with a successful product.

• It is recommended that VM incentive clauses between client and contractor be enacted in the contract; this will encourage the contractor to submit proposals of VM.
6.3.2.7 Legislation and Policies to promote the practice of VM

The interviewees suggested a number of points associated with legislation and policy with regard to VM implementation in Saudi Arabia. VM has been mandated in the Saudi public sector, so it is very significant to enforce all organisations to adhere to the circular issued by Saudi Finance Ministry associated with implementation of VM. This circular demands VM studies for major projects in all governmental ministries, authorities and departments as follows.

- a typical repeated project with a value greater than SR 5 million;
- a project with a value greater than SR 20 million;
- operation and maintenance contracts with a value greater than SR 5 million; and
- the application of VM is optional in first three years and become mandatory thereafter.

They also suggested that enhancement of VM practice needs to consider the following points.

- function, WLCC and ROI and applying VM during early stages;
- teaching and training practitioners on VM;
- inclusion of VM clauses in the design contracts; and
- it is imperative to take into account the hierarchy of a VM unit/division in its organisation; the position of the VM unit/division must follow to top management or executive managers to conduct it away from influential people who work in the project management or design department. Otherwise, they will dictate what they want and influence the views of the VM team by issuing orders and requests.

6.3.2.8 Challenges Facing VM in Saudi Arabia

Within the interviews, qualitative feedback was sought on existing challenges that could hinder the promotion of VM application and any other comments with regard to the
current situation of VM in Saudi Arabia. The following points summarise the findings of the expert interviews.

- The design processes in some projects do not schedule a specific time for implementing VM. Accordingly, a VM study is applied after completing the detailed design; it takes a long time and involves extra costs and then produces recommendations that make little saving or have little value to the project. This practice generates the perception that VM application is time-consuming and results in delay to the design process and project construction.

- A number of governmental organisations often overestimate the budget of a project to obtain additional funds from the Ministry of Finance as a contingency for covering any shortages appearing later, or use it to enhance and add additional works to the project. This technique can be used due to the lack of precise estimated division and manual. They do not like to put themselves at risk of accidentally increasing the costs of the project. These people believe that a VM study may decrease or eliminate these costs from the budget of the project.

- There are bad practices regarding VM techniques, such as concentrating on the initial cost rather than whole life cycle cost of a project which sometimes gives the impression that VM is used as cost reduction.

- The following barriers might hinder the promotion of VM, namely:
  - continuous changing in clients’ requirements and needs;
  - lack of effective communication and coordination between engineering departments and other agencies;
  - mistrust between all parties in a project (client, contractor, designer and consultant firm);
  - projects with ambiguous goals, objectives or scope, and with hasty decisions based on false assumptions;
  - lack of budget and funds for implementing VM; and
• not enough attention paid to whole life cycle cost consideration and determination of time for implementing a VM study in a project.

• A few organisations have complained about receiving many requests to do VM studies for projects and because of this the quality of these studies may be attacked here and there. This should be considered by top management and found suitable solutions to overcome this problem.

• There are opponents of VM who try to place obstacles in its way; this is because of the absence of the system of VM in the country.

• The studies of VM done in some Saudi governmental organisations seem to focus on cost reduction with quality sacrificed. They believe that a VM study is only done in the final stages of a project.

• Sometime a VM study is done in the later stages of design and this takes additional time and cost which results in delays to the project. Moreover, recommendations of the VM study are idealized, inapplicable and more theoretical than practical.

6.3.2.9 Influence of Procurement System on VM Practice in Saudi Public Sector

The prominent procurement system used in the Saudi Public Sector is the traditional method. However, a few governmental and semi-governmental organisations use different procurement systems for specific projects, such as Design and Build, and Lump Sum Turnkey (LSK) where an owner supervises preliminary engineering work and a contractor will take care of detailed design based on the preliminary engineering design and construction. However, this research has revealed that the influence of procurement system on the implementation of VM study in the project is minor.

VM can be used entirely in traditional, management, and construction management contracts. However, it can be difficult to use when a contractor is mainly responsible for design, e.g. Design and Build or PFI methods. Nevertheless, VM is equally applicable to these procurement systems when developing the statement of requirements in a project brief.
6.3.2.10 Advantages of Traditional Procurement System

Most governmental agencies use the traditional system and which is suitable to adopt the VM technique. The benefits from using this method are:

- more flexibility for conducting a VM study; and
- recommendations can be done without further commitment or extra cost before a bidding stage.

6.3.2.11 Drawbacks of Traditional Procurement System

The following drawbacks associated with the traditional procurement system were mentioned by interviewees.

- The traditional procurement system does not have any incentives and motivation for encouraging VM application.
- There is sometimes a long period between the design phase and construction phase which occasionally results in a few changes, such as:
  - needs and wants of clients;
  - technologies used in a project; and
  - approval budget of the project obtained from the Finance Ministry.
- The traditional method does not have a mechanism to involve the contractor in a VM study at pre-tendering stages, nor give any incentives to the contractor and/or other parties.

6.4 CASE STUDIES

One research strategy adopted here is the careful analysis of four case studies implemented in Saudi Arabia as shown below. These were collected from expert interviews and documents. Although the description of case studies was not well-defined, the data aggregated from them were considered satisfactory to reflect a factual
picture of VM practice in the Saudi Arabia construction industry. Case studies approach have been explained and justified in Section 2.9.4.

6.4.1 CASE STUDY 1

The Prince Salman Social Centre for the Elderly (PSSCE) Project is considered a good example for implementing VM in Saudi Arabia. The area occupied by the project is 10,500 square meters. The project comprised five main divisions, namely, a club for men, another for women, a central facility, two staff accommodations and a mosque. The main reasons for conducting the VM study were financial constraints and time limits. The budget for the project was US$16 millions, but at the bidding stage, eight offers were received that ranged between US$24.8 millions and US$34.5 millions with the average US$28.65 millions. The management of the project decided to employ VM in order to tackle the problem.

Afterwards, top management of the project formed a multidisciplinary VM team with a leader. Seven key members from top management and A/E were involved in the workshop, namely, a value manager, an architect, a civil/structure, a mechanical and an electrical engineer, in addition to A/E representative and the owner representative. The study lasted three weeks, the first week for preparation, second week for conducting the VM workshop and the third week for presenting and reporting the VM outcomes.

Many alternatives brought to the VM workshop and the participation of the designer (A/E) helped in achieving this successful VM study. It was not thought that the improvement in its design would negatively affect its reputation or credibility. Approximately 200 ideas were generated, from which 59 proposals were accepted after being listed, discussed, reviewed and ranked by the owner and the designer. After amending the project design according to the recommendations of the VM study, the project was re-bid. Two weeks later, eight contractors submitted their offers. These ranged between US$16.7 millions and US$20.06 million with an average US$19.84 millions. The actual saving was US$8.81 millions from the lowest previous bid. Figure 6.6 illustrates the value of bids of the project before and after application of VM, in addition to the amount saved in the project.
Finally, the project was constructed with low cost, high quality and performance, and functions, and with no detriment to the objectives of the project.

![Bar chart showing bid value in US$ millions before and after applying VM.]

**Figure 6.6: Bid value in US$ millions before and after applying VM**

### 6.4.2 CASE STUDY 2

The Saudi Aramco Company is considered an exemplar for implementing VM in Saudi Arabia. Saudi Aramco is a fully integrated, universal petroleum enterprise and a world leader in investigation, production, refining, distribution, shipping and marketing. Saudi Aramco as an international leader in the petroleum industry (Oilcareers Ltd 2007) and they:

- manage proven oil reserves of 260 billion barrels of oil (nearly a quarter of the world’s total), the largest of any company in the world;
- manage the fourth largest gas reserves in the world, at 240 trillion standard cubic feet;
- own and operate the world’s second largest tanker fleet to help transport crude oil production (3.3 billion barrels in 2005); and
- employ about 55,000 people all over the world to produce, process and distribute 9.1 million barrels of oil per day.
The objectives of applying VM in the company are to improve project value and minimise whole life cycle cost. Saudi Aramco has saved over US$300 million during the period from 1998 to 2000 as result of conducting VM on a number of projects. Having discovered these significant benefits of VM in a relative short period and because of the high demand of the company to execute many projects, Saudi Aramco initiated a new policy to apply VM to each new project with an Expenditure Request (ER) value of US$10 millions or more. Consequently, recognising substantial advantages of VM, Project Management established a VM Unit within the Project Support and Controls Department. The objective of the programme is to increase project value, in addition to reduce project whole life cycle costs by 10% through the application of VM methodology. The following strategies have been used:

- implement VM studies on designated capital projects;
- increase expertise, skills and ability of VM Unit’s employees to facilitate and lead VM studies;
- raise VM awareness through publications, intranet resources and presentations; and
- diffuse VM culture to other departments and administrations that can significantly affect project value, such as engineering standards and procedures.

The VM Unit and Board are the two main agencies responsible for ensuring that Saudi Aramco achieves its vision associated with VM. The VM Unit is staffed by eight value mangers recruited from various departments in the company. The VM Unit in Saudi Aramco has qualified team members (CVS and AVS). They used to bring in external consultant firms at the beginning of the programme, but they have stopped that now, except in special cases to cover shortages. VM study is applied at the conceptual and preliminary design phases. Saudi Aramco has a dedicated division for estimation. They carry out estimations for each a project at different stages. They often produce estimations at the end of conceptual design and at the end of preliminary design. A responsible estimator is appointed for each project. The duties associated with the VM Unit are to:
• represent Saudi Aramco in terms of VM aspects within the company and with outside organisations;
• provide guidance to involved departments on the project, such as study duration and timing, and team selection;
• produce monthly reports including ongoing, completed and scheduled VM studies; and
• conduct management orientations and briefings as suitable and carry out similar briefings about VM for customer and team member originations.

Although Saudi Aramco had already achieved many successful VM studies with huge savings and improvements in project values, it was recognised that there was room for further improving their VM implementation. Accordingly, senior management appointed a consultant to lead a cross-functional study to appraise the VM programme and recommend methods to enhance it.

The important resulting recommendation was the establishment of a VM Board (VMB) to supervise the overall implementation of VM programmes and ensure that their objectives were met. The responsibility of the VMB is to ensure that VM is applied effectively to the capital programme of Saudi Aramco Company, in addition to improve performance. The VMB have five permanent, four yearly changing and ad hoc members from different departments throughout the company. The Board meets formally twice a year. Other meetings are organised based on the need to resolve specific VM proposal implementation issues. The functions of the VMB are as follows.

• Review criteria and guidelines to determine capital projects needed for implementing VM.
• Resolve conflicts associated with the implementation of specific VM proposals.
• Monitor the effectiveness of the VM programme.

6.4.3 CASE STUDY 3
The Jubail Industrial College extension (JIC) project is another good example of implementing VM in Saudi Arabia, the project, owned by the Royal Commission of
Jubail and Yanbu, comprises five student’s dormitories, faculty housing, a mosque, clinic, supermarket and commercial buildings. The general site works included gardening, utilities, exterior fences, potable water, storm water, and sewerage and irrigation network system. The total area occupied by the project is 9,728 square meters. The total estimated initial cost at 90% of design development was US$12.67 million. The objectives of implementing VM were: to reduce whole life costs, use sustainable local material, optimise engineering system performance, establish economical engineering system design criteria, optimise architectural system layout for colleges, meet programme requirements, minimise circulation within housing and other facilities, and improve housing unit performance and operation.

VM was conducted according to the SAVE International Methodology in the presence of a multidisciplinary team, the owner and designer representative. The VM Job Plan followed five key processes: Information Phase, Function Analysis Phase, Creativity Phase, Evaluation Phase and Recommendation Phase. The owner and designer were asked to deliver oral presentations about the project parts and explain reasons behind developing the project. They also discussed the site of the project, building layout, flow charts, process equipments, and architectural, structural, mechanical and electrical system; in addition a site visit was organised to know more about the location of the project.

A Function Analysis Systematic Technique (FAST) graph was developed in order to obtain better understanding about all the functions of the project. Accordingly, many ideas were generated to accomplish the required functions of the projects that satisfied all design objectives and criteria. The advantages and disadvantages of each idea were addressed. Having done that, ideas were ranked based on potential saving, re-design time and client acceptance. The evaluation criteria employed for this study were to meet function, achieve sustainability principles, minimise whole life cost, meet project timetable, ease project implementation, be accepted by the owner and meet architectural aesthetics. In the last phase, the recommendations and summary of cost saved as a result of implementing VM were presented in a formal presentation to the owner and design team for acceptance or rejection, along with illustrations of possible consequences if
these recommendations were rejected. A number of tools were used in the VM study, as follows.

- VM Models for assisting the team to achieve the main objectives.
- Cost Model for helping the team in distributing costs by function to find potential saving areas.
- Quality Model as the basis of the design process and design criteria (this also works as a sensitive measure to be used by the VM team to appraise various design alternatives).
- Life Cycle Cost Analysis (LCCA) to work out initial cost, as well as life cycle cost for each element of the project. 8% annual discount rate and 30 years as life cycle period were assumed and agreed by the owner. The present worth method was used for calculating WLCC for the project.
- The VM study took five days and generated approximately 110 ideas. Of these, 34 proposals were accepted for development including a number of design suggestions that would improve value, minimise negative impact to environment and achieve SC principles. The VM study led to potential savings of US$3.573 million of initial cost and US$0.416 million in LCC annually.

6.4.4 CASE STUDY 4
Alanoud Tower, situated on King Fahd Road, is the third highest building constructed in Riyadh. The VM study was led by the interviewee himself. This study resulted in making a saving of 20% of the initial cost and saving approximately 20-30% in WLCC. They explained that these figures obtained according to particular calculation. They stated that they have historical data from previous projects and they benefited from it in obtaining these per cents. A number of changes were made in the project functions used, for example, top floor, technical issues in the building and the usage of some building elements. A number of other examples mentioned by some interviewees were the Sultan Airbase project in Alkhairj, Islamic University building in Al-Madinah and Municipality building in Jeddah.
6.5 SUMMARY

This chapter has provided an overview of the current situation regarding VM and SC practice in Saudi Arabia. The data collected were based on quantitative and qualitative approaches throughout interviews with people who work in and/or have significant experience in the Saudi Public Sector. As pointed out previously in this chapter, the frequency of application of VM in the Saudi construction sector is “always” and “often”, whereas the frequency of implementation of SC is “occasionally” and “rarely”. The major barriers to VM were lack of information, leadership, time, awareness and client commitment. On the other hand, the major barriers to the implementation of SC were lack of awareness, leadership, client commitment, information and training. The level of knowledge of people who work in the Saudi public sector about VM is “very good” and “good”, while SC is “poor” and “very poor”.

It appears that there is wide VM knowledge and experience, whereas the knowledge of SC within the construction industry would appear to be a problem across the Saudi construction Sector. These findings can be explained as having resulted from VM being known in Saudi Arabia for more than three decades whereas SC has not been implemented yet in the Saudi public sector.

This chapter has also defined SC principles in Saudi Arabia and explored the most important reasons behind its implementation request. Furthermore, it has identified the barriers that could hinder SC application and introduced enablers that could overcome these obstacles. The identified solutions could help accelerate the understanding and implementation of SC dimensions in the Saudi public sector. The results of this study indicate that the most important issues of SC were energy and resources conservation, as well as land use regulation and urban planning policies which are justified by that fact that energy and resource are of increasing concern in Saudi Arabia.

Because of this, it would be beneficial to exploit and apply the VM experiences and skills to accelerate the understanding and implementation of SC in the Saudi construction industry. However, on the basis of the findings of the study, it is clear that several governmental organisations in the Saudi public sector, particularly those who
have not established divisions of VM and do not have practitioners, have a long way to go, before they can effectively apply VM techniques and implement SC principles in their projects. It is also clear that the lack of awareness of SC principles within the Saudi public sector would appear to be a problem across the country.

Practical solutions to the aforesaid problems from the perspectives of the interviewees could involve developing an integrated approach to VM and SC principles. At the strategic level this will involve raising awareness of the key stakeholders about the drivers and benefits of SC and VM. This will help to shift their thinking from cost to value, from short term to long term and from shareholders to stakeholders. Accordingly, the design team will obtain the key stakeholders’ buy-in to achieve SC principles as early as possible and will also encourage the integration of SC principles during VM workshop. The next chapter presents the best practice of VM and SC within the UK construction industry.
CHAPTER SEVEN
CHAPTER 7
VALUE MANAGEMENT AND SUSTAINABLE CONSTRUCTION
BEST PRACTICE BASED ON INTERVIEWS AND CASE STUDIES
IN THE UK

7.1 INTRODUCTION

This chapter aims to develop through the use of semi-structured interview robust background knowledge of the practice of VM and SC within the UK construction industry. These semi-structured interviews were undertaken face-to-face with 15 experts possessing significant experience and knowledge in VM and/or SC, as shown in Table 7.1. The interviews sought insights into best practices associated with VM and SC through the elicitation of interviewees' perceptions, meanings, definitions and practices. These semi-structured interviews were also conducted to probe experts' opinions and knowledge developed from implementing exemplary VM and/or SC projects and their integration as case studies. The main purpose of this chapter is to collect information that will facilitate the development of an integrated approach to VM and SC for construction projects by:

- assessing the feasibility of using VM to implement SC principles within a construction project;
- identifying VM techniques, roles and participants used in the integration;
- identifying the power and limitations of VM and SC;
- identifying the drivers of and barriers to VM and SC;
- defining the processes of developing the integrated approach;
- defining the mechanisms currently used for implementing SC and VM in projects;
• using case studies as exemplary projects for practising SC and/or VM in construction projects; and
• investigating whether or not there any prejudice to the client from implementing SC through VM.

7.2 DATA COLLECTION PROCEDURES

An interview protocol for asking questions and recording information during the qualitative interviews was designed. This protocol comprised a heading, instructions to the interviewer, key research questions, probes to support key questions, space for recording the interviewer’s comments, and space for the researcher records reflective notes. In addition to this, the interviews were audio taped.

7.3 DATA ANALYSIS AND INTERPRETATION

The collected data were analysed to identify and describe the best practices of VM and SC from the perspective of the experts, and to then attempt to understand and explain their patterns with a view to developing an integrated approach to VM and SC during strategic briefing for construction projects. The data collected through taped interviews were transcribed onto 110 A4 single-line pages, prepared for analysis and organised categorically and chronologically, reviewed repeatedly and continually coded. The transcribed data were then sorted and categorised into a number of themes under headings required to develop the integrated approach of VM and SC (Miles and Huberman 1994).

General ideas of all participants, the tone of ideas, and a general impression of the overall depth, credibility and use of information were all investigated (Creswell 2003). This process has facilitated the development of a broad understanding of the interview data. Having identified the themes during the coding process, the themes were interconnected into a storyline (as in narrative) and developed into an integrated approach to VM and SC. Themes were analysed for each interview across all cases and shaped into a general description (Creswell 2003).
7.4 INFORMATION ON THE INTERVIEWED EXPERTS

Miles and Huberman (1994) stated that the selection of interviewees is vital to the depth and richness of information acquired in any research. They also argued that the selection of case studies diminishes the potential richness and variety of results. Experts possessing significant experience in VM and/or SC were purposefully identified through the Institute of VM in the UK (IVM), Society of America for VM (SAVE International), conferences, seminars, previous research in the same area and from the internet for the proposed study. The objectives of these interviews, as indicated above, were to develop an integrated approach to VM and SC during strategic briefing for construction projects.

The information collected from the fifteen expert interviewees yielded data with a high degree of reliability and viability. This is because they possess significant experience in the application of VM and/or SC in the UK construction industry. It can be seen from the details of all interviewees shown in Table 7.1 that they are highly qualified and occupy high positions in their organisations. Furthermore, they have a great deal of experience in VM and/or SC, in addition to their other duties in their various organisations. It can also be seen from Table 7.1 that most of interviewees are practitioners and have performed many studies and delivered training either on VM or SC or both.
<table>
<thead>
<tr>
<th>No</th>
<th>Qualification</th>
<th>Jobs</th>
<th>Expertise</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>BSc, MSc, DIC, CEnv, FICE, MCIWM, MIEnvSc, SiLC</td>
<td>Leads large company’s environmental consultancy services in the Midlands</td>
<td>25 years in civil engineering projects, environmental impacts, contamination land assessments, risk management and remedial design and implementation for industrial, commercial and residential developments.</td>
<td>Carry out environmental audits, studies and impact assessments for remedial projects. Conduct successful applications for waste management licenses, and integrated pollution control authorisations. Deliver specialist technical advice.</td>
</tr>
<tr>
<td>2.</td>
<td>MSc, PVM, TVM</td>
<td>Director of Risk and VM division Chair of IVM</td>
<td>Risk and VM</td>
<td>Deliver 3 day VM Foundation Course. Deliver VM Studies. Participated in many projects.</td>
</tr>
<tr>
<td>3.</td>
<td>MBA CEng FI MechE FCMC MCIM TVM</td>
<td>Director</td>
<td>Value and Risk management Design &amp; management of complex projects &amp; programmes Strategic marketing Technology management Computer modelling &amp; other analytical tools</td>
<td>Work extensively with directors/senior managers of large organisations. Pioneered new techniques for organisational analysis. Facilitate problem solving workshops.</td>
</tr>
<tr>
<td>4.</td>
<td>BSc(Hons) MPhil CEng MCIBSE FRSA</td>
<td>Principal of large organisation Research</td>
<td>30 years experience in VM and SC. Authored a Green Guide to the Architects’ Job Book, Solar Air Conditioning, Animal Architecture, ECO City. Lead partner in low allergy research and an engineer specialising in construction ecology</td>
<td>Develop sustainable solutions for the built environment and facilitate collaborative working with architectural, engineering, urban design and landscape practices and reflects the nature of construction industry’s research requirements in responding to the challenge of SC.</td>
</tr>
<tr>
<td>5.</td>
<td>BSc Hons 1st class, Architect and RIAS</td>
<td>Principal of Architects section</td>
<td>30 years in SC and VM</td>
<td>Architect of the Fairfield low allergy scheme: long-term interest in affordable ecological design and building related health issues.</td>
</tr>
<tr>
<td>6.</td>
<td>MBA, MCIOB</td>
<td>Senior Consultant</td>
<td>24 years in SC and VM</td>
<td>Delivering VM studies and sustainability and training as well.</td>
</tr>
<tr>
<td>No</td>
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<td>Jobs</td>
<td>Expertise</td>
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<tr>
<td>7</td>
<td>MSc. MICE. FIHT. PVM. TVM. Charted Civil Engineer.</td>
<td>Project management facilitation and support.</td>
<td>15 years in VM and 1 SC. Laing construction, Railtrak, Post-award Partnering and team building workshop</td>
<td>Align objectives of client, designer, contractor and suppliers and agree principles and procedure. Do VM, VE, Risk and Partnering workshops and facilitation of workshops and seminar for four Route Management Strategy studies.</td>
</tr>
<tr>
<td>8</td>
<td>MSc. BSc Quantity surveying, MRICS, PVM</td>
<td></td>
<td>15 years in VM, 5 years in SC</td>
<td>Delivered many VM, Risk, and SC Studies. Participated in several construction projects</td>
</tr>
<tr>
<td>9</td>
<td>BSc, MPhil, PhD, MRICS, Chartered Surveyor with industrial and academic experience</td>
<td>Chair of Construction Innovation in large company. Work in the Built and Natural Environment in university</td>
<td>More than 30 years in VM, PPP, FPI, UK construction industry Published many articles and books on this subject.</td>
<td>Research into VM began in 1983 and within the past three years, has attracted over £1/4 million in research grants. Numerous publications: co-authored first UK textbook on VM. Firm believer in the principle of putting research into practice, and has undertaken VM studies as research consultant on a variety of construction projects.</td>
</tr>
<tr>
<td>10</td>
<td>Regional Director- VM and Sustainability</td>
<td></td>
<td>More than 15 years experience in VM and SC.</td>
<td>Director of large Consulting Middle East Limited. Facilitates workshops in VM and SC and both.</td>
</tr>
<tr>
<td>11</td>
<td>M.A., C.Eng., MICE, PVM, TVM</td>
<td>Owner and Manager of organisation</td>
<td>Risk Management, VM, Project Management</td>
<td>Conduct VM studies, risk management studies. Participated in many projects</td>
</tr>
<tr>
<td>12</td>
<td>CVS-life. PMP</td>
<td>Executive Vice President of large organisation</td>
<td>Certified Value Specialist and Project Management Professional, over 15 years, led over 200 value studies.</td>
<td>Services and facilities from forklifts to multi-billion dollar transportation projects. Lead VM studies work as project manager.</td>
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<tr>
<td>13</td>
<td>Chartered civil engineer and a chartered builder</td>
<td>Director of Innovative Construction Research Centre</td>
<td>Worked in University for 20 years following several years experience with a national contractor Gained design experience with a multi-disciplinary firm of consulting engineers.</td>
<td>Regularly acts as a consultant to industry in the areas of VM, risk management and partnering. Facilitated strategic planning workshops involving directors of several national contractors.</td>
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<tr>
<td>No</td>
<td>Qualification</td>
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<td>14.</td>
<td>BSc (Hons), PhD, MCIOM, CVS, TVM, PVM, Technology Manager</td>
<td>VP of Education in large organisation International Executive member of the IVM, Director of organisation of Learning UK</td>
<td>Delivered many VM studies Participated in many projects Good reputation in VM and FAST techniques</td>
<td>Editor of Value World Researching different value methodologies and creative group decision-making for around ten years. Central to this work has been the realisation that the Job Plan conducted by different facilitators can lead to very different outcomes.</td>
</tr>
<tr>
<td>15.</td>
<td>BSc –Mech. Eng. MAPM</td>
<td>Director</td>
<td>15 year experience in VM and SC. Independent project management and facilitation consultancy specialising in business excellence and project management</td>
<td>Excels in the areas of VM, Risk Management and Business Excellence.</td>
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Distinguishing between green buildings and sustainable buildings, one of the expert interviewees stated that "Green buildings are defined as product and sustainable buildings are defined as a process". He also mentioned that "Sustainable Construction must be delivered as monitoring processes which are being managed and run sympathetically". The interviewees mentioned that the essential issues necessary for the delivery of sustainable buildings are: heating, lighting, heat pumps, air-conditioning, construction methods should be more efficient in natural resource and energy use, accessibility, flexibility and adaptability, and minimal waste, fumes and odour generation.

They also mentioned the impact of the project, health and safety, types of materials, day lighting, energy efficiency, fuel, community involvement, how the building would be used, opening hours, whether or not to have shops, cafe, whether they would serve healthy food or not in terms of commercial and office buildings, what the furniture would be made of, what the power appliances to the kitchen, what exhibition centre would be, how the exhibition itself would be procured. Moreover, the interviewees advised that it is also essential to utilise solar panels and provide windows, doors, plumbing materials, electrical devises, finishes, fixtures and paints which are easy to use, run and maintain, and are self-cleaning and durable; all to minimise negative impacts on the environment and people. Moreover, they claimed that the understanding of social factors such as being aware of neighbours' requirements, needs and their potential objections are essential.

The study findings surmised that the commitment of the client during the design process and the workshops is essential to the delivery of sustainable buildings. The study also revealed that clients can misunderstand SC by thinking it costs more, but they will accept it without any imposition once they realise its benefits which are: obtaining a better product, better design quality, better indoor environment, less use of resources, reduction in all running bills, greater staff retention, lower recruitment costs, greater biodiversity, and, because they are not getting charged for pollution, less expense.
Furthermore, it is concluded that the most important issues discussed in the study are building facade details and how these affect mechanical and electrical systems, primarily heating, window opening, architects’ view, fire consultants, ignitions, lights, and fabric of the building; minimising waste, maximising the repetitive nature of construction and offsite fabrication in addition to the building orientation. One interviewee stated that if these aspects are considered from the earliest stage, they will stick in everyone’s mind throughout the project design where those ideas are actually formulated as stepping stones. One of the interviewees narrated the episode below regarding the materials used in building projects:

“The use of UPVC windows are good values rather than using traditional windows because they do not require to be repaired if it have any damages. From my experience now some of these windows last for 6-7 years and almost 15 years which supposed to last for 30-40 years. The best way for that is to throw whole parts of the windows away and then replace it with new UPVC window rather than just repairing the bottom seal and frame. By doing this, the client can obtain new windows with less cost and last longer, self cleaning as well as fix quickly”.

One of the interviewees claimed that it would not be possible to design buildings without AC in hot countries such as Saudi Arabia, but negative impacts to the environment and people could be mitigated by using the right materials, plants, building orientation, water and waterfalls. So this becomes not a piece of equipment, but a piece of landscaping on a very clever glass roof. The plant species and the method in which the water flows should be designed in a particular way. The running cost could be significantly reduced by using the right pre-conditioning of air using water: this is managed in the old fashioned way of having a courtyard that does the pre-conditioning and by then drawing the air from there. Air conditioning will still be needed if the temperature in the summer reaches around 48 Celsius.

This interviewee also mentioned that another method involves bringing the air through a chimney into the basement to be cooled there and then drawn back into the building.
For example, the average air temperature at night and day in winter and summer in the ground here in the UK is about 12 Celsius degrees while in Saudi Arabia, it could be somewhere around 20 Celsius degrees. This requires no heating system in winter and a cooling system in summer.

7.6 THE ADVOCACY OF VM TO IMPLEMENT SC

Most interviews indicate that the drive towards achieving SC has slightly increased and opposition to its implementation have decreased. The interviews revealed that VM is a fundamental methodology for decision making, solving problems and adding value to projects. The direct application of the VM process was shown to be sufficiently robust to cover most decision making issues and means associated with implementing SC to ensure all decisions are properly taken in the best interests of the project. The VM approach was demonstrated to be a very useful tool to join all key stakeholders together in one place for negotiating, agreeing and sharing common strategy for SC across the constituency of the stakeholders and to clarify how this strategy should be rolled forward.

It has become clear, from the analysis of interview data that the generic strength of VM is the clarity of understanding of the project as well as communication between the different specialists and stakeholders associated with the project. Function analysis is particularly used to show the system components and its relationships. Consequently, people will have better means of expressing and exploring the issues associated with SC principles and whole life cost. So, the project will be seen as a whole and as a sustainable system. VM also has a vast number of tools and techniques to be used rationally to ensure the credibility of ranking and prioritisation.

Several interviewees mentioned that once the clients have decided to use VM in their project, they guarantee an independent monitoring system verifying that all the processes of the project are being implemented according to the required standards and performance. This was revealed to include the appointment of a sustainability advisor.
who should not be part of the design team for the whole project, to ensure that the SC principles are considered and implemented in the right way.

It also has been established, from the findings of interviews, that fast diagrams or/and value tree techniques are commonly used in the majority of the VM workshops conducted in construction projects. It has been found that SC principles were incorporated into value trees or fast diagrams in some VM workshops considering the implementation of SC. However, each workshop is different and needs to delve into different ways to integrate the necessary principles such as risk, lean, VM and SC workshops. Furthermore, the results of this study emphasised that the use of mind mapping technique in the project is very important from a SC angle. A number of interviewees recommend the following questions to be posed in the design stage: “How is the project going to be put together? What are the important and required aspects associated with SC? What are the expected risks that could arise from the ideas generated? Which actions can mitigate this risk?

Most interviewees agreed that the use of VM at early stages enables stakeholders to look at each project from variety of perspectives: a function perspective in terms of SC principles social, economic and environmental. They also articulated that VM is important and can create an opportunity to get the stakeholders of the project to devise and sign up on a common position and a shared strategy for SC and the extent to which this strategy is going to be implemented. The VM team will gain more information to understand the project rather than a group of people sitting around the table and talking in a meeting fashion.

The findings also pointed out that stakeholders are sometimes afraid of the expression of SC and are reluctant to adopt the concept in their projects. However, the interviewees demonstrated that the principles of SC can be implemented in the projects without mentioning SC (which they perceive as strange). A number of interviewees saw that the inclusion of a green agenda to be discussed in a VM workshop is of great benefit because both VM and SC can deliver green buildings at the same price as non-green buildings. They also mentioned that it will also ensure value for money in capital cost,
gaining a better quality building with minimum running cost and producing an easy and cheaper building to operate/use. It was established that many practitioners implement SC principles without naming them: sometime they call them environmental issues or resource conservation, and sometimes they do not know it but they want to maximise the whole life cost of a project. Accordingly, they pay attention to producing healthier buildings and nobody complains, all of which is also very good for environmental reasons and as part of the SC agenda.

7.7 BENEFITS FROM THE INCORPORATION OF VM AND SC

The experts interviewed in this study declared that integration of SC and VM will increase the demand of VM due to the strong imperative on the implementation of SC all over the world. On the contrary, they stated that VM is a technique to ensure the implementation of SC in a most comprehensive and robust methodological manner. They also emphasised that the integration will help practitioners and stakeholders to enhance their skills and knowledge and add value to the project. One interviewee said:

"I have never ever seen drawbacks from implementing VM rather than the very positive ratios whether they are 200, 10 or 5 or some other figures. It is just the value of undertaking clear decisions at the early stages of the project and the relationship between the decision making and the time of the project and its effect on the cost is well known".

The interviewees also confirmed that incorporation of VM and SC will result in added value and monetary savings over the whole life of the project. One expert stated that the savings caused by conducting VM was measured as ratio of 200 to 1, which means the cost or benefit of conducting VM in a project was 200 times against the cost of the workshop. They also revealed that the consideration of SC in the design strongly encourages the innovation in the project and minimises waste and material use.

Moreover, the interviewees clarified the idea that the implementation of VM and SC as a combination in one study does not take much time or affect the schedule of the project.
when compared with having them done separately. The experts claimed with regard to
the cost perspective that there is little extra cost in comparison with delivering clients’
aspirations, needs and requirements as the cost of carrying out the exercise is only the
wages of the people involved in the study. VM costs are very low if it is applied at the
right time, especially when VM integrates into the project development process. The
potential cost of not doing VM is enormously high when we consider the long-term of
the project.

7.8 DEVELOPING AN INTEGRATED APPROACH TO VM AND SC

Many interviewees claimed that the proper way to develop an integrated approach to
VM and SC for construction projects would be to follow the VM Job Plan, and the
principles of SC and VM should be fitted quietly and smoothly into the Job Plan
methodology. They also recommended that the framework to be proposed as part of this
research should come from high senior management to the affected stakeholders,
including design team. The framework should illustrate clearly the benefits that can
accrue as well as fitting the processes, techniques and tools into the suitable places on
the Job Plan and giving them their appropriate importance. They also focused heavily
on the clarity of the project objectives within the workshop, and the selection of a team
that has the right array of knowledge and experience to be able to address the SC issues
for that specific project. A number of interviewees recommended as essential the use of
a variety of approaches and different methodologies rather than just relying on one. It is
often argued that the dominance of the SAVE methodology, which is one way of doing
a workshop for all projects all over the world, might prevent innovation and lead to
sterility.

The experts also suggested that the benefits of implementing SC principles in projects
should be introduced to clients and key stakeholders, in addition to providing them with
as much information as possible in advance of the study. They contend that once clients
understand the approach, they will go for it and that it depends on how well SC is
facilitated as, if people think they will gain more benefits from its achievement, they
will strongly support its initiatives. Moreover, they also argued that decreasing the VM
workshop duration to one day instead of five would be useful and lead to more innovation in addition to creating greater opportunities for the participation of key stakeholders and top management.

7.8.1 PLANNING
Most of the experts interviewed in this study stressed the need for the planning stage (strategic meeting) in any project to identify information sources and key stakeholders for the project and to identify the right issues to be addressed during the VM process, in addition to appointing the facilitator and the sustainability advisor. However, the procedure of applying VM differs from organisation to organisation. Some organisations have an in-house VM team and some of them bring in external specific VM consultant firms to conduct the study. But, in both cases, VM implementation depends on the strong advocacy and support of senior or top management. The interviewees asserted that the support of top management or clients depends on their understanding of VM and SC and their importance and benefits, and that it is not something that they routinely think of doing. They also emphasised the power of senior management to enable its implementation and the project design team to schedule sufficient time for it in the project process developments. Moreover, they advised the project team to agree at the beginning of the project on suitable processes to be used in the project design.

They additionally focused on the importance of planning and information stages by raising awareness among key stakeholders of the three SC-associated “bottom lines”: environmental, social and economic factors. Furthermore, they importantly advocated the issues to be incorporated into the VM processes to facilitate implementation of SC principles into the project. One of experts recommended posing, at early stages of a project, questions such as the following: Who are the key stakeholders? How can they attend the workshop? What are options or alternatives or solutions that could be generated for implementing SC? What are the risks that could happen in the project? How can these risks be avoided or mitigated and fixed into the nominated stages?
7.8.2 THE TIMING OF SC AND VM
The interview findings confirmed that the best time to integrate and implement SC and VM is at the outset of a project. They justified this by underlining the difficulty of identifying the overlaps between considering one area and another. They also believed that VM has connections with SC principles and other techniques that add value to the project and contended that because each project is unique, there might be a need for additional time to gather the required information either for SC or other disciplines. Also emphasised was the great importance of scheduling the timing and number of VM and SC workshops from the beginning so as to avoid any circumstances or delay that could affect the timetable of the project.

Most of the interviewees entirely agreed that the best time to consider VM and SC by the key stakeholders is at the earliest possible stage of the project. This means that the consideration of SC and VM as early as possible will result in better benefits and these benefits will increase if the contractor is appointed in advance to participate in the design process. They recommended the use of the design and build method in order to obtain a clear opportunity for delivering sustainability through the project design. The stages mentioned are: pre-design, early stages, conception, conceptual feasibility, pre-feasibility or feasibility design. Four interviewees stated that:

"SC is a new philosophy and a way of thinking; if it is done at early stages it gets embedded in the mindset of people and that can feed through the whole life of the project."

"The best stage to consider SC and VM is the concept, the feasibility or the pre-feasibility and then into the design; it may be more than one workshop according to the size and complexity of a project. Some clients start the project without knowing what they want. Thus, in the workshop it comes down and defines the clients' requirements and wants, so the essence of conducting the study at the early stage is easier to help the clients and rationalise the consideration of SC principles and other suggestions."
“If the concern of SC is left until the outline design stage, it is too late to change the mindset of clients to go back and consider implementing SC in the project, so the suitable stage is as early as possible”.

“It is very important to consider SC at all stages of project developments. But if you do not get it right at any particular stage then it will fall down. If you don’t get your brief right, then you will not have anything to work on; if you do not get your design right, then you have not gotten people who are committed to doing it, if you do not do your tendering correctly then it all goes away, if you do not hand it over properly who knows how to manage it then it has all gone. And if that person does not have the right skills to manage it in a long-term then you lost it”.

An interviewee who works as project manager and Certified Value Specialist (CVS) stated that spending money upfront on a project will result in savings in the feasibility design and construction phase. Another interviewee said

“if you want to spend money and spend it wisely then spend it much in advance of the project because you are not committing all those thousand and thousand and million pounds into hardware”

7.8.3 SOFT AND HARD VM
The experts interviewed in this research advised that the use of both hard and soft VM approaches is crucial to come up with a successful VM and SC study. They agreed that the approach of soft VM is very important initially at an early stage of a project to open the eyes and minds of people involved for the benefits of SC and to identify the roadblocks for its implementation in the project. On the other hand, the approach of hard VM is important for thinking more about generating specific options and alternatives. Two interviewees defined soft and hard as:

“Soft is the perception of people; while hard are about pounds notes”.
"Soft relates to values whereas hard relates to finance which gets it back to value engineering".

They suggested asking a couple of questions to facilitate debate in order to come up with important issues to help draw up action plans for the implementation of SC into the project.

7.8.4 METHODS TO IMPLEMENT SC
Most of the interviewees perceived SC implementation as not significantly different from other subjects or decision making techniques in any project, but stated that the clients need to think about SC from the outset of the project, from different angles and not just consider keeping initial costs as low as possible. They emphasised that clients should employ sustainability advisors and consultant firms when they (clients) have gathered solicitors, the financial people and the main team members such as other disciplines, namely, structural or mechanical or electrical engineers.

The interviewees lamented the fact that contractors are often not appointed at early stages of the project and that it is of great benefit for the clients to appoint contractors at early stages to participate and give their views on the project design. The expert interviewees emphasised that clients should take into account in the employment of an architect the possession of significant experience and knowledge about SC. They also recommended that SC specialists should be involved in the design and decision making processes from the beginning. They justified this view by saying that these processes will enable the clients and project manager to integrate all specialists and disciplines in the right way to consider the implementation of SC principles. Two interviewees postulated that:

"Architects are typically not very good at SC, especially big name architects".

"the first step that the client should do in the first thought of the inception of the project is to think about the SC, when the client considers sustainability
earlier, it is easier to be executed in the project. The critical thing with achieving SC is monitoring the process throughout the whole stages of design, planning, development, construction and operation; if that monitoring does not properly happen, then it is very easy for the client to lose all sustainability elements and just end up with box standard design”.

Most experts indicated that it is essential to ensure that VM is embedded in the project development from the outset. They stated that the key advisors of VM and SC should be highly qualified, knowledgeable and have a good reputation in addition to being independent because the most successful projects occur when the people have been given the necessary independence. A number of interviewees mentioned that the roles of the advisors are to assist clients to guide them and determine the rights and benefits associated with both VM and SC implementation from the outset of the project to the handover to come up with the most effective and efficient project.

They also highly recommended that clients need to give attention to effective briefing in the design and management of the project, particularly during tender documentation of the project, instead of focusing on the design stage for achieving SC. The challenges that they should consider throughout the project developments are avoidance of waste and toxic materials and minimising resource consumption, in addition to considering social and economic issues. An interviewee mentioned that:

“the current quality of buildings design is inadequate and a lot better can be done at the same price, because it is not about money, it is about design and about quality. It does not have to get around the client; it just has to convince him/her that it can be done a better job”.

The experts strongly advised clients and contractors to look for more qualified, suitably educated, trained and certified people who have the right experience and knowledge to deliver green buildings for real value for money. They also recommended that they should be involved in the project design developments on a full time basis because the big gaps for implementing SC are to use the right people with the right experience and right knowledge at the right time.
Some of the interviewees strongly recommended assisting the contractors in obtaining good profits because this will incentivise them to deliver sustainable buildings, and will prove good publicity to attract other contractors to bid to construct sustainable building projects and enhance their knowledge and experience in terms of SC. So clients, especially governmental agencies, have been encouraged to strive to assist contractors to gain financial advantages when they are constructing sustainable buildings through subsidising sustainable products and materials. The findings of this study pointed out that SC and VM issues have to be seen as an integrated system into the project. This will happen by adopting a management approach to create similarly integrated sound common sense implements through the planning stage. The system should take account of all appropriate interventions not only for SC aspects, but also for other techniques and disciplines.

A number of interviewees said that the greatest benefit of the implementation of SC and VM is to produce a successful project with minimal whole life cost, environmentally friendly healthy materials and comfort for its occupiers. Moreover, some interviewees advocated building exemplary projects adopting sustainable principles through VM. They consider this as a clear demonstration of the integration of both topics to convince and encourage the key stakeholders to espouse this approach. They also recommended delivering buildings together with the matrix of the cost of their various sustainable elements which will be the strongest demonstration to convince those who might oppose the implementation. An interviewee stated that:

"The efficient way of implementing SC is to include it as part of the main stream design process and not as an add-on, or something which has to be organised on additional demand".

Many experts claimed that offsite fabrication is a significant method of reducing waste and for improving the quality of projects. Moreover, the innovation related to natural ventilation and daylight for traditional buildings is a fundamental way to minimise energy, water and air conditioning. One interviewee, who had worked in Saudi Arabia, said that because of the huge challenge of the shortage of drinking water in Saudi
Arabia they had searched for ways to efficiently maximise the use of water in building projects. One of the methods that were being looked at in Saudi Arabia involved encouraging developers to use suitable natural vegetation on landscaping rather than trying to replicate European vegetation which then requires an incredible amount of irrigation. The results of the interviews indicate that there are many things within the buildings themselves that can be done to improve water and energy consumption. These attempts include using aerated spray showers where air is forced through shower jet so it can obtain the effect of a powered shower but with only a fraction of water, because the air is actually forcing the water through. This is in addition to emphasising the use of passive means as opposed to technically mediated means and devices and appliances.

7.8.5 THE TECHNIQUES AND TOOLS
The findings of interviews indicated that the selection of appropriate tools and techniques as well as the methodology used in the project design and execution are very important for obtaining successful and sustainable projects. The interviewees stated that suitable tools and techniques should be selected from the starting point in a strategic meeting for applying a VM Job Plan for the project to help the design team to achieve project objectives. They also mentioned that VM offers good services and relevant tools and techniques based on the workshop, including the team, outside views and knowledge to explore the project from different perspectives.

According to the interviewees, the main techniques and tools used by the organisations and experts investigated during VM studies and considering SC into the process of design developments of the project are: Mind Maps, Function Analysis System Technique (FAST), Value Tree, Legal Economic Political Environmental Social Technological (PEST), Soft Skills, Force Diagram to obtain all the barriers up on the sheet, the KISS Principle (Keep it simple, stupid!), Pareto Rule (80:20), Cause and Effect Diagram (Fishbone or Ishikawa), Process Mapping, Cost-benefit analysis and Whole Life Costing Analysis.

They also mentioned guidelines and tools used in considering and evaluating SC which are: the London Plan Supplementary Planning Guidance, Building Research
Establishment Environmental Assessment Method (BREEAM), ECOHOMES, the Leadership in Energy and Environmental Design (LEED), The Sustainable Project Appraisal Routine (SPeAR), The Civil Engineering Environmental Quality and Assessment Scheme (CEEQUAL), Environmental Impact Assessment and Whole life cost (ENVEST), Sustainable Building Assessment Tool (SBAT), the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) and SBo5 Tokyo in Japan.

7.8.6 THE LIMITATIONS OF THE INTEGRATION

The potential limitations and constraints of implementing and integrating VM and SC identified in the interviews were as follows.

- The reluctance of the stakeholders to participate in the workshop. The interviewees revealed that this was due to:
  - their tight schedules;
  - lack of awareness of benefits and drivers of VM and SC; and
  - long duration of the workshop (40 hrs).
- Insufficient time allocated either to the project as a whole or to VM and SC workshops.
- Resistance to change associated with the implementation of VM and SC from clients who do not want to change their way of working.
- Clients see the process of the project design as a fast track programme and VM is seen as a platform stop for getting off from this fast track.
- Instrumental outcomes are never guaranteed and seldom end up with the outcomes anticipated.
- Difficulties surrounding getting clients to buy into VM and SC.
- Lack of guidelines for VM and SC implementation for clients, contractors and architect firms.
7.8.7 THE STAKEHOLDERS

The interviewees stated that the best way to identify key people is by using the stakeholder analysis technique, classifying them according to their importance to the project and identifying their needs and interests in addition to engagement and access of achievability. They recommended that the actual key is to identify the difficult issues associated with the implementation of SC in the project. Having identified these issues, appropriate methods for overcoming them are then sought. The interviewees also stated that the roles of stakeholders are different from each another. They mentioned that some of them must be actively managed and some of them should just be kept informed. A number of interviewees recommended that the key stakeholders should be involved in the study, such as clients, financers, project manager, and people with knowledge of public amenities, the water board or electricity supply. They also recommended the participation of the regulators and the planners who feel that they cannot achieve their views because of conflict interests but it is certainly something that can be sorted out by mutual discussion.

The experts interviewed identified the expected key people to be involved in the implementation of SC as clients, developers, project managers, the financial and main design team members (architects, engineers), contractors and subcontractors, in addition to some local authorities. Some of interviewees stated that the Architect and project manager should have knowledge and experience about SC and they should clearly introduce its benefits, principles and drivers to all participants in the project. Moreover, the involvement of the community, design team and the end-users of the project are very important to obtain sustainable projects. Two interviewees said:

“If we have unsustainable buildings then everybody suffers”.

“SC cannot be done without everybody signing up; if somebody does not sign up to it then will be a risk”.

Most experts said that the consideration of SC is not for particular people: it is for all and particularly for the clients’ desire. They recommended that clients should appoint a
champion to follow up and coordinate between all the parties participating in the project to successfully implement SC. An SC advisor said that:

"It is actually a specific project management service of sustainability to deliver sustainable buildings”.

The interviewees also mentioned the following key people who should participate in VM buildings projects workshop: the client, architect, cladding facade consultants, and mechanical and electrical consultants, in addition, the local communities and both the employers and employees who will be using the building should be consulted.

Moreover, the interviewees clarified that the reason behind the participation of stakeholders in the workshop is to give everyone the opportunity to influence and defend his/her views associated with the project. One of the interviewees mentioned the following exemplar about a school workshop: the identified stakeholders attending one school workshop were the local authority who pay for it, the teachers, the schoolchildren, the children who might have been to the school before children coming to the school, the local community who might affect/be affected by the path to the school, the transport infrastructure, the local police, the shopkeepers and everybody having any views were entitled to attend and participate in the workshop. In this case, everything about the project and why it should be done were known. In this workshop everything about the school was known, which helped meet all stakeholders’ valid wants and needs and nobody was seen as more important than any other in satisfying their requirements.

An interviewed facilitator provided an example of a VM workshop associated with London underground with a large number of stakeholders. They held an exhibition for the participants to demonstrate how they designed the project, how they were using the latest cutting-edge equipments, how they reduced costs, and how they carried out Value and Risk Management. Subsequently, the local people who were also stakeholders actually came back and said:
"We do not care about any of that, how much dust is going to be on our washing lines?"

They went back and thought “OK, we now have to satisfy the requirements of our stakeholders”.

An expert working in Network rail organisation stated that they hold VM study as an internal (in-house) study, with the participants coming from Network rail agency. These participants have knowledge and experience associated with the study aspects. However, sometimes they bring people who are specialists in a certain area from outside the organisation. These areas typically include:

- the environmental agency as they have knowledge about sustainability and the latest requirements and needs;
- the British Transport Police (equivalent to police force in transportation): they have knowledge in crime prevention with experience of particular crimes in certain areas; and
- people with relevant knowledge from the public amenities such as the water board and electricity supply.

7.8.8 THE PREJUDICE TO CLIENTS
The findings from the interviews showed that the VM approach cannot influence or force clients to consider the implementation of SC or other topic in their projects without knowing their benefits obtained from its consideration, because everything is aimed at meeting clients’ requirements, legislation, planning and guidelines. A number of interviewees stated that the VM team is often independent in most studies and is not compromising the clients, but it does endeavour to educate them with the required information to enable them to make better decisions. They also claimed that clients have rights and options to reject or accept the VM study’s outcomes including recommendations and alternatives. Moreover, they mentioned it is not easy to prejudice the clients because most clients or their representatives are multidisciplinary and
knowledgeable people. Therefore, they also mentioned that some recommendations and proposals introduced by VM team were not often accepted by the clients.

The interviewees also argued that there is a lot of room to improve the quality of building designs at the same price. They stated that it is not about money but about design quality and innovation. They believed that the application of VM and SC can provide clients with useful recommendations information and rationale for helping clients to make clear and informed decisions. They also held the view that the participation of the clients in VM studies are very crucial to removes clients’ misperceptions that SC costs more than traditional projects. The expert interviewees contended that once clients understand SC, they can accept it and obtain better design quality, better indoor environment, less use of resources, reduction in all running costs, better staff retention, lower recruitment costs, better biodiversity, and removal of penalties as charges caused by pollution; in addition, clients can acquire better products which meet their own needs and wants but with no added expense.

The interviewed VM practitioners mentioned that while they facilitate VM workshops, they normally identify clients’ and study’s objectives in addition to advising clients of important missing issues that the design team have not considered, such as SC. Typically, if the clients are interested in considering SC, they normally introduce them to its principles, benefits, drivers and limitations. Consequently, the clients will ultimately understand SC and this will enable them to make a suitable decision, i.e. whether to consider it or not without any prejudice. The experts also declared that clients or their representatives are always part of the design process and that the objectives of VM workshop are derived from the client’s objectives. Therefore, whether the clients are participants or not, the VM team always seeks to address the clients’ objectives, requirements, needs and wants. Moreover, they mentioned that the clients and their teams are often required to participate in order to establish value criteria, which are clients’ criteria rather than technical team’s value criteria.
7.9 THE PARTICIPANTS’ ROLES

The duties of key stakeholders listed below were obtained by asking the interviewees “Who are the key stakeholders and what are their important roles in a VM study in order to consider SC in a project?” They generally mentioned all stakeholders have responsibilities in considering and implementing SC, however, they mentioned that stakeholders have different influences and missions for the projects and they identified a few tasks for the following stakeholder groups. They also emphasised that the consideration of VM and SC in the building design process is very important because the ultimate success of building developments is significantly attained when the main stakeholders are involved in design processes from earlier stages. They also strongly recommended the participation of the key stakeholders in the VM study as their absence may result in conflicts and subsequent dissatisfaction among these stakeholders.

7.9.1 THE CLIENTS

The experts agreed that the clients usually have the major influential role to consider the implementation of VM and SC in the project. They highlighted the following tasks associated with clients in order to consider VM and SC in a project.

- The client should pay attention in the appointment of an experienced facilitator who can bring the best out of the group as well as team members in addition to engineering and consultant firms.
- The establishment of very clear objectives for the project that the design team need to address through the design.
- The identification of the project constraints such as time, finance, strategy, layouts and requirements of the buildings in addition to operation and maintenance requirements.
- The clients should be open-minded and not have made decisions before understanding and beginning the VM and SC processes.
The client should have multi-specialist people and independent experts for consultation to obtain the right advice and comments on the proposals received from the consultant and architect firms.

7.9.2 THE FACILITATOR

It has been elicited from the findings of the interviews that the facilitator should always be independent and not influenced by anyone during the facilitation of the study. They stressed that he/she should understand the full scope of SC and VM in the workshop to guide the design team and select the right people, right processes, right techniques and suitable tools for the project. They stated that the facilitator should deal with each project as different and unique and ensure that key stakeholders are identified and invited for briefing beforehand. They claimed that the facilitator should determine the requirements and value for each stakeholder as well as their duties in order to satisfy their needs and requirements in the project. The followings tasks were elicited from the interviewees for facilitators.

- The facilitators should fully understand VM and SC principles to educate team members and key stakeholders and incorporate these principles into the design process.

- There is an important opportunity for the facilitator to spread SC throughout the VM workshop by introducing SC benefits and drivers to the design team and key stakeholders. These will also enable the design team and stakeholders to obtain the guidelines to adopt SC in the project and will raise their awareness about SC and how it can lead to added value to the project.

- A facilitator should identify valid needs, requirements and wants of the clients/customers and end-users in addition to ensuring that solutions and alternatives given by all participants in the workshop are reasonable and viable.

- After appointing a facilitator, he/she should help clients to plan for the application of the VM study in appointing the team, setting objectives, and preparing the timetable and agenda for the study, in addition to checking all the elements to ensure that nothing is missed.
Facilitators should not try to do everything by themselves and must know their own limitations. They should bring specialist people to undertake those tasks that they cannot deal with such as running creativity workshops, SC, function analysis and similar techniques.

The facilitator should ask open-ended questions and carefully listen to all the participants. He/she should be open-minded in approaching a VM study and should encourage the consideration of SC during the VM exercise.

Each facilitator should usually be familiar with a reasonable portfolio of tools and techniques to cover most issues required in a workshop. He/she should also know what further expert support in terms of facilitation might be necessary to produce innovative ideas and solutions.

7.9.3 THE TEAM MEMBERS
The experts mentioned that the establishment of the clients' requirements and the objectives of the project should be based on skills, experience and knowledge associated with VM and SC, in addition to the right disciplines of the facilitator plus team members. A number of the interviewees also stated the team members should also be able to contribute to any aspect of VM and SC without constraints within their own disciplines, all of which will grow the understanding of the key stakeholders and enable them to apply SC principles in the project.

7.9.4 THE OTHER PARTICIPANTS
Most of the interviewees mentioned that participants should be open-minded, have professional responsibility and trust each other. They also recommended the participations of owners, operators and users of the property from the outset of the project to give the design team specific user requirements and other useful guidelines. A number of interviewees also mentioned that facilities managers have the biggest say in considering SC principles because they focus on operational perspectives associated with operations and maintenances in terms of issues such as types of boilers, fixtures, electrical and appliances devices, and other equipment used in building projects.
They also mentioned that manufacturers, suppliers, contractors and team members have responsibilities to produce better sustainable equipment and materials, innovative ideas and alternatives. They said that by doing so they will increase the size of the sustainable buildings’ market and do better than they are doing now. Two interviewees said that the participants should work together to introduce a futuristic system that can address the contemporary agenda associated with SC implantation. One interviewee stated that:

“They should make a difference; it is actually about making Rolls Royce buildings rather than larger buildings”.

7.10 DRIVERS OF SC AND VM

Many interviewees stated that there are limits to the ability to provide resources for our needs and absorb harmful impacts of the pollution created on the planet. They also mentioned that climate change plays an influential role in terms of considering SC principles. They said that a holistic, long-term and short-term outlook is needed to deal with problems in the UK associated with the warmer and warmer climate. They mentioned that sustainability issues are top agenda items across international governments and with the general public all over the world. Therefore, there is a huge need for the whole underpinning of SC principles to deliver better and fairer distribution of resources to deal with health, biodiversity, dignity, equity and mitigate negative impacts. The interviewees mentioned that many clients want successful, economical, healthy and environmentally friendly buildings and VM can be used as a vehicle to implement SC principles to achieve this. This section introduces a number of drivers for adopting the implementation of SC principles.

One expert interviewee said that 30 years ago, people started thinking about sustainability as weird, but nowadays they believe that sustainability is actually common sense and beneficial for us, as well as our next generations. They also mentioned that people nowadays want to obtain better value for their money formerly used to pay for unsustainable buildings and where they did not gain the expected benefits. One of the interviewees claimed that anticipated advantages obtained from
adopting principles can be much healthier buildings, more self sufficient and better buildings and landscape.

It has been concluded that the implementation of VM is addressing the real cost of all elements that constitute the whole life of the project which can do much better and maximise the value for the client. These will enable the client to make a profit from constructing sustainable buildings if he/she wants to rent or sell or occupy it. One interviewee said sustainable projects can be delivered with the same money (the initial cost) spent on traditional buildings. He also stated that SC does not cost more, but bad design does.

7.10.1 THE CLIENT
The experts in SC mentioned that the majority of clients considering sustainable design approaches in their building projects were very satisfied because they came up with better buildings which were high quality and easy to manage, let and sell. These buildings were also cheaper to run in the long term, had a better quality environment, produced less liability, were naturally ventilated and illuminated and more easily maintainable. They last for longer and do not generate too many fumes and odours; they are self cleaning in terms of windows, doors, floors and some perspectives, and are environmentally friendly. The occupants or staff who live or work in these buildings are very happy, more productive and less prone to absenteeism; and there is a better environment for people to learn in. These sustainable buildings also save money and resources and have less carbon footprints. An interviewee said

"It cannot be thought that clients will not want to build sustainable projects although they can be run 40% cheaper over 20-25 years over the whole life cost rather than the unsustainable ones".

One interviewee stated that the research proved that the absenteeism in sustainable building is less than in normal or unsustainable buildings, so a great number of benefits accrue to the clients in terms of social, financial and environmental issues. However, another interviewee said some of the clients were disappointed because they had not
obtained the building with the benefits expected because the processes throughout implementing SC were not monitored. The interviewees emphasised that a sustainable design approach considers the whole life cost of the project and the project will recoup the extra money within a few years if there are no further costs occurring. They also mentioned the clients can benefit from the positive media coverage as well. A number of experts stated that many clients rely on funding agencies to provide the capital cost for the project under the condition that they consider SC in these projects and this generates a growing interest in ethical investments.

The findings of interviews conducted in this study indicated that the planning policy in the UK requires a sustainability assessment for each application submitted to build new buildings. This means that if the clients take sustainability on as a mainstream design issue, they will obtain the planning process relatively easily, which can save time and money in issuing and approving the planning application without delay. The interviewees mentioned that there are strong client drivers to consider SC approach for delivering sustainable buildings which are: obtaining good publicity that will enable these projects to win various awards which will encourage developers and stakeholders to move forward and deliver more sustainable projects in that manner. The project will have a very high profile for more practical aspects until they end up with a high quality development, which normally will have much lower operational cost because one of the objectives of sustainable design process is to minimise the maintenance and operation throughout the whole life of the building. Two experts narrated the following stories:

"The existence of termites in the southern hemisphere is affected by the orientation of buildings with relation to the Sun. They are edged on the sun in the morning when the sun hits that side all the termites go to that side of the building and in afternoon they go to that side of the building and that is what happens in modern tower blocks. The people also move away from the sunny side to the cold side and then in the afternoon it will be the other way, which means these buildings were built wrongly".
"We design a healthy house in Perth which was monitored for 2 years for low allergy to people who are infected with asthma. A 74-old-woman who lived in the house had been taking prescriptions for 50 years. Her prescription for the first year was downsized by a half which means she had saved approximately £300 on prescription bills. She saved on both the prescription bills and the energy by having a low energy house. She now believes that all new houses being non-allergic would be an enormous saving to health services."

7.10.2 THE OCCUPANTS OR USERS
A number of interviewees said that facilities managers are very positive regarding the implementation of SC principles in their building projects. Their perceptions are to increase the cost of both phases of design and construction to recoup the increment if any and save in the other phases of the project, namely, operation, maintenance and decommissioning which are very essential factors in terms of reducing the whole life cost of any project.

The findings indicated that the users and occupants would like buildings that have good appeal which will help to avoid local residents' objections to the project. They also emphasised the quality of light and lots of natural daylight and ventilation works which are very important for users. Two interviewees said:

"One organisation made a survey of their staff who work in sustainable building and they found them very healthy, happy and enjoying working in this building which helps the organisation in retaining their staffs".

"We can advertise or market ourselves that we stay in a green building which is carbon natural which will enable us to have benefits to win potential clients and show that we care about people, economic and environmental issues."
In general, it is surmised from the interviews that when the project is built more sustainable, the running cost will be less and the building will be healthy which will attract occupants to work in it with high productivity. One interviewee said that the findings of research found in a recent study done on school pupils showed that when children taught in well day-lit classrooms, they perform 25% better than children taught in lower daylight. It is indicated that the best indoor air quality is typically natural daylighting and natural ventilation (as opposed to artificial lighting) leading to a boost of 26% in reading and writing. This is seen by interviewees as added value that one cannot put a price on. Moreover, an American study proved that buildings with high indoor air quality cost less than traditional buildings and they found 90 percent of the cost of running a company is salaries and 10 percent is maintenance and energy.

7.10.3 THE CONTRACTOR

The interviewees articulated that the consideration of SC principles helps the contractor deliver more healthy buildings and better product with high quality work. Moreover, they informed us that contractors will save money from reducing waste and inefficient use of water and energy, which are the biggest things that contractors might suffer from in making profit. They also mentioned that the adoption of SC will increase the branding, reputation and marketing of contractors to obtain more tenders and these benefits can enable them to sell themselves to other companies and projects. They anticipated in the near future that the consideration of SC approach will be a main criterion in selecting the contractor. Many experts expected that the construction industry is very grateful to accept realistic sustainability because it is a way of funding of any futuristic regulations. They also believed that construction companies would adopt SC principles because many governments will regulate its implementation if the companies do not attempt their achievement by themselves.

Furthermore, a number of experts articulated the view that the implementation of SC will enable each contractor to become a specialist in a particular job, such as fixing fibre glass insulation into a wall, and using more environmentally friendly insulations. They mentioned SC will help contractors to use sustainable, healthy and organic paints and materials without smell or negative impacts either to the environment or people. These
materials are also good for the peoples working in-site to develop at least good site practices that distinguish the good contractors from others; these were considered as self-evident benefits for contractors.

The results of interviews indicated that there are green developers and contractors who can develop sustainable projects. An interviewee stated that:

"We are certainly busy with developers; I have spent the last 10 years trying to interest developers and contractors in adopting a sustainable agenda. For some reason, in the last 18 months "Click!", a light bulb's gone on and they see the development opportunity, whether it has to do with the sudden rise in the energy prices or to avoid climate change. I have been sitting for 28 years working for this movement to happen, so I think the big responsibility is put on architects, clients and less responsibility is for contractors".

7.10.4 OTHER PEOPLE

The interviewees mentioned other advantages for many people involved in the project. They mentioned that benefits for team members depend on where they come from and their disciplines. If they have environmental or sustainable backgrounds, this will help them to sell the benefits resulting from implementing SC. They can return to their organisations and managers and tell them that they have participated in delivering a green project. Government agencies including local councils would buy it because it fits their policies associated with sustainability. This is driven by architects with their philosophy and green developers. Different countries have got different drivers: the UK is driven by architects and green clients who want to build "green" houses or other facilities. This has been happening in Germany and Austria for years by green developers as well.

They mentioned different drivers that would come from diverse perspectives to consider SC. These drivers would be incentives, political pressure, pressure from environmental agencies, and pressure from Friends of the Earth or Greenpeace or any environmental
side. They stated that people have become more aware of SC with regard to environmental, social and economic concerns. They expressed the view that SC has come to the top of the agenda in the UK and other countries. Therefore, it is very important to find how the construction industry should respond to this request.

7.10.5 DOES SUSTAINABLE CONSTRUCTION COST MORE?

Many SC practitioners interpreted the main reason behind the perception of extra cost attached to SC as resulting from bad design, including preaching about unsuitable equipment and materials such as wind turbines or portable cells which are not appropriate for some buildings and are expensive. They also illustrated that people think SC costs more due to the current practice which is cost optimisation and unbelievable wastefulness. Furthermore, they mentioned that buildings cost a wide range of different prices depending on their specifications, brief and the way of managing and constructing them. An expert in SC articulated the opinion that sustainable buildings are achieved by getting the basic things right and doing it cost effectively.

One SC expert also said people do not believe that SC implementation does not cost more even though they are continuously told so. He also said:

"I have done many keynote speeches at many conferences. I have done around 30 lectures in the year saying 'Hello, SC does not cost more! Hello, hello you are listening over there? It does not cost more!' and even when I have finished the lecture, the first question always posed was 'Will it cost more?' I have just spent 45 minutes telling you it does not cost more. Oh yeah, but does it still cost more? And it is like how much prejudice?"

Moreover two interviewees said that:

"An office building was designed to be a sustainable building with the same cost as in a traditional building. This proved that the same money spent in the initial cost to build traditional building can be used to construct sustainable buildings".
"If it is sustainable it does not cost more, bad design costs more. The use of whole life cost can generate precise figures to justify and demonstrate savings on water, energy and materials which can switch more people on to adopt more SC at early stages of their projects".

By way of contrast, some interviewees stated that buildings which have greater sustainable elements will cost more because they will require materials that have higher cost: 5-10% of the value of the normal building. But they mentioned that sustainable buildings will payback the extra cost through their running cost during operation and maintenance and productivity of employees over short periods varied from 5 to 10 years.

It was also emphasised that the calculation of whole life costing is very crucial for illustrating the benefits that can result from the implementation of SC. The interviewees claimed that the advantages will not only be for clients or contractors but also for the environment, parties living near the project and occupants as well. They stated that completions will help to obtain more information about costs of all types of buildings to build precise historical data base about sustainable building projects. An interviewee said that the design fees could increase if the application of VM and SC are done by external consultant firms rather than in-house division of the same organisation. Moreover, he said capital costs of design and construction could increase due to better materials, better efficiency, and better design that take a longer-term view.

7.10.6 LEGISLATION AND POLICIES
The study indicated that most governments all over the world have their own agenda to move toward implementing the principles of SC. The interviewees stated that the principles of SC have come to the top of government agenda in the UK to focus on how the construction industry should be operated in terms of whole life considerations, social context, and environmental impact issues. They emphasised the idea that, in the UK, planning policy requires a sustainability assessment for every application submitted. However, it was revealed that a large number of governments all over the world are unwilling to regulate the construction industry in terms of SC implementation.
Therefore, there are elements by which they can promote the notion of SC as a form of soft regulation.

The study also indicated that the significant enablers currently being increased such as governments’ legislation and policies pushed the key stakeholders in the direction of SC principles consideration. However, some interviewees said that the policies and legislation are actually following rather than leading. They believed that the regulations and polices issued so far are below what are expected and needed from the developers. Moreover, they believe that developers are very unambitious and do not like to think about SC because some of them have always thought that they were way ahead of the game and not fallen behind.

The findings of study also revealed that a number of countries have issued their regulations and polices such as Holland, Denmark, Austria and Sweden, Australia, USA, Japan and the UK. They have all gradually increased the standards and specifications of implementing SC principles. Some of these countries are subsidising the use of wind power, renewable energy and sustainable materials. They claim that all these issues are subject to political control. They recommend that clients and governments support the implementation of SC from their side, and contractors are intent on following their lead and realising a framework agreement on SC issues from the other side; it is not just cost issues. The results of study found, accordingly, that many construction companies have adopted SC implementation because if they do not do so they might have SC principles imposed on them by government and they would not like that to happen. In addition, it has become difficult to find funding approval if SC principles have not been considered as a fundamental part of a project brief.

The interviewees mentioned that the reports associated with the construction industry over the last few years (such as Latham and Egan) have concentrated on added value and whole life cycle cost. They also claimed that the policies in place do not put together a good brief nor understand added value obtained, in addition to resources required in the projects. They recommended that policy, briefing and selection of qualified interdisciplinary design team as well as contractors should be a process and
not a product to end up with a successful sustainable project. Most experts interviewed strongly recommended that to let clients adhere to SC procedures, on the one hand government should continue to push and raise the bar on the SC issues while on the other hand, they should use different techniques to spread and promote SC into the construction industry and to stakeholders. They also testified with Latham’s and Egan’s reports, rethinking construction and something along on those lines pushing sustainability issues further down in the construction sector might well be the way forward.

7.11 BARRIERS TO VM AND SC

In this section the barriers mentioned by interviewees have been categorized into three broad groups namely, technical, human and financial. They are briefly discussed below.

7.11.1 TECHNICAL BARRIERS

It could be discerned from the interview results that the ambitions and aspirations of clients are not actually against implementing SC principles; the problem is the ability of the process to deliver a better value in the form of sustainable products. These processes are currently driven to deliver generally expensive, poor quality projects with full toxic material, and unhealthy and non-valuable buildings at the end of their useful lives. They maintained that more often than not the SC performance is not monitored throughout the project developments processes and these results in non-achievement of the objectives of sustainability.

An interviewee, who has worked in Saudi Arabia, said that the cooling and heating of buildings are amongst the biggest challenges faced the implementation of SC in Saudi Arabia because air-conditioning is horrendous in terms of energy and water consumption as well as gases emission. He mentioned that the challenges against SC implementation in Saudi Arabia might be the huge amount of energy generation and consumption, the quality, cost and use of materials, waste management and the construction methods. He stated that the shortage of drinking water is another big issue
in the country and recommended that the Saudi government search for soluble ways to efficiently maximise water use in building projects and other usages.

He also claimed that there are problems in writing a good brief, employing the right design team, getting project managers who are committed and not allowing other people to take control of the project, and not just people who know how to do SC but others. He also said that VM is practiced sometimes as cost cutting which may drop out some SC elements and the clients' aspirations, especially if the process starts without a proper monitoring system in place.

They also mentioned that it is ambiguous to design for a hot or cold climate in the long-term or design for both in the UK. They said the answer should come from climatologists to ensure these issues are properly addressed. They mentioned that it will take a long time to create a suitable heating system because gathering all relevant information will take a great deal of time. It was discovered that there is also a lack of guidance for clients, contractors, architects and other parties on the benefits gained from the implementation of SC via VM. One expert said that:

"I am not fan of the VM application that is being practised at this moment, because it is very quickly done and looks only at the financial aspects, which are not compatible with the sustainable development. So a method of VM needed to be promoted to look at wider aspects of added value including SC".

7.11.2 HUMAN BARRIERS

The study identified a number of human barriers that could impede the implementation of SC and VM. These barriers include: lack of awareness and the egos of people involved in the project design; the difficulty of getting clients to buy into implementing SC and VM in the project; and the misplaced enthusiasm of some people in construction who tend to be very enthusiastic, want to achieve progress rapidly and expect to achieve results as quickly as possible once they have made the decision, however, such can enthusiasm sometimes get in the way of common sense and clear decision making.
The findings of the study proved that most challenges are the mindset of senior management, clients, governments, local councils and environmental agencies and whether they will support the concept of considering SC or not. The mentality of people can lead them to be suspicious and resistant to different or new concepts, which makes it difficult to revolutionize their mindset. Furthermore, some engineers and architects (particularly architects) involved in the project design fear that their creative ideas on the project may be removed through misuse of VM.

The findings also indicated that many members of the design team have a misunderstanding of sustainable development. They still think that the implementation of SC is expensive and only nice to be considered but not important. Furthermore, the key people are very narrow in their outlook and have not obtained a wider vision of the impact of the decisions taken. They do not look at the benefits of SC for the whole lives of a project but rather focus on making the initial cost as cheap as possible.

The study also identified the following obstacles that could hinder the application of SC: lack of knowledge and client commitment; work with ignorance; and insufficient time allocated either to the project as a whole or to apply VM technique. Moreover, it was established that some architects and consultants firms do not have the necessary skills and expertise, specialist knowledge, and resources associated with SC and VM implementation. There were also difficulties in identifying and inviting the key stakeholders to attend the study and with a general resistance to change.

A number of interviewees articulated the view that many SC and VM practitioners demand participation in too many workshops in a short period, which affects the quality and the benefits of their work. They expressed the opinion that the implementation of SC needs specific professionals who have the right knowledge, which is not broadly available. They also mentioned that the length of the workshop, either the traditional 40 hrs approved by SAVE International or other methods, makes it difficult for the key stakeholders to participate in the study to their tight timetable.

It is also concluded that the biggest challenge facing the practitioners of VM is the ability to convince people that VM is not a threat to their innovative ideas and that it is
an aid and good method to ensure the implementation of what they have created within the constraints of the project. An interviewee describes a school building estimated to cost £3 million where the architect designed the roof of the school at one third of the whole building cost without considering the principles of SC in the design. The challenge for VM manager was “How the facilitator can deal with the architect in the workshop to maximise the value of the design and minimise its cost? Architects already have the misconception that VM is a threat to the architect design but the objectives of VM are to achieve a practical and workable facility that maximise the clients’ satisfaction and the achievement of his/her needs and requirements.

7.11.3 FINANCIAL BARRIERS
The results of the interviews identified the major barriers to the implementation of SC relate to financial aspects. Most clients are under serious constraints with regard to the budget and the funding of their projects. Moreover, the way of procuring projects is one of the major barriers because developers are often only interested and concerned with procuring the buildings as quickly as possible and then selling them to obtain quick profits. They often ignore SC and the whole life cost considerations of the projects because the main objective of the clients and developers is quick profit in the short-term instead of on a long-term basis. Clients only reflect on SC when they want to enhance the marketability of buildings. The consideration of SC has not really been a serious issue at all because there were no economic advantages to the developers in addressing sustainability principles. But the law and climate has changed over time which might be the biggest driver to sceptical developers to consider SC in the project developed.

It is also inferred that the key driver for clients, contractors and developers is the lowest cost, which is the potential barrier for considering the implementation of SC and VM in their perceptions. Furthermore, some clients appreciate the initial cost rather than considering the added value to the projects. In addition, they need the project to satisfy their existing desires and requirements rather than looking at the future. An expert claimed that procurement decisions on certain sustainable materials can be critical to the long-term period with regard to operational and maintenance cost of the project and that may have affected the timing of the workshop. He also said that the consideration of a
certain approach of SC in a project becomes a requisite for certain types of funding, particularly government funding which is contingent upon meeting certain SC requirements. Therefore, this might have some bearing on the timing of the workshop, which requires convincing information to support funding applications.

7.12 MEASURERING SC

A number of interviewees stated that SC performance can be measured in terms of energy, water, land and material consumption and use, toxicity in the buildings, materials used (whether they are harmful or not), what it is going to happen at the end of life of the building, as well as productivity and comfort of occupiers. One interviewee claimed that 75% would be added value in terms of productivity. People who work in better rooms, with better daylight, natural ventilation and a good view will be more comfortable and productive. It is suggested that there are a number of quantifiable tools and techniques used for measuring SC outputs and value by the end of design stage. However, the interviews showed that most people are committed to the quality side, which means general appreciation. Although it could be done from design quality indicators, they are adjudged unsuitable.

7.13 SIZE OF PROJECTS FOR CONSIDERING SC

The experts interviewed stated that the application of SC principles does not depend on the cost of the project. It mainly depends on the desire, need and awareness of the clients. The findings of the study found out that the cost of projects that have applied SC principles have varied from £20k to £6 billion. They mentioned that the types of project were housing units, office buildings, university campuses, schools, NHS buildings and leisure buildings. Moreover, SC principles are often considered in renovation projects, which can cover large areas of communities. They also revealed that the implementation of SC has dramatically changed in last 10 years, as a result of which, nowadays whole sustainable cities are being constructed in different countries. One interviewee said:
“There is no limit for considering SC in projects. Give me anything, I will make it sustainable regardless of the cost; say from £15,000 to £15 billion. It is not about concrete value, it is about process and design”.

7.14 CASE STUDIES

The objectives of these case studies were to obtain a deeper understanding of the current best practices of VM and/or SC in the context of each case study. This is to facilitate the development of an integrated framework that will overcome existing barriers. The development of case studies was based on the experiences of the expert interviewees from their participation in exemplary projects where VM and/or SC have been applied. The data collection was triangulated by supporting evidence from interviews, with appropriate documentation. Expert interviews were employed to conduct the case studies in addition to obtaining some documents. Sometimes the duration of the interview was extended to acquire extra information about the case study by posing additional questions pertaining to more details about the case studies. The researcher contacted the experts by using follow-up calls and emails for other clarifications, and gained further information to validate the content of the case study and its presentation.

Four case studies were compiled to investigate in-depth individual best practices of SC and/or VM as experienced by the experts interviewed. A summary of the findings of all four case studies is presented below.

7.14.1 Case Study 1

Case Study 1 was the East Midlands Parkway project, which involved constructing a new station to provide a link to East Midlands Airport. This project was aimed at encouraging people to travel by rail into major cities, thereby minimising traffic on the roads. The project is still in its early stages and the contract has not been awarded yet but the implementation contract has been valued at approximately £12 million. The person that was responsible for leading the VM study was the value manager (the
interviewee) with assistance by one of her team. She prefers someone independent to lead the study in some projects depending on the type of business.

Beforehand and particularly at the pre-workshop meeting, a stakeholders’ analysis was properly carried out to establish which group(s) of people would be affected by the project. The participation of influential stakeholders in the workshop led to discussion and a better understanding of their requirements and needs. The findings of stakeholders’ analysis in the East Midlands Airport study also led to the invitation of a number of people and agencies that could be either affected or interested stakeholders to participate at subsequent workshops. These participants were: environmental specialist in safety and the triple bottom line; route planners who know how much capacity and how fast the trains run and how much they have to slow down; local council and highway authorities; people possessing knowledge of estates and building to deal with the station building; signalling people; local operations people who know the area, interface with facilities of the power station; and people that are in conversation with them and people from East Midlands Airport authority possessing significant experience.

On the other hand, the VM team liaised with the stakeholders that attended the workshop to elicit their requirements and needs. This team included project managers, development managers, engineers who know what they do in the design and how easy it is to deliver, and planners who talk about the programme, cost engineers or quantity surveyors who talk about how much an element would cost and feasibility study consultants as well as the facilitators.

Consequently, the VM Job Plan was conducted at an early stage of the project. The team comprised multidisciplinary people in triple bottom line environmental, social and economic issues as well as other aspects. Two VM studies have been carried out so far in the current stage of the project and there will be another one in about six months time. In total, four VM studies were scheduled to be conducted in the project.

The agenda discussed by the VM team was a standard agenda in addition to an introduction given by the clients to provide an overview of the project and the reasons
behind its implementation. The VM team work through each element of the project in detail. The team did an overview on car parking proposal from the standpoint of East Midlands Airport Authority and what they should look like. They looked at different options and alternatives by working through each stage and looking at each of the options that would be structured loosely in their agenda but by following the standard VM job plan. The timetable of the project was always behind and then later on they catch up.

7.14.2 Case Study 2
The initiative for considering SC principles in this project (office building) came from the client who was technically aware. The owner of this project was the architect and the project manager as well. The study was primarily a joint process between the architect, the client and other stakeholders. Several regular meetings between architect, design team and project manager were held to know who against and for SC implementation. Mutual discussion were conducted for learning and pushing all parties involved in the project to ensure that they have understood the client's wants and needs and SC principles. Many very important issues and stakeholder analyses were discussed in the planning meetings, such as design process, procurement system, materials and their transportation, waste minimisation, crime preventions and natural resources conservation. Two officers were invited to participate in some meetings for security reasons. The ultimate stakeholders are the staff, the occupiers and the company itself. Staff and both officers' surveys were carried out and analysed to identify their wants and needs. These were also fed into design meetings to satisfy a number of the staff's wishes. The client also obviously had to be aware of local authority and the landowner's requirements because the land was leased and not owned by the client. So after design meetings, efforts were made to ensure that all the various stakeholders' wishes were being addressed and that created quite a bit of conflict.

The first step taken in this project was collecting information about cost, sustainable building guidance and the client's wants/needs/objectives at early stages. The consideration of implementing SC principles in this project is among the objectives of the building design. The client had known that the initial cost of some building projects
which have greater sustainable elements may cost more because they may need more expensive materials with special specifications, but these costs will be recouped in a short period by reducing operating and maintenance cost and other added value in approximately 5 and 10 years depending on the type of the project. This additional cost was estimated at between 5 and 10% of the total cost of the building. But in this project, the client and design team targeted the same cost as in traditional buildings to make it a more sustainable building and to demonstrate that a sustainable building can be designed for around the cost of a traditional building.

The brief was socially, economically and environmentally well-written by the architects, Arup Associates, comprising 350 diverse design and engineering disciplines. The main objective of the brief was to entirely fulfil the developer's requirements and expectations for market acceptability in terms of cost effectiveness, flexibility, and commercial viability. Cost benchmarking was developed at the early stages of the design development. A typical Midlands-based commercial office of similar scale with air-conditioning was adopted to monitor the cost effectiveness of the design.

Phase I of the Arup Campus development comprised two pavilions connected with a central area housing the reception, café, lecture theatre and open meeting spaces. The pavilions were large open plan buildings with mezzanine two floors to enable communication between people upstairs and downstairs so as to be able to see each other to encourage social cohesiveness through these visual and actual linkages. The 24m deep building is naturally ventilated via roof openings with passive climate control supported by the use of thermal mass. The design included a high level of flexibility and connectivity to encourage the interactive teamwork that is so characteristic of the firm and its ethos. Artificial lighting was reduced with day-lighting from the roof and extensive glazing in the façades. Solar gain and glare were controlled by shutters and louvers, electrically or manually operated depending on their orientation. Automatic lighting control included daylight linking to dim the direct element of lighting and balance the natural light.
The following principles of sustainability have been integrated into design: at least 20% recycled material used in construction; design for de-construction and reuse of components; low embodied energy; low maintenance; low energy use; natural ventilation; maximum use of natural day lighting; and occupant control of internal environment. This building project was designed from the beginning to be sustainable and the landowner agreed to that. In the beginning, the client wanted to develop the project in partnership with the contractor to implement the SC themes. This unfortunately did not happen because the contractor wanted a more traditional form of contract. The client faced a challenge in implementing sustainable building in the construction phase because the contractor at that time, like most other large contractors, ended up engaging subcontractors to do the work and so the actual workforce on the site had little experience, interest and knowledge about sustainability. They also did know that they were working on what was hoped to be a very special building. Therefore, there was a very heavy load on the supervision and consultation team to educate and persuade the contractor and sub-contractors to consider and implement SC principles and do the job properly.

The final bid was 5% more than the base model. This increment was because during the pre-planning infrastructure for phase two of the development, a third pavilion was planned within two years. Differential costs of the roof, external cladding and mechanical installation were particularly notable because of the disparity between completed design and the benchmark office. The result was a pleasant and productive workplace for 350 staff, and the building has awards from the British Council for Offices and the Institution of Civil Engineering. Moreover, the number of Campus staff of Arup’s two Midlands offices in Birmingham and Coventry has grown dramatically since this property was constructed and occupied. The success of the business has resulted in Campus Phase II. This consists of a third connected pavilion to accommodate 650 staff. The interviewee said that:

"The Arup Campus has been designed from its inception to adopt SC themes as a fundamental part. The working environment created has made a
major contribution to the SC principles of the business with an inspiring workspace that embodies Arup's commitment to Total Design”.

7.14.3 Case Study 3
This case study concerns a VM study led by the interviewee for building project. He was the leader of this VM study applied at the concept stage of a project which was estimated at 50 million pounds. There were two of his team involved as staff and a recorder. The number of VM studies planned during the project was one because the overwhelming circumstances of the project did not allow for any more. The objectives of the study were to measure the value of the project at the concept stage and then later, in addition, to integrate several aspects associated with SC themes. To come up with a successful VM study, the participant stakeholders included client, architect, cladding facade consultants, mechanical and electrical consultants.

The agenda discussed in the study were to explore what, why and how to construct the project in relation to its objectives. According to the interviewee:

"We delved into the VM tools and techniques to select the ones suitable for this project and tried to incorporate risk and SC into the study as well".

Therefore, the consideration of SC principles was taken into account in this study to come up with a sustainable building that meets the aspirations and expectations of affected communities including future building users and managers. The development of proposal risks as a result of implementing sustainable principles and how to avoid and transfer it was a good practice to convince clients to implement SC principles. However, the most important issues discussed in this workshop associated with SC were facade detailing and how that affects mechanical and electrical systems, particularly heating. The workshop explored different options with respect to cladding as mechanical and electrical and how these would affect the design and air-conditioning.
7.14.4 Case Study 4

Case Study 4 was a school building project. The design team suggested several proposals for the heating system such as biomass or windmill, but the interviewee suggested benefiting greatly from the heat generated by pupils studying in the school. However, the school needed special attention to be paid to insulation and airtightness to external form elements such as walls, ceilings, roof and ground floor and windows in order to prevent any air leakage as the continuity of insulation is significantly influenced by design and performance of building fabric, energy consumption and waste.

The elimination of carbon for all parts of the school was a very complex issue. So the building was insulated and made airtight in the interest of energy conservation. The school building from inside has plastic wallpaper, plastic floor, window floor and normal wallpaper. It was painted with gloss paint, which had organic compounds, and the flooring underneath was chipboard with a lot of amaldade and glue in it to prevent air leakage, all resulting in increased energy conservation and a less draughty or cold building.

However, when a building is so sealed up, it can act as an incubator which could be a good environment for helping mould, dust, mites to exist. These may cause poisons or problems in the whole of the indoor building which accordingly could affect the occupants. This might cause other problems such as asthma and allergic diseases. Moreover, if the moisture cannot be eradicated from the interior of the building, it may cause problems for occupants in this building especially when the bathrooms and kitchens are parts of this environment. Therefore, they have to ventilate the whole building, which may cause a loss of heat with the ventilation. If the ventilation is designed realistically and these sorts of problems predicted and considered in addition to use of with healthy materials, it is possible come up with sustainable buildings. So the design team had to look at the whole range of the agenda that came out of the experience. That is why the interviewee stressed that when doing a sustainable building, an experienced architect should be selected, someone who knows from past experience that if he does “this”, the result will be “that”.

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The interviewee said that he was involved in the design of a building for a university to be used as laboratories. It was decided to use clay plaster to enhance indoor environment and control the moisture. Hygroscopic materials control moisture 10 times more effectively than mechanical ventilation. The use of clay plaster or any grade timber as a finishing would solve the indoor moisture problem. These findings were taken from research done in Finland three years ago. The use of mechanical ventilation to eliminate moisture is not a proper way because if the air that flows through the room does not cover all the room, the moisture will not go out with the air. But if it is clay, 40 - 60% of the moisture will be absorbed, or until it reaches a comfortable level to live in; then the moisture is given back when it is dry or needed. This maintains the indoor environment of the building at a suitable temperature level for the occupiers. Architects with this sort of knowledge are very few and far between, although it is not a secret as it has been published.

When the design was completed, the quantity surveyor reported to the client that the use of clay plaster (£5,000) and air tightness (£10,000), in addition to other green issues was going to increase costs by about £20,000. But the quantity surveyor had not picked up the fact that there were no heating system, which saved approximately £26,000 and none or very minimal use of mechanical ventilation saved about £15,000. These two items saved approximately £41,000 but the cost engineer did not consider them because they did not appear in the project documents. That is reality and the interviewee had to fight with the client saying "Ok, take that out and put that back in. it was saved £21,000 and you are arguing about £20,000". The architects did not demythologise the saving because it was not important for them and that is the problem. This story illustrates the questions about how people set things up because they are prejudiced and it goes back again to their understanding something that is really quite subtle.

The interviewee stated that he had been working with very few resources for 30 years and had monitored and got feedback for the materials and works that had been done. He was reviewing his work all the time by obtaining feedback from occupants, users and clients to know the negative and positive impacts for the environment and people. From this feedback, he has built a bank of scientific information and experience. This
information focuses on many materials used, what is poisonous and what not. The interviewee is now writing a book now chemical toxicity in the building and the fact that only 1.5% of the 70,000 materials available have been assessed for their toxicity on people.

7.15 SUMMARY

This chapter has investigated in-depth the practice of SC and VM separately and there potential integration in the construction industry. It has identified the barriers and enablers of the implementation of SC and VM and the expected solutions to overcome these barriers. It has also introduced a number of good practices from four case studies that implemented VM and SC in order to obtain benefits from them and to aid the development of an integrated approach to VM and SC for building projects.

It is concluded from the study finding that the best opportunity for implementing SC principles is at the earliest stages of the design process. The place of the theory, for the most part, is well-established. The key stakeholders must be engaged to take responsibility for setting realistic goals in the planning and briefing stakeholder phases for raising their awareness about benefits and drivers of sustainable design. When they have understood sustainable design and have communicated with relevant stakeholders, they will be encouraged to provide the required support for SC principle implementation. Owner personnel must become familiar with SC principles and be prepared to suggest areas for study to the designer. SC principle implementation should be performed during VM workshops to develop project objectives and design, and any alternatives, at the earliest possible stages of facility design, so that any changes may be made with minimum effort and optimum effect.

The chapter revealed that the integration of VM and SC is required and great benefits can be gained from delivering sustainable projects with added value. The integration of VM and SC will, therefore, bring together different functional disciplines through the free exchange of information among the participants in the workshops. Accordingly, the next chapter presents the development of an integrated approach to implementing VM
and SC for construction projects. The next chapter presents the development process of an integrated approached to VM and SC during strategic briefing in construction project.
CHAPTER EIGHT
CHAPTER 8
AN INTEGRATED APPROACH TO VALUE MANAGEMENT AND SUSTAINABLE CONSTRUCTION DURING STRATEGIC BRIEFING

8.1 INTRODUCTION

This chapter aims to present an Integrated Approach to VM and SC during Strategic Briefing. It incorporates the VM and SC processes at the strategic level of the project to increase value towards the implementation of SC during developing the strategic project brief. The main objective of the proposed framework is to provide a Value Methodology for the consideration of SC principles in construction projects by decision makers. This methodology defines sustainable terms, establishes its essential elements and principles, and clarifies roles and responsibilities of stakeholders with a view to increasing the value of sustainability application in the project. It also describes the functions and activities that need to be undertaken at each stage, as well as the tools and techniques required, to effectively enable clients to satisfy their needs and requirements.

This framework has been developed from the literature reviewed in Chapters Three, Four and Five, and the findings presented in Chapters Six and Seven. It integrates the data and information obtained from the findings from studies conducted in both Saudi Arabia and the UK to realise an approach to help in the implementation of SC and VM and to overcome barriers identified in the study.

8.2 THE BRIEFING PROCESS

The briefing process can be divided into two major stages strategic briefing and project briefing (CIRIA 2001). Strategic briefing identifies the client's vision and main objectives of the project, and offers an opportunity to examine them against the SC criteria. The project brief converts the strategic brief into construction terms and options
such as environmental performance, social impact of the project and affordability can be also evaluated at this stage (Halliday 2007). Moreover, Kelly et al. (1992) stated that the briefing process is usually split into two main stages, the first of which comprises a strategic review of the client’s organisational needs. The second stage is more tactical in nature and is primarily concerned with issues of performance specification.

The briefing is a formal and basic document for a construction project, delineating the objectives and functional and operational requirements of the completed project. It should be produced in sufficient detail to enable the project team to achieve best value and quality in the design of the project. Raveendranath and Kaka (2006) stated that the quality and consequently the value of a project are mostly considered during the design, particularly at the early design stages. They also claimed that this most important issue of construction has not been given the required consideration yet, particularly in the developing economies. It is defined as the different project solutions before the enactment of the feasibility studies (Cooper and Aouad et al. 2005).

Sufficient pre-planning is necessary if the project team wants to achieve the project within the estimated time, cost, and quality, while satisfying client requirements and considering sustainable value in three aspects: economic, environment and social. It requires the establishment of a robust framework for decision making and communication, including planning controls, environmental impacts, and the possible effects of future works, for example, carbon taxes or emission permits or changes in fuel prices (Best and De Valence 1999). The outset of the project is mostly the time of greatest aspiration in terms of environmental quality and SC objectives for the client, architects or both (Halliday 2008).

The briefing stage, also called architectural programming, is the first important step for starting any project. It defines the project that the client expects and desires through developing a good understanding of the client’s needs and requirements. It also helps to identify any potential problems and find possible solutions. Latham (1994) stated that eight areas of construction which may lead to client dissatisfaction can originate from inadequate briefing. The original brief often causes misunderstandings between the
client and the procurement team due to insufficient information about the project. This shortage of information may result in poor performance of the outcomes (Brigden 1984). Moreover, briefing has become an extremely complicated task, needing to match the increasing complexity of client organisations and the parallel complexity of building projects (Kelly et al. 1992). According to Jenks (1988, p32):

"Inadequate briefing is probably the main reason why buildings have been wasteful of resources or defective in use".

The research establishes that the design briefing is the most important stage to start the design development processes. It is the basis of the project initiation, which decides the direction and scope of the project and forms the 'contract' between the project team and consultant or engineering firms or programme management. Any significant change to the design contained in the design briefing late will be difficult and needs further agreements between the parties of the project.

The study also confirms that a briefing stage is the best place to consider SC principles and VM in order to achieve value for money in the project. The consideration will result in a more effective and efficient design process through a high quality and more manageable brief, and better communication between stakeholders. It will provide instant access to accurate information in terms of the identification of requirements and expectations of the key stakeholders, in addition to tracking and tracing modifications. Pugh (1991) stated that the design brief can be written by using stakeholders' requirements, market research, legislation, best manufacturing benchmarking products, reports, proceedings and market gaps, combined with statistical data and other tools.

It has also been established from the findings of this research that the strategic briefing, for construction projects, is a cornerstone of the project design and execution stages. The briefing environment in terms of effective communication between the client, the users of the project, the design team, facilities managers, the contractor, sub-contractors and specialist consultants is fundamental to achieving SC principles in the project. Smith and Jackson (2000) stated that facilities managers play significantly role in strategic needs analysis during briefing. This has been confirmed in this study that
facilities managers have the biggest say of the consideration of SC in the project at the strategic briefing.

**8.3 DEVELOPMENT OF THE INTEGRATED APPROACH**

VM offers an essential framework with different methods and tools which can be applied to develop a strategic briefing together with complementary ones. The results of the work done in the last few years indicate that a number of the tools used in the Sustainable Development area can be integrated with the VM tools, resulting in a constructive hybrid methodology; this is superior than using each one individually (Alexandre and Maia et al. 2007). With a good understanding of the respective strengths and weaknesses of both disciplines, the key stakeholders - including client, facility manager, financier, design team, contractor, sub-contractors, developer, facilitator and other authorities - are able to construct sustainable projects with an environment where the two approaches of VM and SC collaborate. This collaboration can enhance the effectiveness in VM efforts and its promotions as well.

The VM Job Plan is a systematic approach which helps team members to identify problems and find the right solutions in a scientific manner. It also has sufficient tools and techniques to assist decision-makers to take the appropriate actions to realise value for many in a project (Yeomans 2002), by raising the SC principles during the workshop in the strategic briefing. This section aims to present a specific methodology to obtain a good strategic briefing of a project and demystify the design process developments at the level of practices to increase value towards a SC consideration. The framework, developed after a study of the synergies, tools and techniques of VM and SC, works to facilitate and accelerate the understanding and implementation of their principles into strategic briefing to achieve the best value in the project.

Bartlett and Howard (2000); Sorrell (2003) and Zainulabidin and Pasquire (2005) claimed that VM could be used as a tool to achieve sustainability. Bartlett and Howard (2000) suggested the integration of sustainable practices into the design in the early stages and then proactively value managed. VM focuses on eliminating waste and
examining the whole life costs of the project to ensure the best value option is selected based on the values important to the client. Van Bueren and Priemus (2002) highlighted the improvement of communication between stakeholders which is clearly action that VM could address. Moreover, the lack of funds is the most common reason of business collapse and can lead to the failure of profitable growing firms as well as those declining. Thus a financial plan is a crucial factor of the overall strategy of any enterprise, which it should be estimated to guarantee providing satisfactory funds for the need of that enterprise (Kaka 1994).

The VM approach comprises the quantification and monitoring required to achieve best value. It focuses on what things do rather than what they are (functionality). It requires the development of a value culture within the project, and places the focus on clients’, occupants’ and other stakeholders’ requirements. The findings of this type of research encourage a reduction in useless and unnecessary efforts, and the orientation of limited resources towards areas where they can lead to increased value. This approach aims to become a strategic instrument to create the sustainable value of the project.

It aims to intrinsically harmonise different points of views, thus enabling the project to be constructed and to attain the best value in the best way. It also aims to satisfy settled objectives at the lowest resources consumption through reducing energy, materials and water consumption; enhancing material recyclability and usability in addition to extending the product durability and the close of materials cycle. Furthermore, it attempts to reduce environmental impacts through minimising emissions and waste, reducing toxic dispersion and maximising the sustainable use of renewable resources. Moreover, it helps to create an indoor environment with the quality to satisfy users and to ensure occupants’ comfort.

The integrated approach comprises eight stages: Planning; Stakeholder Briefing; Information, Innovation; Evaluation; Development, Decision-Building and Implementation. It is divided into two stages: the Stakeholder Briefing stage and the Workshop stage, as illustrated in Figure 8.1. The main objectives of the integrated approach to VM and SC during the briefing strategy are as follows.
Raise awareness of top management, client, project manager, study team, design team and other stakeholders about SC and VM.

Provide good communication, understanding and project functions between the team members and the key stakeholders.

Identify the project's objectives.

Identify client's needs and requirements.

Obtain the support, agreement and commitment of clients to consider SC principles and VM implementation at early stages of the project developments.

Estimate the project budget.

Develop initial concept and scope of works, in addition to obtaining a consensus of stakeholders on important issues in terms of technology readiness, architecture study, project risk exposure and business case study of SC and VM.

8.4 INITIATIVE AND TIMING

The best time for using the integrated approach to VM and SC is during the briefing stage, shortly after appointing the project manager, facilitator and before appointing the design team. This study may be initiated by one or more of: (1) the client who wants to find the best solution, developing a good strategic briefing, reducing risk to achieve best value in the project; (2) the project manager who has interests in obtaining a better briefing, involving stakeholders in the planning process, saving time and obtaining buy-in of top management; (3) the project sponsor or client (government agency) who wants to identify optimal solutions for delivering the project; and (4) the facility manager who seeks innovative design and WLCC achievement through SC to minimise the operation and maintenance.
8.5 PLANNING STAGE (1)

The main aim of this stage is to plan and prepare a successful study to enable a client achieving SC and VM to obtain a sufficient strategic briefing to realise best value in the project. In any VM Study, considerable benefits are obtained from the interaction of stakeholders and the exchange of their knowledge and experience. The success of a VM study depends upon the appropriate application of the following five essential elements: a prescribed work plan; the mix and commitment of group members; management of
the VM study; senior management commitment and support; and effective facilitation (AS 4183 2007).

The duration of a VM Study or its workshop should be determined in advance by the estimated time required to achieve the study objectives. Where a specific time limit (for example, one or two, three, or five days) is given for a workshop study, objectives should be set such that the work plan can be effectively addressed within that time limit. Where appropriate, a VM study may continue over an extended period of time, particularly where actions are required before going onto the next phase. The duration of any study depends upon the size and complexity of the project (AS 4183 2007). The proposed time for conducting this study varies between 2-5 days according to the experts’ estimation. The following tasks identified from the research findings should be done in the planning stage to guarantee a successful sustainable value study application in the project.

8.5.1 Appoint a qualified and experienced facilitator

The first step in the study is the appointment of a facilitator by the client or anyone mentioned in Section 8.4. The VM workshop facilitation is considered an essential part of VM studies. Although most facilitation skills will be known to most VM Studies, specific facilitation skills will only be needed for particular conditions, such as when a large number of people are involved, or when particular techniques or principles are to be considered. The main role of the study facilitator is to assist the client and all participants to raise their effectiveness through enhancing and promoting the processes used. The study facilitator will also evaluate the work plan’s progress and provide guidance as appropriate, including devotion to the Job Plan and time constraints.

The study facilitator should possess a number of facilitation attributes including: being a qualified, have experience and skills; active listener; interpersonal communications; questioning; lateral thinking; analysis, synthesis and evaluation of information and of options developed in the workshop; promoting cooperative and collaborative behaviour; and overcoming resistance to change (AS 4183-2007).
The incorporation of SC principles into VM processes in addition to participants will place a significant load on the study facilitation. Therefore, a facilitation plan needs to be organised for each study. The role of the study facilitator is crucial in creating a collaborative learning environment, structuring study activities in accordance with the job plan; providing guidance, directing and counselling to the group, identifying potentially problematic situations, satisfying consensus, and modelling appropriate behaviour (AS 4183-2007).

It is necessary to ensure that the person appointed to facilitate the VM and SC study possesses relevant experience and knowledge in SC beside VM. He/she should be certified and qualified in VM and SC as, for example, a Certified Value Specialist (CVS) and LEED Accredited Professional (LEED APs). If the facilitator is only qualified in VM, the client needs to include a sustainability consultant to act as a champion to guide the SC thinking and progression of proposals and guarantee consistent application of goals and evaluation criteria. The followings points associated with the facilitator were elicited from the interview findings.

- The facilitators should fully understand VM and SC principles to educate team members and key stakeholders and incorporate these principles into the design process.
- There is an important opportunity for the facilitator to spread SC throughout the VM workshop by demonstrating SC benefits and drivers to the design team and key stakeholders. These will enable the design team and stakeholders to obtain guidelines by which to adopt SC in the project, and will raise their awareness about SC and how it can lead to added value to the project.
- The facilitator should identify valid needs, requirements and wants of the clients/customers and end-users in addition to ensuring that solutions and alternatives given by all participants in the workshop are reasonable and viable.
- The appointing a facilitator should help clients to plan for the application of the VM study by appointing the team, setting objectives, and preparing the
timetable and agenda for the study, in addition to checking all the elements to ensure that nothing is missed.

- Facilitators should not try to do everything by themselves; they have to know their own limitations. They should bring in specialists to undertake those tasks that they cannot deal with personally, such as running creativity workshops, SC, function analysis and particular techniques.

- The facilitator should ask open-ended questions and carefully listen to all the participants. He/she should be open-minded in approaching a VM study and should encourage the consideration of SC during the VM exercise.

- Each facilitator should usually be familiar with a reasonable portfolio of tools and techniques to cover most issues required in a workshop. He/she should also know what further expert support in terms of facilitation might be necessary to produce innovative ideas and solutions.

8.5.2 Clarify objectives of the study
The objectives of VM and SC study must be identified, agreed and included as the basis of any agreement written between the clients and the value manager or facilitator.

8.5.3 Agree on the total cost of VM and SC Study
The cost of the VM and SC study application depends on the quality, qualification and experience of the facilitators and team members either in VM or SC who will be involved in the study. It should be based on best value that will be achieved and its criteria. All costs should be agreed on in advance between the client or his/her representative and the facilitator. They also should agree who will build and pay the team of the study.

8.5.4 Appoint a sustainability advisor
An advisor or consultant is an organisation or individual who provides expert advice or professional consultation in a particular field of interest of project development (El-Gohary and Osman et al. 2006). The main function of the consultant in this study is to educate the key stakeholders and the study team so as to raise their awareness about SC
benefits and drivers achieved in the project. He/she should provide certain guidelines that have to be followed for implementing the SC themes into the project and/or conducting the involvement process, in addition to monitoring the performance of the implementation of the SC principles in the strategic briefing and design process.

Appointment of a SC advisor or consultant who is certified by BREEM or LEED, or some other such organisation is recommended Campbell (2005) stated that it is increasingly appreciated that a further number of consultants needs to be selected rather than just an Architect, Quantity Surveyor or Project Manager, with strong client 'buy in', so as to deal with comprehensive issues related to SC.

8.5.5 Select appropriate team members
The selection criteria for appropriate team members of the VM and SC study who can contribute to the process through the preparation of the strategic brief to deliver sustainable project is a critical factor for obtaining successful strategic briefing. In appointment of the study team members, the following attributes should be taken into consideration: individual commitment to openly interact with others; proper responsibility and authority and decisiveness; commitment to working collaboratively; willingness to realise best value for money; receptiveness to new ideas; desire to actively participate throughout all stages of the study; essential breadth and depth of required knowledge and technical experience to accomplish the study objectives (AS 4183-2007) and consider SC and VM themes, drivers and benefits for the clients; and credible representatives of stakeholder groups.

When the team members are involved throughout the whole of the VM and SC study, they accept that the overall interests of the study are more fundamental than sectional interests or personal concerns, and accept the obligation of the group to the study objectives and outcomes. The establishment of pre-qualification criteria for consultant and other team members, including contractor and sub-contractors, may provide substantial benefits to the project as the best equipped and qualified people can be added to the project (Best and De Valence 1999).
The people participating in the study should have the desire to listen and participate to create good communication and an understanding environment between the team members to create a building that functions as a whole. It was established from the study findings that the participation of operational personnel in the strategic briefing is very important. They are considered the best equipped people to increase value because they know the problems and solutions that have happened in previous projects. They are the people best prepared to evaluate alternatives and options generated in the workshop. To ensure their effective involvement, they should also participate in the implementation and approval process.

8.5.6 Do Stakeholder analysis

A main driver in the creation of sustainable value is to satisfy stakeholders in the process of the delivery of the functional unit through the project or service. For example, clients may be satisfied but if users, occupants and suppliers are poorly treated, new ideas and improved productivity will not be produced, and the project may fail resulting from reducing quality of life for other stakeholders. It is therefore essential to aim to improve the quality of life of all stakeholders in the project (Charter 1998).

Each construction project has its own stakeholders who often have different and conflicting interests associated with the project objectives (PMI 2004). To manage those stakeholders, it is fundamental to understand if they are for or against the project’s objectives and how much power and influence they have (Dallas 2006). Insufficient management of stakeholders’ interests frequently leads to conflicts and controversies about the implementation of the project (PMI 2004). Therefore, to avoid this, the project manager or a study leader (the facilitator) should be sure to recognise the concerns of all stakeholders and to reconcile their conflicting interests by negotiation (Olander and Landin 2005). The European VM Standard states that:

“Stakeholders, internal and external customers may all hold differing views of what represents value. The aim of VM is to reconcile these differences and enable an organisation to achieve the greatest progress towards its stated goals with the use of minimum resources” (BS EN 12973 2000).
Stakeholder is defined by Cleland (1998, p.55) as

"People or groups that have, or believe they have, legitimate claims against the substantive aspects of the project. A stake is an interest or share or claim in a project; it can range from informal interest in the undertaking, at one extreme, to a legal claim of ownership at the other extreme".

Grimble (1998) stated that the greatest distinction between stakeholders is likely to be between those who affect or take a decision or action, and those who are influenced positively or negatively by the work or its outcomes. Stakeholder analysis also differentiates between conflicts and trade-offs. Conflicts concern the state of competition and prospective disagreement between two or more stakeholder groups in terms of execution and completion of the project. A trade-off is the procedure of balancing conflicting objectives within a single stakeholder group. Thus, the identification of the key players amongst the key stakeholders both internally and externally and the analysis to discover their interests and their influence on the project will boost decision support and implementation success throughout the participative group process of the VM study (Thiry 2004). Therefore, the implementation of SC and VM principles and achieving value for money in the project depends completely on obtaining the support of key stakeholders at early stages of the project.

Table 8.1: A number of project stakeholders (Adapted from Winch (2002))

<table>
<thead>
<tr>
<th>Internal Stakeholders</th>
<th>Supply Side</th>
<th>External Stakeholders</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Side</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Client</td>
<td>Consulting engineers</td>
<td>Local residents</td>
<td>Regulatory agencies</td>
</tr>
<tr>
<td>Sponsor</td>
<td>Principal contractors</td>
<td>Local landowners</td>
<td>Local government</td>
</tr>
<tr>
<td>Financiers</td>
<td>Trade contractors</td>
<td>Environmentalists</td>
<td>National government</td>
</tr>
<tr>
<td>Client’s employees</td>
<td>Materials suppliers</td>
<td>Conservationists</td>
<td></td>
</tr>
<tr>
<td>Client’s customers</td>
<td>Employees of the above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Client’s tenants</td>
<td></td>
<td>Archaeologists</td>
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<td>Client’s suppliers</td>
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Stakeholder analysis is a tool which helps to find the key stakeholders associated with the project to produce the information required to start the design process for any project. There are various methods and ways to perform a stakeholder analysis. The following steps are strongly recommended to successfully manage stakeholders to discover opponents who have misconceptions about the project and, considering SC implementation, convince them by illustrating and educating them regarding the drivers and benefits of sustainable design thus changing their thinking from cost to value, short-term to long-term, shareholder to stakeholder and from local to national to international. Table 8.1 illustrates the range of stakeholders that might be involved in any construction project. This table will help in the identification and listing of the key stakeholders when it is necessary to engage them as part of the project planning process.

8.5.6.1 Timing of Stakeholder Analysis

Stakeholder Analysis timing is an influential factor in the project life cycle development. Doing this at the strategic briefing enables the facilitator and team members to understand stakeholders’ requirements and expectation, and any opinions against the project at an early stage. It will also ensure the identification of the project objectives and draw the attention of affected stakeholders to consideration of SC and VM implementation in the project. In this study, Stakeholder Analysis should be conducted at the planning stage, as shown in Figure 8.1.

In early stages of developing strategic briefing, Stakeholder Analysis can help measure the possibility of acceptance of innovative ideas integrated with SC and VM themes so as to achieve value for money in the project. Doing the analysis prior to the Stakeholder Briefing in the VM and SC study will significantly help the facilitator to satisfy the project objectives and identify the issues that need to be included in the workshop to develop strategic briefing. The use of Stakeholder Analysis at the right time, in conjunction with other techniques such as VM and SC assessments, can increase the success of the project and achieve best value in addition to overcoming opposition, building coalitions, and changing information and resources to promote and sustain the proposed strategic briefing.
8.5.6.2 Reasons behind Stakeholder Analysis

It is very important beforehand to know the objectives for doing stakeholders analysis at an early stage of design for any project. In addition to knowing the key stakeholders who have great interest in and power to affect or be affected by the works and/or outcomes of the project, the following points associated with stakeholder analysis were elicited from the study findings to help the facilitator and study team in analysing stakeholders.

- Knowing and agreeing the objectives of doing stakeholder analysis in the study.
- Identifying and understanding needs and expectations of the key stakeholders.
- Understanding how the stakeholders might affect or be affected by the implementation of SC and works and its outcomes.
- Understanding and managing the relationships between stakeholders including any potential conflicts of interest in relation to considering SC in the project or any other issues.
- Obtaining better understanding of who and how the various stakeholders can be involved in the project and contribute directly or indirectly to support achieving best value, including considering SC at early stages of the project.
- Raising awareness of the key stakeholders about benefits and drivers of considering SC and VM into the project.
- Exerting influence on stakeholders who are not supportive of considering SC in the project.
- Identifying sustainable value criteria in addition to CSFs and KPIs for selecting sustainable options and innovative ideas as well as monitoring and measuring progress in the project.
- Finding opportunities to reconcile the stated needs of each of the stakeholders and explore trade-offs to optimise the outcome for all.
- Building shared understanding between stakeholders, illustrating the project objectives and targeting the sponsoring client body (possibly comprising several organisations).
- Identifying potential supporters of and opponents to the consideration of SC and VM implementation in the project.

### 8.5.6.3 Identifying project stakeholders

The identification of stakeholders is the most important step because they cannot be managed until they are known. Therefore, the project’s stakeholders must be identified and their requirements and expectations found to avoid predicted conflicts and discrepancies (PMI 2004). The intervention with five of the key project members illustrated in Table 8.1, at the planning stage and before starting conducting the VM and SC workshop, can help to identify stakeholders. All possible stakeholders with any relation to the project must be listed. Moreover, similar projects and previous literature review could help to identify the key stakeholders of the project. It was concluded from the study that the key stakeholders for building projects could be owner, sponsor or financer, users or occupants, facilitator, study team including multi-disciplines and related authorities. It was concluded for the study findings that stakeholders may consist of the client, developer, project manager, financier and design team (architects, engineers), end-user or occupant, contractor, subcontractors, local authorities, knowledgeable people with public amenities, the water board, electricity supply, the regulator and planner.

### 8.5.6.4 Identify of requirements and expectations

Having identified stakeholders, it is important to define their requirements and expectations within the project. Quality Function Deployment (QFD) can be used as a sequence of matrices to collect, understand and deploy the requirements of the client or users throughout a project. It ensures obtained requirements and expectation are reflected throughout the project design developments, materials production, installation, service and demolition of a project. The most common arrangement of these matrices is known as the House of Quality (LeBlanc 2004).
The external and some internal stakeholders have their perceptions which may not be well-matched to the corporate project objectives. It is therefore essential to recognise the impact of each of these stakeholders then try to exert them on the project objectives (Njie and Langford et al. 2005). The following questions can help satisfy the previous objectives identified in step 8.5.6.2 to identify the requirements and expectation of stakeholders.

- What are the stakeholders' expectations and needs from the project?
- What stakeholder benefits would be gained by considering SC and VM in the project?
- What resources will be used or avoided by each stakeholder in the project?
- What are the reasonable and realistic roles and requirements of the stakeholders assumed to implement the principle of CS into the project?
- What expected negative or positive responses are likely to occur for the stakeholder as a result of considering SC and VM in the project? How can these be overcome?
- What are the power relationships and how weak players can have an influence?

8.5.6.5 Prioritising stakeholders

This step aims to prioritise all stakeholders identified in previous stages in order to decide who should participate in the workshop and deal with others. The prioritisation depends on the influence and importance of each stakeholder. Influence is the power of stakeholders to instruct change to the project, control decision-making, exert influence which negatively or positively affects or is affected by the work and outcomes in addition to the consideration of SC and VM or any other techniques in the project. The suitable definition of influence is the extent to which people, groups or organisations are able to persuade others to make decisions, and follow certain courses of action associated with SC implementation in the project. Influence can derive from the nature of stakeholders in terms of their organisations, or positions in relation to other
stakeholders or organizations. It is also necessary to consider stakeholders whose influence will increase due to resources used by the project (ODA 1995).

Figure 8.2: Stakeholder mapping, the power/interest matrix (adapted from Thiry 2004)

Importance indicates the priority given to satisfying stakeholders' needs, interests and requirements through the project. It mostly becomes noticeable when stakeholder’s interests in a project meet directly with its objectives. There are often stakeholders who have only a weak capacity to participate in the project, and limited power to influence decision making (ODA 1995). The stakeholder power/interest matrix illustrated in Figure 8.2 can help to evaluate stakeholders’ relative power and influence, importance to the project, and possible contributions to the success of the project.

8.5.6.6 Involve stakeholders

The engagement of the key stakeholders in one place will enhance the overall strategic briefing and consequently the project design. All stakeholders will interact during the VM and SC study, which will result in strong working relationships, effective
communication, understanding and mutual consensus. The findings should draw up a working definitions plan concerning the implementation of SC and VM; the objectives and intended outputs; the relevant decision-makers and key stakeholders; how to achieve best value in the project; and how outputs will be measured. These will form the basis for developing a good strategic briefing.

The identification and selection of stakeholders to participate in the intended stage should be done at the planning stage. Further stages and information obtained from the study may reveal previously unrecognised stakeholders, or show that a particular stakeholder is less or more significant than initially supposed. Thus, it is strongly recommended that verification and possible update of the list of stakeholders identified should be kept in mind throughout the study. These findings from a stakeholder analysis need to be included in the project brief depending on the nature of the stakeholders’ positions regarding implementation of SC in the project; this will form the basis of a project strategic briefing.

The purpose of participation of each stakeholder should be clearly defined and could be either for direct engagement during the project process developments or for learning if the stakeholder has a lack of awareness of VM and SC and/or their drivers and benefits achieved in the project. The purpose of his/her participation is to introduce the benefits and drivers and added value that could be achieved from the consideration of SC and then convert opposition to considering VM and SC into support through negotiation, raising awareness, information and/or coalition building, including offering trade-offs. By the end, it is very important to ensure commitment of the key stakeholders in the project.

8.5.6.7 Synthesising Information

The success of the study depends on obtaining sufficient information from the project’s stakeholders. The collection of information is crucial for the design team and the key stakeholders in order to understand the project objectives. This information could include budgets, project inclusions, starting and finishing times for the construction of new facilities, demographics, policies, location and regulations, needs and expectations.
of stakeholders. The proper way to compile this information is to interview the people previously identified, in addition to examining related documents. Suitable methods needed to collect this information are: conducting interviews face-to-face, telephone conversation, responses to questionnaires exchange of emails, historical data and similar projects.

The facilitator should gather any relevant information with regards to similar projects, SC and VM guidance and the obligations of all participants. The information collected in the Planning Stage and during stakeholder analysis, should be sorted and organised before being circulated to the participants in the study prior to the workshop stage with enough time to give all participants a quick brief about the project and what is required from them in the study. This method will definitely enhance the effectiveness and efficiency of the VM and SC study performance.

8.6 STAKEHOLDER BRIEFING STAGE (2)

The main aim of this stage is to ensure that VM and SC are effectively understood, attained and approved by the key stakeholders. They may have different understandings of what constitutes added value with relation to SC and VM. Thus, teaching the key stakeholders is among the objectives of this stage to shift their thinking from cost to value, from short-term to long-term, from shareholders to stakeholders and from local to national to international. This stage endeavours to achieve value for money and consider SC and VM as part of the clients’ requirements.

Patel and Fortune (2006) indicated that stakeholders must be identified and involved from the outset of the project. They also state that it is vital that the key stakeholders review the brief to ensure that the information provided is analysed and interpreted in right way. They also indicate that the design teams have not communicated well with the end users in previous projects. However, concern for sustainable project development should now be seen as the opportunity for designers to educate the stakeholders about any benefits such as long term value and achievement of social and environment sustainability resulting from sustainable designs. This should be
considered during the early stages of design to avoid later revisions and subsequent delays (Halliday 2007)

The Stakeholders Briefing Stage must provide all stakeholders that were previously identified and invited to attend the stage with clear understanding and communication in addition to common consensus in terms of SC and VM consideration in order to achieve best value and resolve any potential problems that might appear in the project. The stage must end with a clear statement of appropriate and accepted objectives for the project. An evaluation of the briefing performance that should incorporate economical, environmental and social criteria is necessary. The stakeholder should know about the impacts of inputs and outputs of the project activities and therefore a continuous process of transparency, communication and continuous improvement should be planned and provided.

SC principles are a mechanism for changing thinking in the design and construction process to realise an innovative project. The most efficient method to deliver this change is to involve the stakeholders in the project, and share in achievements by, for example, underlining the fact that lots of small wins are as important as the big wins. This will help to bring greater commitment, ownership, satisfaction and innovation into projects. Sustainability certainly helps the organisation to improve its understanding and management of risk at all levels by creating opportunities for the business to improve in many areas (Leiper and Fagan et al. 2003).

The incorporation of SC and VM principles into the project context should take into account the interests of the different stakeholders, either external or internal, and the result of its activities must be a trade-off between the satisfaction of the real needs and expectations of all stakeholders. The facilitator should illustrate constraints affecting the quality and achieving best value in the project to the key stakeholders. These restrictions could include budget, schedule, code, regulations and guidance. On the other hand, the facilitator should clarify stakeholder concerns associated with the implementation of VM and SC and general inputs of the stakeholders with respect to the
project being developed, including comments, needs, requirements or objections, and should demystify the solutions.

8.6.1 Building knowledge and understanding

This is the foundational part of the workshop involving learning, explaining and translating SC and VM issues into vocationally relevant language to empower the key stakeholders and project team. Moreover, learning, shared knowledge and understanding take place among the stakeholders, and especially the key decision makers and design team, about any and all factors related to SC principles and VM to achieve value for money. This stage might use a systematic, sequential approach to building knowledge and understanding.

If top management and the VM team members are sensitised to SC principles and their contribution to creating value, these aspects will be integrated into the project’s strategic briefing so that they will contribute to its viability in the long-term whole life (Alexandre and Maia et al. 2007). Change Management could be used at this stage. The key issues of change management are education, training, communication, team and leadership development. The stakeholder is the heart of any change process; therefore communication and participation are key elements to ensure Change Management success. The important factors of Change Management are education, training, communication, team and leadership development (Kelly and Shen et al. 2003).

In addition to Change Management, single-loop and double-loop learning could also be used at this stage to teach the key stakeholders and study team about SC and VM. The theory detects and corrects any misconception (error) in the stakeholders by having them draw up a strategic plan to address and work within the governing variables, which in this case is integrating SC into the project. Argyris and Schön (1978) defined the theory and describe the process illustrated in Figure 8.3 in the context of organizational learning as follows:

“When the error detected and corrected permits the organisation to carry on its present policies or achieve its present objectives, then that error-and-
correction process is single-loop learning. Single-loop learning is like a thermostat that learns when it is too hot or too cold and turns the heat on or off. The thermostat can perform this task because it can receive information (the temperature of the room) and take corrective action. Double-loop learning occurs when error is detected and corrected in ways that involve the modification of an organisation's underlying norms, policies and objectives.

Governing variables are dimensions that stakeholders try to keep within acceptable limits. Any decision has the probability to impact upon a number of such variables; therefore, any situation can target a trade-off among governing variables. It is suggested that SC and VM principles are governing variables in this case. Action strategies indicate the moves and plans used by stakeholders to keep their governing values (SC) within the acceptable range. Consequences refer to outcomes occurring as a result of an action. These can be both intended - the actor believes will result - or unintended. In addition these consequences can be for the self, and/or for others.

**Figure 8.3: Single and double loops learning (Argyris and Schön 1978)**

8.6.1.1 Introduce SC and VM principles

Communication, learning and training are seen as the key tools to deliver understanding and sustainable solutions for the way we all live (Leiper and Fagan _et al._ 2003). The following SC principles were obtained from the study findings and literature reviews. It is beneficial to teach these aspects to key stakeholders and the study team who are participants in the study to raise their awareness of the value of sustainability. These
themes are: applying whole life cycle costing (WLCC) to the project; choosing environmentally responsible suppliers and contractors; creating a healthy (non-toxic) environment; decreasing the amount of harmful emissions; designing for minimum waste; designing for renewable, recyclable and reusable resources; designing for serviceability, flexibility, durability, reliability, adaptability, functionality and quality over the whole life of the project; encouraging reuse of existing built assets; enhancing competitiveness by adopting policies and practices that advance sustainability; enhancing the quality of life and satisfaction of clients, users and occupants; ensuring financial affordability for intended beneficiaries; establishing skills training and capability enhancement of disadvantaged people; humanising larger buildings; maintaining and restoring the earth's vitality and ecological diversity; and maximising efficient use of non-renewable resource (materials, energy, land and water) to meet needs of future generations.

Moreover, the following are important: maximising the efficient use of renewable resources in preference to non-renewable resources to meet the needs of future generations; minimising damage to landscapes including scenic, cultural, historical and architectural; minimising pollution to air, land and water at universal, national and local level; optimising fossil fuels and minerals; preserving and enhancing biodiversity and protecting natural environments; promoting employment creation and, in some cases, labour intensive construction; protecting and promoting human health through healthy and safe working practice; providing and supporting desirable natural and social environments; pursuing quality in creating a built environment; respecting people and their views and the local environment; revitalising present urban infrastructure by emphasising the rebuilding of mixed-use pedestrian neighbourhoods; satisfying the fair or equitable distribution of social costs and benefits of construction; raising awareness of people towards sustainability and harmful things that might affect their health. Chapters 3, 4, 5, 6 and 7 have illustrated the benefits and drawbacks, if any, that could be encountered by the clients in the project.
8.6.1.2 Introduce benefits and drivers

This step should cover the drivers of SC and VM for the key stakeholders as a result of adoption of their consideration in the project. Most drivers were identified in Chapters 4 and 7. These drivers will be gained from sustainable design and construction in a holistic approach throughout the life-span of a project; from cradle to grave; from the outset of design to construction, to operation and maintenance and demolition. They should include the total direct, indirect, internal and external costs of the whole life of project.

They should also include informing the key stakeholders of relevant SC principles and sustainable design resultant benefits, such as community involvement, manageability improvement, waste and pollution minimisation, cost in use advantages, user and occupants satisfaction, health and safety benefits, increased productivity and/or minimised environmental liability. This should be achieved through sustainable strategic briefing of the project with regard to location, envelope and orientation, attention to detail, infrastructure, manageability, usable controls, appropriate tender procedures, performance targeting and integration (Halliday 2007).

8.6.1.3 Clarify sustainable value

Patel and Fortune (2006) stated that SC criteria should be included within the main brief including a variety of SC issues rather than developing a separate SC brief one. Therefore, by the end of this stage, the facilitator should manage to have the key stakeholders agree on a strategic plan including the goals and objectives of SC implementation in the project. These will be generated during stakeholder analysis through working together as a group to define the elements of sustainable value of the project and should be expressed as essential functions.

Moreover, collaboration helps to identify and foster agreement on sustainable value criteria that are used to determine the success and sustainable ideas or alternatives and performance. In this way, knowledge and understanding of the sustainable value of the project will be established early in the workshop. It is supposed that the collaboration of all stakeholders will bring different perceptions of usefulness, benefit and importance
about the project and that will make it successful. The facilitator needs to capture these perceptions and innovative ideas from the various perspectives of the participants.

8.6.1.4 Set up the scope and objectives of a project

The study facilitator should seek confirmation from the key stakeholders and other participants in the study that the scope and objectives of the study defined in the Planning Stages are understood. These need to be made explicit and examined for compatibility and validity. The scope may be further refined again during the workshop stages. The integration of SC and VM to achieve value for money in the project should be made clear to the key stakeholders so as to gain their support and confirmation. Particularly in this case, certain functions may be identified as collectively describing the scope of the study. SC should be a core objective of the project to comply with the following.

- The key stakeholders must have a clear statement of its commitment to achieving and undertaking development that is more sustainable and sets out the action that it is undertaking to be achieved.
- The project should have clearly stated SC objectives and outputs to be implemented.
- The key stakeholder should demonstrate leadership through clear briefing and the approach adopted to commissioning the design team and contractor.
- The design team, consultant and the contractor must be competent and high qualified in the SC field and committed to collaborative working.

8.6.2 Motivate team members

The findings of study show that motivating team members who will participate in the study is very important for the attainment of innovative ideas and a successful study. Motivation, rewards and respect encourage integrity and professionalism. They are very important for obtaining a true teaming approach to determine and achieve the objectives of the project. These issues should be agreed between the participants in the study.
beforehand. The client’s requirements and expectation can be met if the VMSC team intentionally desire to do so.

8.7 INFORMATION STAGE (3)

The aim of this stage is to build understanding for all the key stakeholders and the study team from a full sharing of information. It integrates SC principles into functions of a project to develop common understanding among the project’s stakeholders. It also includes identifying relationships, attributes and value drivers. This stage of the methodology combines two traditional stages: Information and Function Analysis.

Information is a crucial factor in VM application. It will be gathered by the facilitator and VM team during pervious stages. The objective is to identify a clear idea of the project in terms of the elements and functions. It should include client needs and wants, project constraints, budget limits, time limits for design and construction, barriers to SC and VM identified in this study and the level of quality required by the client.

Information should also be collected through expert judgment and historical data such as documents that define a VM methodology, common terminology, and standard practice in both VM and SC. The team may also conduct interviews with stakeholders identified previously as main players who cannot, or will not, attend. The purpose of the information is to direct the study practitioners and project managers to effectively improve the value of the project. Moreover, the use of guidelines and tools and techniques such as standards, benchmarks, sustainable specification, computer-based simulation and software studies, access to new products, materials and innovative ideas including developing technologies will considerably help to provide comprehensive information for the project (Isaacs and Kurtz 2004).

8.7.1 Finalise project objectives

The study facilitator should also confirm the objectives of the project and the study circulated to all members prior to the workshop. In some cases, the objectives may need to be modified in light of questions or statements from the study participants. In these
cases, it is vital to ensure that the altered objectives are still valid and attainable within the time allowed for the study (AS 4183-2007).

8.7.2 Analyse Functions
The main tasks of this stage are to integrate SC principles into functions to convert information into understanding of the project. Function Analysis (FA) is considered the heart of VM, providing one of its defining attributes and distinguishing it from numerous other problem-solving techniques. It also improves understanding of the project and underlining areas for value improvement to generate innovative solutions to problems that as yet may have evaded them. FA filters needs from wants so that primary objectives can be promptly and agreeably shaped. FA has a number of different techniques, some very structured, such as the Function Analysis System Technique (FAST) which is known by many practitioners and is practiced broadly in the United State, and some less formal, such as value trees, which may give a similarly scrupulous functional model of the project (Dallas 2006). Figure 8.4 illustrates means to quantifying sustainable value in the project.

Figure 8.4: Evaluating value (Alexandre and Maia et al. 2007)
A function is that which makes an item or service work or sell (SAVE International 1998). It could be defined in this stage by VM from the perspective of SC principles. A similar application of the VM process can be used with the same topics and needs within SC principles initiatives. Function analysis enables the team members to apply
SC issues in assigning the components of a project; it also helps define the drivers which are consequently prioritised and rationalised to achieve Triple Bottom Line (TBL) dimensions (Yeomans 2002). This includes four steps which are explained as follows.

8.7.2.1 Identify and define functions
Miles (1972) stated that “the determination of function(s) is a requisite for all value studies”. In order to accomplish the project objectives, it is essential for the project team to determine its primary functions. These primary functions clearly describe the project objectives with regard to what the client is expecting from the building (Dallas 2006). A function is invariably articulated by an active verb and measurable noun. The verb answers the question, ‘What is it to do?’ and the noun answers question, ‘What does it do?’ respectively (Shen and Chung 2004). Figure 8.5 helps to identify and define functions.

8.7.2.2 Classify functions
This step aims to classify the functions articulated in the earlier step into two categories, basic and secondary. A basic function in a FAST diagram for a building project is the primary aim for which that building is designed. It must be accomplished to satisfy the purpose of the project. Secondary functions are defined as those that support the basic function. They can be broken down into sub-classifications of ‘required’, ‘aesthetic’ and ‘unwanted’ functions in order to improve the analytical evaluation process (SAVE International 1998). Figure 8.5 can be used to classify functions.
### Function Analysis

**Project:** Gifted Foundation

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*B = Basic Function
*S = Secondary Function
**Original Cost Estimate
***Worth = Least Cost to Accomplish Function

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**Figure 8.5: Function Analysis form**

### 8.7.2.3 Develop function relationships

The primary task of this step is to depict the relationships between functions through using FAST models. FAST is a horizontal diagram portraying functions within a project, with the following statutes: (1) a series of functions that happen in a sequence on the critical path from left to right and answer the questions *'How is the function to its immediate left performed?'*; (2) a series of functions that happen in a sequence on the critical path from the right to left and answer the question *'Why is the next function performed?'*; (3) functions happening simultaneously or caused by functions on the critical path appear perpendicularly underneath the critical path; (4) the basic function of the project is invariably farthest to the left of the diagram within the scope of the study; (5) two more functions are categorized as (a) highest order- the reason or purpose that the basic function exists (it answers the 'why' question), or (b) lowest order – the function that is required to initiate the project and is depicted farthest to the right (SAVE International 1999). FA is also defined as a structured process that identifies,
describes and analyses functions, their interrelationships and, where appropriate, total costs or total resources used (AS 4183-2007 2007). Figure 8.6 shows a classic FAST model diagram.

Figure 8.6: Classic FAST model (adapted from SAVE International 1999)

In order to illustrate the technique, a logical diagram for SC has been presented in Figure 8.7. The ultimate purpose is the implementation of SC, which is placed on the left hand side of the diagram. The basic functions including the purpose of the design are located next to the highest-order function. Level 1 functions are broken down into Level 2 functions, which can then be broken down into further sub-level functions to describe how these functions can be accomplished. The diagram and dimension can also be developed further with cost and sustainability impacts.
8.7.2.4 Assign weighting to functions

This step attempts to establish the relative importance of functions. Many ways can be employed to obtain the importance of each function. One method is to distribute 100 scores among Level 1 functions, further distribute the scores assigned to a Level 1 function among its corresponding Level 2 functions, and so on. This enables assessment of functions at an identical level. Obtaining the importance of a function not only aids clients to comprehensively understand their requirements and the importance of the sustainable factors, but also gives useful information to those professionals who are in charge so that they can design according to these requirements. The relative importance of SC principles is illustrated in Figure 8.7.

8.7.3 Build sustainable value criteria

This step aims to set the priorities for SC principles illustrated in Figure 8.8 in order to obtain sustainable value criteria depending on selection and judgment of the key stakeholders according to the type of the project. One method is to spread 10 scores
among all sustainable factors: environmental, economic and social. The highest stakeholder-defined sustainable factors could be used as measurable criteria to ensure the attainment of best value in the project. It also aims to develop a systematic understanding of the dynamics at play and to identify low value, high cost and low performance functions to be used for Stage 4. In this case, the stakeholders-defined sustainability factors could be screened and evaluated against each other by using Parametric Paired Comparison (PPC), as shown in Figure 8.9. The successful criteria are those most influenced by stakeholders’ agreement and satisfaction. For example the criteria of a government organisation or a not-for-profit organization will differ significantly from those whose aim is to make a profit from the project (Kelly and Shen et al. 2003).

Parametric Paired Comparison is a very effective tool for measuring and prioritising customer values and translating these values into project characteristics (Modafferi 2003). Understanding the relative importance of these principles by prioritising them using the Parametric Paired Comparison will help the study team and team members to achieve sustainable and innovative ideas in the project. PPC also plays a key role in getting a consensus within the study team. The essence of the methodology is to compare attributes, two by two. This is done using the matrix illustrated in Figure 8.9. For example, considering Factor A (Durability) and B (Transport), the participants were asked “Which factor is important?” the degrees of importance are “a/b = equal”, “1 = slight”, “2 = moderate” and “3 = major” as demonstrated in Figure 8.9. These results are very effective in the preparation of ideas and options, and in the evaluation and definition of requirement specifications.
8.7.3.1 DEFINING SUSTAINABLE CONSTRUCTION FACTORS

Realising SC is reached by the delivery of competitively-priced goods and services that meet human needs and bring quality of life, while progressively reducing environmental
impacts and resource intensity throughout the life cycle, to a level at least in line with the earth’s estimated carrying capacity (WBCSD 1992). The following elements of the project should be considered at strategic level: form, orientation, comfort, energy, thermal insulation, thermal mass, air tightness, materials, moisture management, ventilation, cooling, lighting and daylight, heating & domestic hot water, water and management in use (Halliday 2007).

8.7.3.1.1 ENVIRONMENTAL SUSTAINABILITY FACTORS

This section aims to introduce and define the environmental sustainable elements that should be considered at the strategic level and beyond of a project. It involves seeking materials and methods of construction that will not harm the environment or use excess natural resources. Reusing existing buildings and energy conservation techniques such as day lighting and natural ventilation are examples of those alternatives carrying a high initial price tag that must be factored into the WLCC considerations in selecting the best choice for a given owner or user (Dell’Isola and Kirt 2003).

The environmental impact of the construction industry is possibly larger in developing countries than in developed countries. This is because the developing countries are mostly still “under construction”, and they lack the required degree of industrialisation, making the construction industry one of the biggest factors impacting on the biophysical environment (Du Plessis 2002). Environmental sustainability factors includes the notion that SC needs to protect the natural environment rather than pollute it, encourages the use of renewable resources, and reduces the use of water, energy, materials and land in each stage of a project.

8.7.3.1.1.1 Air quality

Air quality concerns the quality of air both indoor and outdoor. The major factors that can affect its quality are direct and indirect emissions, environmental conditions, dust and particulate matter, and refrigeration or ozone depletions. The following five objectives are guidelines related to air quality: (1) to ensure an acceptable level of air quality which does not negatively affect the health of humans or the ecosystems of the
natural environment; (2) to keep a level of air quality that stops damage to projects and infrastructure; (3) to minimise human causes of climate change and prevent depletion of natural barriers against ultraviolet rays; (4) to connect air quality and energy issues; and (5) to maintain air clarity (Ashe et al. 2003).

Indoor environmental quality (IEQ) is connected to physical quality. A main part of IEQ is indoor air quality (IAQ) but IEQ also comprises acoustics and lighting. The main elements of IEQ consist of: (1) indoor air quality which is the level of pollutants such as building product estimations, external pollutants, dust, and pollen; (2) humidity which is the level of moisture in the air; (3) air movement which is fresh air and drafts; (4) acoustics which is noise transmission between rooms; (4) light intensity and quality which come from windows, skylights and artificial lighting (SBIC 2007).

8.7.3.1.1.2 Ecology/Biodiversity

Ecology is the study of organisms and their environment in terms of living relationships and interactions. It also includes humans and their natural and built habitats (Williams 2007). Most construction activities affect natural habitats in environments where species other than humans struggle to exist. Natural habitats and breeding patterns consideration is among the best practice construction management requirements proposed by bodies such as CEEQUAL (the Civil Engineering Environmental Quality assessment and Award Scheme), which monitors changes in biodiversity. We should also aim to enhance opportunities for colonising species through providing wildlife corridor, using surface of water, native planting, designing breeding areas and avoiding polluting treatments and materials, and to protect and enhance existing biodiversity by building the built environment integrated with this wildlife (Halliday 2007).

8.7.3.1.1.3 Emissions

Greenhouse gases, such as carbon monoxide, sulphur dioxide and nitrogen dioxide, result in global warming leading to climate change and sea level rise. These emissions cause acid rain and negatively affect human health. Climate change is now universally
Identified and global conventions require utilisation of renewable energy, such as solar, wind, biogas, biomass, hydro, wave and tidal energy, across the world. In this regard, the specific characteristics of sustainable design are natural or displacement ventilation; optimum use of daylight, high thermal mass (preferably exposed), solar shading and light shelves, waste heat recovery, and high levels of insulation (Edwards 2005).

The reduction of all possible emissions as resulting from the project development should be taken into consideration. These gas emissions can be generated from materials, furnishings, equipments, construction processes and energy. This includes ozone from laser jet printers, photocopiers, ultra violet lighting, formaldehyde from glues used in wooden products, and also emissions from carpets and soft furnishings in addition to CO₂ production (Addis, Talbot 2001). It is estimated that buildings emit over 40% more CO₂ than any industry. Emissions include greenhouse gases such as CO₂, CFCs, HCFCs, HFCs, Halons, methane, N₂O and other chlorinated hydrocarbons. This could also be reduced through considering the use of embodied and operating energy at the strategic level (Ashe et al. 2003).

Moreover, site dust, emissions and odours lead to frustration and ill-health. They have legal, site health, ecological and cost implications. The following are crucial steps to avoid or minimise the previously mentioned problems: (1) checking haul routes are suitable; (2) using containment methods for demolition; (3) keeping plants clean, including exhausts; (4) keeping earthworks damp; (5) ensuring efficient material handling and storage, and monitoring wind direction; (6) cleaning concrete pour-and-batching system; (7) reducing site cutting, grouting and grinding; and (8) avoiding burning on site (Halliday 2008).

8.7.3.1.1.4 Energy

The study team should aim to reduce load requirements strategically, to save on infrastructure or upgrading and costs. The following elements should be considered during strategic briefing: insulation options; the building fabric, roofs, lofts, external walls and floors; draught proofing and ventilation; heating; alternatives to conventional
heating; domestic hot water; lighting; the building as micro-power station; water and
energy conservation in appliances; materials and waste disposal and recycling (Smith
2006)

Furthermore, the consideration of the subsequent themes are essential: (1) proactive fire
engineering at an early stage can produce innovative passive design options by avoiding
the use of PVC-based materials and components and thus removing the need for fire
retardants, which have a toxic impact on the environment; (2) minimising heating needs
using suitable orientation, form, layout and proper glazing/insulation; (3) eradicating air
infiltration in the design of ventilation; (4) targeting the use of minimal polluting
sources of energy for heating; (5) identifying local energy sources such as wood, straw,
wind and geothermal while avoiding the addition of unnecessary expense and
maintenance costs; (6) formalising a complete and clear strategic briefing to ensure that
the operational requirements are deeply understood and can be taken into account at the
outset; and (7) considering using the combination of heat and power systems for huge
loads, where high maintenance is an acceptable overhead and where there is a summer
heating load (Halliday 2007).

8.7.3.1.1.5 Envelop and orientation
The function of the building envelope is to separate the indoor environment from the
outdoor environment so as to provide protection from the weather, intruders, pests,
oise and dirt, and to control the access of sunlight and air circulation so that
temperature and light are maintained at a comfortable level. The envelope of a building
consists of a structure that supports and forms the roof and resists lateral loads and
effects of winds or earthquakes. It also consists of foundations, walls and floors, wall
cladding or exterior surfaces, roofs, insulation and air sealing, and windows and doors.
A durable and effective envelope is a crucial element in a sustainable design (SBIC
2007).

It is very important to pay great attention to the building orientation, envelope and
massing to maximise solar gained through low surface loss and high internal volume:
high mass within the insulation and design provides appropriate shading. The classic passive design is to orient a building to locate its long side on a true east west axis to reduce loads on east and west perspectives, especially during summer (Kibert 2005).

8.7.3.1.1.6 Land and site

Land use, site selection and landscape design are strongly connected. Land is a crucial and valuable resource, so the proper use of land is a major consideration in a high-performance project development. In optimising the use of the site to suitably incorporate it with local ecosystems, the site’s geology, topography, solar insulation, hydrology and wind patterns are carefully considered. During selection of the location of the project, it is very important to consider prime farmland loss, building in 100-year flood zones, using land that is a habitat for endangered species, and reusing brownfields, grayfields and black fields (Kibert 2005).

This includes land utilisation and use which may include the following factors. Land utilisation is about soil profile, designated area protection, contaminated land replacement, derelict land rehabilitation and waste fill land determination. Land use should be concerned with site location on previously used land, surroundings in context, mixed use space and diversity, flood plain location and open space availability (Nirah 2006). Moreover, coastal regions in Saudi Arabia have special regulations, which must be understood by the study team during the briefing stage. Furthermore, the Saudi government has taken several actions to reduce desertification in the country, a factor emphasised by a number of expert interviewees. All these issues should be considered during site selection in the strategic briefing.

The site location should be appraised taking into account the flexibility in use, air quality, noise levels, existing services, land contamination, ecological value of the site in addition to enhancing the quality of life and user satisfaction; flexibility against future changes. The following general methods are guidelines to optimise land use: (1) protecting and preserving wetlands and important factors for the existing ecosystem; (2) using native and adapted, drought-tolerant plants, trees and turf for landscaping; (3)
developing brownfield properties that are contaminated or perceived to be contaminated; (4) protecting key natural features; (5) reducing the negative impact of the project on the site; (6) minimising earth movement and soil compaction; (7) using the sun, existing winds, and foliage on the site in the passive solar design scheme; (8) reducing impervious areas; and (9) using appropriate storm water management technology (Kibert 2005). It is also important to pay particular attention, during site selection, to the special process of needs, access, public transportation, public services such as electricity, water drink and sewage, and communication media such as internet and telephone, etc.

8.7.3.1.1.7 Materials

The selection of appropriate materials for a project has significant consequences in terms of its effects on the environment, people and economics. There is a strong link between the selection of materials at the strategic stage and the future sustainability of projects. Some materials need a considerably different energy and CO$_2$ production in their manufacture than others (Sayce and Walker et al. 2004). The following specific characteristics of sustainable building design are crucial: using recyclable, reusable, renewable materials; using locally sourced materials; constructing for disassembly; and using high-tech materials of energy engineering (Edwards 2005).

Materials selection is a difficult process including many variables, and there is hardly ever one best way that can be employed to choose project materials. The life cycle environmental impacts should be used to assess products. This tool tracks a material from its extraction, through its production, manufacturing process and transportation, to its characteristics in use and ultimately its disposal, reuse or recycle options. The following attributes should be considered during the selection of materials: renewability, recycled content, reusability/recyclability, durability, embodied energy environmental and people impact (SBIC 2007).
8.7.3.1.1.8 Pollution

The minimisation of pollution to water, air, and land should be considered at the strategic level and beyond of a project. Checking local plans for sources of pollution and noise is very important from the SC point of view. These sources could be flight paths, power stations, incinerators, factories or other industrial activities upwind of the site (Harris and Borer 2005). In addition, minimisation of organic waste to landfill, sewage treatment and discharge impacts must all be considered. Pollution should be limited to the lowest levels to avoid damage to natural systems and people.

8.7.3.1.1.9 Renewable resources

The facilitator and study team should encourage the use of renewable resources that are grown, naturally replenished, or cleansed, at a rate which exceeds depletion of the useable supply of those resources (ISO/TC59/SC3-N4).

8.7.3.1.1.10 Transport

The facilitator and study team should consider the varieties of transportation options to the project, namely, walking, biking, using public transit and driving. They should take into account the negative impacts of these transportation methods in terms of SC components: environment, social and economic (Williams 2007). It is advisable to avoid using mechanical conveying systems such as lifts and escalators in projects, except for necessary use and disabled access. The use of stairs through appropriate layouts is recommended and no system should have asbestos (Halliday 2007).

8.7.3.1.1.11 Waste

An effective waste management plan is very important in the construction industry from the outset of the project to its demolition. The plan can be tailored to satisfy the conditions of the project. It should take into account the entire range of aspects associated throughout the project including the design, materials manufacturing, purchasing, transporting, fixing, disposal and recycling costs, existence of outlets, and
the feasibility of changing worker habits. The plan should be distributed to all relevant 
people, on the jobsite, in the office, suppliers and subcontractors. Figure 9.10 illustrates 
the waste management hierarchy (SBIC 2007).

![Figure 8.10: Waste Management Hierarchy](image)

The implementation of a well established design is the most effective way to reduce 
wastage in construction in the Middle East and India (Raveendranath and Kaka 2006). 
Moreover, the greatest opportunities to minimise waste are through effective design, 
optimum purchase and minimum materials package. The following steps are guidelines 
to reduce waste: reduce packaging; reduce waste factors; produce compressive detailed 
construction drawings; increase spacing of joist and studs; create a central cutting area 
of wood and steel; separate reusable lumber; use cardboard or drywall off-cuts; ask sub-
contractors to keep the jobsite clean; consider precast or poured concrete or insulating 
concrete forms; designate set work areas; point out and empower individuals; and 
execute a waste audit and sift-separate waste for recycling (SBIC 2007).

8.7.3.1.12 Water

The facilitator and the study team face difficulties when the water supply does not 
reverse the boundaries of the users. Water sustainability requires policies and a land use 
guide that promote regional self-sufficiency (Williams 2007). Water is heavily affected 
by the construction activities through pollution, contamination and waste. The following 
steps are used to ensure safe water management during the process development of the 
project: (1) assess the potential risks for water contamination, such as disposal of silty 
or oily water, seepage into groundwater, etc.; (2) establish suitable methods for control
and management for each risk; (3) raise awareness of the risk; and (4) dip contaminated materials appropriately (Addis, Talbot 2001).

The following aspects should also be considered within water strategy: abstraction, disposal, spillage, vehicle washing effluent, solid wastes, surface water run-off, silty water, pumping to grasslands, settlement tanks, lagoons and sewage discharge (Halliday 2008). The provision of water and wastewater treatment needs early strategic decisions. The following points will help at the strategic stage, namely: (1) auditing water supply and demand; (2) making decision in terms of water collection, usage, conservation and treatment; (3) considering water impact on form and surrounding land requirements; (4) considering the costs of water and its waste in use; (5) allowing sufficient time to design efficient systems; and (6) considering function, maintenance, water use, effluent quality, chemical use, energy consumption, materials, land use, and aesthetics (Halliday 2007). Moreover, the following specific characteristics of sustainable building design should be considered: dual-flush toilets; spray taps; urinal sensors; rainwater collection; reduce, recycle, reuse (Edwards 2005).

8.7.3.1.2 SOCIAL SUSTAINABILITY FACTORS
This section aims to introduce social elements that should be considered at the strategic level and beyond in design developments of a project. It highlights improvements in the quality of human life and human living environment, which includes the following issues.

8.7.3.1.2.1 Cultural consideration
The understanding of the community culture is very important to meet the requirements and needs of the owner and users or tenants and other stakeholders. The influence of culture issues, for example, language, time orientation, use of space, religion, habits, customs, power distance, individualism-collectivism, masculinity-femininity, uncertainty avoidance, and long-term/short-term orientation must be taken into account. The study team may encounter ethical dilemmas which influence decision-making in the briefing process.
8.7.3.1.2.2 Health and welfare

The built environment has fundamental effects on the physical and economic health and welfare of people, communities and organisations. Buildings contribute to illness through poor ventilation, moisture management, using chemical toxins, poor transport facilities and access to amenities. Moreover, buildings can undermine a community by providing poor space either privately or publicly and by causing extreme financial liability due to inefficiency.

Thus, the identification of the needs and requirements of a community are significantly necessary so that the interventions of the stakeholders (community) of the project can meet and enhance community aspirations. This depends on the real involvement of the community; the higher their engagement, they more successful they will be in fulfilling their requirements (Halliday 2007). The specific characteristics of sustainable building design include limited automation of environmental control, low-toxicity materials, natural environmental and materials, social space as well as work space and visible nature inside and outside (Edwards 2005).

8.7.3.1.2.3 Neighbourhood

Careful selection of the project location can provide neighbourhoods with a unique character, improve the walking environment, and create satisfaction in the community (Williams 2007). The following steps should be taken into account during strategic briefing (Halliday 2007): (1) full involvement of all stakeholders in development issues; (2) consideration of shared functions such as walls, heating, access and management etc between neighbouring buildings; (3) provision of safe open-space environments for exercise and socialisation; (4) encouragement of a superefficient, diverse, integrated transport system; and (5) respect for people’s culture, religion, privacy and dignity. The understanding of social factors such as being aware of neighbours’ requirements, needs and their potential objections are essential.
8.7.3.1.2.4 Security and accessibility

The facilitator and study team should consider the following factors when developing a strategic briefing and include them in the design. These factors are respect for privacy, provision of evacuation areas, consideration of disabled issues and of smoking aspects, as well as prevention of crime in buildings. Ease of access to buildings and site construction by occupants and users is very important as well. Moreover, the accessibility for existing transportation and corridors inside the building should be early considered in the design in addition to the building's ability to meet the needs of the owner, tenants, visitors and other stakeholders.

8.7.3.1.2.5 Public amenities

The location of a project is very important in terms of the surrounding amenities. This factor is dominant when deciding to design, rent, live or buy that project. The existence of the most normal facilities is a fundamental means of minimising the use of cars and commuting strain. These services could be schools, work, shops, quiet roads and area, good rail links, private gardens, car parking, and distance from flight paths. Suitable cycle routes and access to bus and train services are also very important to the entity location from an environmental point of view. Pedestrians and sports should be encouraged in the area (Harris and Borer 2005).

8.7.3.1.2.6 Society inclusion

The facilitator and study team should include the community in the decision making process in project planning at the strategic level. The following issues should be considered through social inclusion: promoting health and well-being through security and clean and pleasant environments; providing health care to prevent ill-health. People should live in self-confidence without fear of violence or crime, and free from discrimination due to their race, gender, sexuality, personal circumstances or beliefs. Local customs and cultural identity should be appreciated, providing leisure and recreation to all. In addition, all people should have the right to access to the skills, knowledge and information needed for them to play a full part in their society and its
decision-making. This should also include community interaction, donations to voluntary groups, decision-making by consultation, and the enhancement of local social identity (Nirah 2006)

8.7.3.1.2.7 User comfort and satisfaction
User or occupier satisfaction is fulfilled through the strategic briefing of public and private spaces, multi-use development, local service and social infrastructure, as well as good transport options. The users or occupants of the building should be able to see without glare or dimness. Comfort can be met by controlling the level of temperature, thermal comfort, humidity, ventilation, and lighting in buildings. Healthy environments are often based on natural sources of light, ventilation and materials. This can also be improved by insulation, breathing walls and removal of unwanted air movement (draughts), individual user controls and occupant feedback (Halliday 2007). Privacy is also an important element to meet comfort in the project. It is very important that information associated with privacy implementation in the building is gained during strategic briefing.

8.7.3.1.3 ECONOMIC SUSTAINABILITY FACTORS
This section aims to introduce and define sustainable economic elements that should be considered at the strategic level and beyond by decision makers in design project developments. Economic sustainability includes the use of full-cost accounting methods and real-cost pricing to set prices and tariffs for goods and services and achieve more efficient use of resources. It also requires high performance, durability, quality and mixed use of a project. It includes the following issues.

8.7.3.1.3.1 Adaptability
Adaptability concerns the capability of projects to accept considerable change (Russell and Moffatt 2001). This includes: (1) flexibility, which means the ease of change of spatial organisation, of technology or of services; (2) convertibility, which means the
ease of change for new uses; and (3) expandability, which means the ease of additions (Ashe et al. 2003).

8.7.3.1.3.2 Affordability and viability

Affordability is about much more than just the ability to purchase or rent and sustain an adequate building at an acceptable cost. It is also about the contribution that a building can make to accomplishing positive outputs in education, health, employment and in building stronger communities (DTZ June 2004). Finally, it is about minimisation of excessive financial liabilities through the long life with low maintenance of a project from the outset to demolition (Halliday 2008).

8.7.3.1.3.3 Durability

Durability is often a method for fulfilling the major requirements of health, safety and amenity. It is not particularly targeted at SC, although it can be argued that prolonging the life span of products has a positive effect on sustainability in minimising the consumption of materials (Ashe et al. 2003). It should be considered at all stages of the construction process, from development of the client brief, through the design and construction phases, into operation of the project.

8.7.3.1.3.4 Employment/jobs

This includes business opportunities, the number of jobs provided by the project, equal opportunities, diversity and investment in skills, programmes and trainings.

8.7.3.1.3.5 Quality

The emphasis given to the management of design quality has a great impact on the overall success of a project, especially if that happened at the early stages (Raveendranath and Kaka 2006). Srinindhi (1998) claimed that Strategic Quality Management is ‘the formulation and deployment of quality management within the overall framework of strategic planning, in a way that is aligned with all the other
initiatives such as process re-engineering, cost management, inventory control and target analysis'. The achievement of quality in design is extremely difficult to appraise. However, there are a number of tools and techniques that could be used to measure and ensure the realization of a quality process during strategic briefing and consequent design development if the client and study team agree on suitable ones in briefing stage. These could include the Design Quality Indicator (DQI), BREEM, LEED, CEEQUAL and SPeAR.

8.7.3.1.3.6 Whole life cycle cost

Adetunji and Price et al (2003) cite Kibert (1994) who outlined what is involved in SC, this includes; whole life costing, procurement, site planning, material selection and use, recycling, and waste and energy minimisation. From this, it is clear that sustainability is a huge field incorporating different dimensions and areas within SC.

Sorrell (2003) claimed that energy efficient use of new buildings is significant to achieving sustainable opportunity. He emphasised that new construction projects can take benefit of energy efficient technology if right options are selected and designed on building form, fabric, orientation and building services including heating, ventilation, air conditioning and lighting. Boussabaine and Kirkham (2004) selected the below definition for whole life-cycle cost (WLCC) as the appropriate one:

'WLCC is a dynamic and ongoing process which enables the stochastic assessment of the performance of constructed facilities from feasibility to disposal. The WLCC assessment process considers the characteristics of the constructed project, reusability, sustainability, maintainability and obsolescence as well as the capital, maintenance, operational, finance, residual and disposal costs. The result of this stochastic assessment forms the basis for a series of economic and non-economic performance indicators relating to the various stakeholders' interest and objectives throughout the life-cycle of a project'.
Another practical definition is adopted by the construction best practice programme (CBPP 1998):

'...the systematic consideration of all relevant costs and revenues associated with the acquisition and ownership of an asset'.

Whereas the BS ISO 15686 of service life planning (BSI 2000) defines WLC as:

'a tool to assist in assessing the cost performance of construction work, aimed at facilitating choices where there are alternative means of achieving the client's objectives and where those alternatives differ, not only in their initial costs but also in their subsequent operational costs'.

- WLC includes the systematic consideration of all relevant costs and revenues associated with the acquisition, use and maintenance and disposal of an asset.
- Procurement costs can include: initial construction, purchase/lease, interest and fees.
- Recurring costs can include: rent, rates, cleaning, maintenance, repair, replacement/renewal, energy and utilities, dismantling or disposal, security and management.
- Revenues can include: sales of recycled materials, interest in asset and rental income.

### 8.8 INNOVATION STAGE (4)

The main aim of this stage is to use innovation techniques to generate as many ideas and alternatives as possible for achieving each function selected in the study within the scope and objectives of the project. Innovation is defined as 'the successful implementation for new ideas to meet the need of stakeholders, including planet earth' (Godfrey 2006). Stimulation is provided by a number of techniques such as brainstorming, checklist, six hats, Delphi and so on in creative thinking. SC principles
should be born in mind when the team starts to generate these ideas. Ideas arrive as a result of efforts done in the information stage and from the study team creative sessions. This creative type of effort should be completely unimpeded by customs, tradition, negative attitudes, assumed restrictions and specific criteria.

This stage session gathers experts of all desirable fields together to share a common understanding of the performance-based objectives of the project to strive for sustainable design solutions that meet the objectives of the project. There are typically ten rules for an effective brainstorming session (Thiry 2004): (1) writing down all ideas and comments; (2) aiming at quantity rather than quality; (3) excluding criticism and assuming each idea will work; (4) leaving judgment until the evaluation stage; (5) eradicating the word “impossible” from the collective dictionary; (6) allowing the imagination to roam free; (7) using piggybacking (building on other ideas and comments); (8) cross-fertilising ideas (associate or modify ideas and comments); (9) letting everybody talk and contribute; and (10) avoiding interruption.

8.9 EVALUATION STAGE (5)

This stage attempts to screen the idea(s) generated earlier in the innovation stage by selecting the best ones for development. The study team should evaluate and agree them based on the project objectives and scopes to produce proposals for the next stage. From the large number of ideas, those that perform best against the agreed success criteria are selected. The following steps are guidelines for the study team to effectively perform this stage: (1) build shared understanding of each idea; (2) discuss how each idea affects the project in terms of sustainable value criteria identified previously; (3) eliminate unworkable, redundant and irrelevant ideas; (4) rank and combine the ideas within each category according to sustainable value evaluation criteria identified at the information stage; (5) identify a champion for each group to develop ideas in more detail; and (6) use performance measurements identified in stage two for ranking the grouped ideas.

The facilitator and sustainability advisor can use other tools and techniques related to measuring value from a sustainable point of view with regard to its three components;
economical, social and environmental aspects. It is necessary for the facilitator and the study team to know the existent tools and techniques and synergies between these different methodologies, where appropriate, namely, Whole Life Cycle Cost (WLCC); Life Cycle Assessment (LCA), Environmental Code of Practice for Buildings; The CIBSE Log Book; the Green Guide to the Architect’s Job Book, the Sustainable Neighbourhood Audit Technique and the ISO 14000 Environmental Management Service. The previous tools and techniques can be used to promote awareness of the process and intrusion at the suitable time.

Whole Life Cycle Cost connects initial costs and ownership costs to optimise total costs. This benefits the facility manager by improving decision making. It also permits the economic assessment of the idea being considered in response to these issues (Alphonse 2003). Moreover, the following tools could be used as benchmarking to establish and measure performance in terms of agreed indicators and enable projects, products and process to be evaluated, such as Construction Best Practice Programme, Design Quality Indicators (DQI). The following techniques reward accreditation for a project applying their standards in terms of sustainability: BREEAM, Eco-Homes, LEED and CEEQUAL. These tools and techniques, for the different phases, at the end of the application, where appropriate, enable the facilitator and study team to measure the value variation with relation to sustainable concerns: economical, social and environmental.

8.10 DEVELOPMENT STAGE (6)

This stage aims to develop the idea(s) selected in the evaluation stage to create viable proposals. It also attempts to decide on and prepare the “best” alternative(s) or ideas achieving sustainable value criteria to achieve value for money within the project objectives and scope. The study team should start investigating the highest ranked ideas to prepare strategic briefing including sketches and WLCC estimates taking into account SC issues. Each alternative or idea should provide as much technical, cost, schedule information, impact on time, cost and quality, disadvantage and risk as practical. Where appropriate, the designer and project sponsor may need to make an
initial assessment concerning the feasibility of the implementation of these ideas. The best ideas will be developed only when all participants collaborate as a team and seek an optimum solution for achieving SC principles and overcoming the total problems. It is necessary to consider the long-term cost-effectiveness of the ideas as a whole.

The following steps are guidelines for the facilitator and study team to achieve this stage: (1) determine and prepare doable scenarios and evaluate the ‘whole scenario’; (2) make an initial assessment concerning the feasibility; (3) conduct benefit analysis and implementation requirements; (4) develop estimated initial life cycle costs; (5) generate sketches and information needed; (6) establish action plan for those ideas recommended; and (7) ensure that ideas recommended are implementable, workable, sustainable and reliable.

8.11 DECISION-BUILDING STAGE (7)

This stage works to present a strategic briefing resulting from the recommendations of the workshop agreed upon to build a common decision. Advantages and drawbacks of all proposed ideas, refined in the previous stage for developing strategic briefing, should be presented to senior managers and other key stakeholders to help them make wise and correct decisions. The following steps are guidelines for the facilitator and the study teams to achieve this stage: (1) prepare presentation and supporting documents for decision-makers and key stakeholders, in addition to preliminary report; (2) make sure the people who attend the presentation are the same who attended stakeholder Briefing stage because they are already aware of SC benefits and drivers, and they are responsible for sponsoring the project to convert plans to reality; (3) exchange information with the project team; (4) use a rigorous decision-making process; (5) ensure top managements has full and objective information and attended in the previous stages so they can make right decisions; (6) plan expected execution schedule; and (7) ensure decision can be obtained from decision-makers.
8.12 IMPLEMENTATION STAGE (8)

This stage aims to draw up an implementation plan for all ideas and scenarios accepted and agreed by decision makers in the previous stage. The following steps are guidelines to the facilitator and study team to achieve this stage: (1) review the preliminary report; (2) work out and update drawings and specifications and validate benefits of implemented ideas; (3) establish action plans for all ideas accepted and document the raison d'être for the rejected ideas; (4) obtain commitments of all participants in working out implementation plans of accepted idea(s); (5) set a timeframe for reviewing and implementing all ideas accepted; (6) ensure that SC principles become embedded in all ideas; (7) agree on performance measurements with project; (8) track sustainable value achievement resulting from implement ideas; (9) sign off the implementation plan and follow up; and (10) track benefits.

8.13 SUMMARY

The integrated approach to VM and SC during Strategic Briefing was developed to identify the client’s requirements, facilitating and accelerating the understanding and implementation of SC principles through its integration with the VM process. The approach comprises eight stages: Planning; Stakeholders briefing; Information, Innovation; Evaluation; Development, Decision-Building and Implementation stages. The framework is divided into four phases: Planning stage, Stakeholders briefing stage, Workshop stage, Decision-Building stage and Implementation stage.

The approach depends on the participation and learning of the key stakeholders of the project, such as, top management, the client, the users or occupants, the facility manager, the sponsor or the finance representative and the study value team including the facilitator (value manger) and sustainability advisor or consultant, in addition to design team if they have been appointed. The facilitator of the study should be qualified, experienced and skilled because the incorporation of SC principles into VM processes and the participants themselves will place significant demands on his /her facilitation skills.
Moreover, the appointment of the sustainability advisor is necessary to teach the key stakeholders and introduce SC benefits and drivers during the stakeholder briefing stage, in addition to monitoring the implementation process of SC principles during strategic briefing and design stages. The number of people involved in the workshop and its duration should be determined while doing a stakeholder analysis. The integration of VM and SC offers the clients the ability to see thorough the image of SC and use the power of VM for continuous improvement to create sustainable value in the project. The use of both disciplines effectively during strategic briefing will reap the benefits and achieve best value in the project.
CHAPTER NINE
CHAPTER 9
THE VALIDATION OF AN INTEGRATED APPROACH TO VM AND SC DURING STRATEGIC BRIEFING

9.1 INTRODUCTION

The Integrated Approach to VM and SC during Strategic Briefing, which has been developed throughout the earlier chapters, has been undertaken in this section. Validation here means the judgment of whether or not an approach successfully fulfils its intended purpose; this judgment should be made by qualified and competent people (Church 1983). Moreover, Mister (1993) stated that any validity judgement depends on its use or purpose and its situation. Smith (1993) claimed that difficult and non-quantitative frameworks can be validated using a qualitative approach through interviews and questionnaires underlining the pros and cons of the model in the validation process. Hence, given the previous discussion, and since the integrated approach developed in this research is non-quantitative, the validation process is followed through by obtaining expert judgment and feedback.

9.2 VALIDATION TOOL DESIGN

The validation tool was designed to seek modifications, changes and evaluation of the integrated approach from experts possessing significant experience and knowledge about VM and/or SC. The validation sheet requested qualitative comments through open-ended questions, in combination with quantitative closed-ended questions using the Likert scale. The validation sheet is illustrated in Appendix D.

The validation sheet aimed to investigate whether the integrated approach would satisfy the aim of the research or not, this aim being to integrate VM and SC principles during strategic briefing. The reasons behind that integration are to accelerate the understanding and implement the principles of SC through VM and its practitioners'
experience and skills in the Saudi construction industry. Moreover, this approach also aims to upgrade VM to continue its competitiveness, enhance its performance and spread its implementation all over the country in delivering value for money. Furthermore, it endeavours to improve and promote the technical knowledge and awareness of VM practitioners about SC aspects.

This was conducted through a validation sheet which reflects the anticipated aspects of the integrated approach and seeks the insights of experts in the field. These aspects include all the various components connected with the integrated approach in terms of any changes and/or modifications suggested to its stages, steps, sustainable factors and tasks.

Sample size, as in any qualitative approach, can be fairly small if the emphases concentrate on the variety of feedbacks and on achieving a better understanding of the aspects under investigation; thus, a convenience sample was employed in the qualitative research (Sekaran 2003). The validation employed the Likert scale because it is less laborious and ensures that all components measure the same thing (Oppenheim 2003). The validation covered the following six points.

To obtain in-depth feedback on the integrated approach, experts were asked if any changes and/or modifications would be suggested to refine the integrated approach.

The extent to which the developed integrated approach stages addressed the required steps, techniques, tools and mechanisms to achieve its objectives were rated according to their importance on a 5-point Likert scale ranging from ‘very high=5’ to ‘very low=1’. These stages were: Planning Stage, Stakeholder Briefing Stage, Information Stage, Innovation Stage, Evaluation Stage, Development Stage, Decision-Building Stage and Implementation Stage.

Identification was made of the approximate time required to apply the integrated approach for medium building project in days.
The general aspects of the integrated approach associated with efficacy were evaluated on a 5 point Likert scale with ‘not efficacious = 1’, ‘slightly efficacious = 2’, ‘moderately efficacious = 3’, ‘very efficacious = 4’ and ‘extremely efficacious = 5’.

The general aspects of the integrated approach associated with practicality were evaluated on a 5 point Likert scale with ‘not practical = 1’, ‘slightly practical = 2’, ‘moderately practical = 3’, ‘very practical = 4’ and ‘extremely practical = 5’.

The general aspects of the integrated approach associated with effectiveness were evaluated on a 5 point Likert scale with ‘not effective = 1’, ‘slightly effective = 2’, ‘moderately effective = 3’, ‘very effective = 4’ and ‘extremely effective = 5’.

9.3 RESPONDENTS

A validation sheet containing the validation questions was sent to twelve experts possessing significant experience in VM and/or SC. The details of experts are illustrated in Tables 9.1 and 9.2. They were intentionally identified for the proposed study through the Institute of VM in the UK (IVM), Society of America for VM (SAVE International), conferences, seminars, previous research in the same area and through the internet. They were highly qualified and occupy high positions in their organisations. They are also practitioners and have performed many studies and delivered training either on VM, on SC or both. The validation forms were sent to the experts either by email or post.
<table>
<thead>
<tr>
<th>No</th>
<th>Qualification</th>
<th>Organisation</th>
<th>Expertise</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>BSc, MSc, CVS, PMP</td>
<td>Saudi Commission Engineer, and he owns private business</td>
<td>Performs many studies in VM and has experience in Saudi Public Sector</td>
<td>Construction projects, design, management, lead VM studies, and deliver VM courses</td>
</tr>
<tr>
<td>2.</td>
<td>BSc, MSc, DIC, CEnv, FICE, MCIWM, MiEnvSc, SiLC</td>
<td>Leads large company’s environmental consultancy services in the UK</td>
<td>25 years in civil engineering projects, environmental impacts, contamination land assessments, risk management and remedial design and implementation for industrial, commercial and residential developments.</td>
<td>Carry out environmental audits, studies and impact assessments for remedial projects. Conduct successful applications for waste management licenses, and integrated pollution control authorisations. Deliver specialist technical advice</td>
</tr>
<tr>
<td>3.</td>
<td>BSc (Hons), PhD, MCIOM, CVS, TVM, PVM, Technology Manager</td>
<td>VP of Education in large organisation International Executive member of the IVM, Director of organisation in the UK</td>
<td>Delivered many VM studies Participated in many projects Good reputation in VM and FAST techniques</td>
<td>Editor Researching different value methodologies and creative group decision-making. Doing research in FAST diagram</td>
</tr>
<tr>
<td>4.</td>
<td>BSc (Hons) MPhil CEng MCIBSE FRSA</td>
<td>Principal of large organisation in research and industry</td>
<td>30 years experience in VM and SC. Has written a number of books in sustainability, Solar Air Conditioning, Animal Architecture, ECO City. Lead partner in low allergy research and an engineer specialising in construction ecology</td>
<td>Develop sustainable solutions for the built environment and facilitate collaborative working with architectural, engineering, urban design and landscape practices and reflects the nature of construction industry’s research requirements in responding to the challenge of SC.</td>
</tr>
<tr>
<td>5.</td>
<td>MBA CEng FIMechE FCMC MCIM TVM</td>
<td>Director of a consultant firm</td>
<td>Value and Risk management Design &amp; management of complex projects &amp; programmes Strategic marketing Technology management Computer modelling &amp; other analytical tools</td>
<td>Work extensively with directors/senior managers of large organisations Pioneered new techniques for organisational analysis Facilitate problem solving workshops</td>
</tr>
<tr>
<td>No</td>
<td>Qualification</td>
<td>Organisation</td>
<td>Expertise</td>
<td>Tasks</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 6.  | MSc, PVM, TVM                      | Director of Risk and VM division Member of IVM                                | Risk and VM                                                              | Delivers 3 day VM Foundation Course  
Delivers VM Studies  
Participated in many projects |
| 7.  | MSc. MICE, FIHT, PVM, TVM, Charted Civil Engineer. | Project management facilitation and support.                                  | 15 years in VM and 1 SC. Laing construction, Railtrak,  
Post-award Partnering and team building workshop                           | Align objectives of client, designer, contractor and suppliers and agree principles and procedure.  
Do VM, VE, Risk and Partnering workshops and facilitation of workshops and seminar |
| 8.  | MSc. BSc Quantity surveying, MRICS, PVM |                                                                           | 15 years in VM, 5 years in SC                                             | Delivered many VM, Risk, and SC Studies. Participated in several construction projects |
| 9.  | BSc, MPhil, PhD, MRICS, Chartered Surveyor with industrial and academic experience | Chair of Construction Innovation in large company. Work in the Built and Natural Environment in university | More than 30 years in VM, PPP, FPI, UK construction industry  
Published many articles and books on this subject.                           | Researching in VM  
Writing numerous publications  
Firm believer in the principle of putting research into practice, and has undertaken VM studies as research consultant on a variety of construction projects. |
| 10. | CVS-life, PMP                       | Executive Vice President of large organisation                               | Certified Value Specialist and Project Management Professional, over 15 years, led over 200 value studies. | Services and facilities from forklifts to multi-billion dollar transportation projects.  
Lead VM studies work as project manager. |
| 11. | Chartered civil engineer and a chartered builder | Director of Innovative Construction Research Centre  
Worked in University for 20 years following several years experience with a national contractor. Gained design experience with a multi-disciplinary firm of consulting engineers. |                                                                           | Regularly acts as a consultant to industry in the areas of VM, risk management and partnering.  
Facilitated strategic planning workshops involving directors of several national contractors. |
9.4 VALIDATION FINDINGS AND DISCUSSIONS

The findings from this validation process represent the feedback obtained from twelve construction industry experts. The general outcomes were very positive from most experts. They expressed some comments/modifications/criticisms that are illustrated in this section. The findings also revealed a high degree of adoptability of the integrated approach components among the experts. Both the quantitative feedback associated with the integrated approach facets’ rating and the qualitative feedback in terms of the open-ended questions and through general comments were considered and the pertinent stages and tasks modified.

The required time or study duration estimated by the experts for the implementation of the integrated approach during strategic briefing mostly fluctuated between two and five days. Most experts stated that several factors would affect the determination of the study duration, such as the size, complexity and type of the project, in addition to the number of stakeholders of the project. The quality of implementing the integrated approach in terms of communication, commitment and decision-making within the process will also affect the duration and outcomes. They recommended that the study duration should be decided by the facilitator, the client and the sponsor during the strategic meeting. The following comments were given by the experts during the validating the Integrated approach.

"I like the logic and the graphic visualisation above. The concern I have is that many clients are reluctant to spend time and effort (money) up front, on a team of experts, when they have already selected a lead professional to perform the planning and design of their project. The clients have to see their benefits (including financial rewards) and agree to this level of planning effort, or it will be omitted. Investors are usually short term (quick return on investment) thinkers. It would be helpful, if government demand and/or subsidies, or somehow reward this level of long-term effort that will be beneficial for future generations as well as the present population".
"An interesting and extremely detailed Framework, I have estimated that the workshop could be undertaken in 3 days but this may take longer if you are working through each stage in detail".

"I agree it could be used quite widely as a vehicle to implement SC within building projects. Definitely how it is thrown out here in the diagram looks interesting; it's a different way of looking at it, different perspective but I think it's one we could use in construction projects. So, yes to quite a high degree".

"The efficacy will depend greatly on how the process is applied. If every step is adopted for every job, the result could be counter productive. Applied appropriately and skilfully, the framework could be very efficacious".

"If done superficially 2 days, if done properly 5 to 10 days within the design process rather than as a bolt on service done to the project".

9.5 THE INTEGRATED APPROACH PROCESSES EVALUATION

In order to objectively examine the components of the developed integrated approach to VM and SC during strategic briefing, a descriptive statistical analysis method was employed by using the Statistical Package for the Social Sciences (SPSS). The experts were asked to rate the importance of each stage and add any missing stages that they perceived as necessary and rate them. They were also asked for any general comments that they believe would add value to the integrated approach.

All experts agreed that the integrated approach components were very high in importance. Some of them mentioned comments which were taken into consideration in refining the approach. It can be seen from Figure 9.2 that all the degrees of importance of the integrated approach stages were rated high and very high.
The integrated approach processes rated in the validation sheet by the experts are all related to the study. The stages are represented in Table 9.3 according to mean score, standard deviation, median mode and variance. Table 9.3 presents a summary of descriptive statistics for some important aspects of a set of data.

The importance degree scores ranges from 1 to 5 (1 being low importance and 5 very high importance). It can be seen from Table 9.3 that mean values range from 4.42/5 to 4.67/5. Standard deviation values range from 0.49 to 0.67. The findings denote that all stages are very important and have approximately the same value.

![Figure 9.1: Stage evaluation](image)

Table 9.3: Integrated Approach process: statistical parameters

<table>
<thead>
<tr>
<th>Statistical Parameters</th>
<th>Planning</th>
<th>Stakeholder Briefing</th>
<th>Information</th>
<th>Innovation</th>
<th>Evaluation</th>
<th>Development</th>
<th>Building-Decision</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.42</td>
<td>4.67</td>
<td>4.58</td>
<td>4.58</td>
<td>4.50</td>
<td>4.42</td>
<td>4.58</td>
<td>4.67</td>
</tr>
<tr>
<td>Sd. Error of Mean</td>
<td>0.19</td>
<td>0.14</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td>0.19</td>
<td>0.15</td>
<td>0.14</td>
</tr>
<tr>
<td>Median</td>
<td>4.45</td>
<td>4.67</td>
<td>4.58</td>
<td>4.58</td>
<td>4.50</td>
<td>4.45</td>
<td>4.58</td>
<td>4.67</td>
</tr>
<tr>
<td>Mode</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Sd. Deviation</td>
<td>0.67</td>
<td>0.49</td>
<td>0.51</td>
<td>0.51</td>
<td>0.52</td>
<td>0.67</td>
<td>0.51</td>
<td>0.49</td>
</tr>
<tr>
<td>Variance</td>
<td>0.45</td>
<td>0.24</td>
<td>0.27</td>
<td>0.27</td>
<td>0.27</td>
<td>0.45</td>
<td>0.27</td>
<td>0.24</td>
</tr>
<tr>
<td>Range</td>
<td>2.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>2.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Sum</td>
<td>53.00</td>
<td>56.00</td>
<td>55.00</td>
<td>55.00</td>
<td>54.00</td>
<td>53.00</td>
<td>55.00</td>
<td>56.00</td>
</tr>
</tbody>
</table>
9.6 EFFICACY, PRACTICALITY AND EFFECTIVENESS EVALUATION

Efficacy considers to what extent the integrated approach will achieve the intended result, which is integration and consideration of VM and SC during strategic briefing. Practicality relates to the extent to which the integrated approach will incline to action rather than theory or speculation in producing the intended target, mentioned above. Effectiveness analyses to what extent the integrated approach will help the attainment of long-term goals associated with stakeholders' expectations to achieve value for money in their projects.

In order to objectively evaluate the above three attributes of the integrated approach to VM and SC during strategic briefing, the descriptive statistical analysis method was employed by using the Statistical Package for the Social Sciences (SPSS). The average evaluation of the three aspects (efficacy, practicality and effectiveness) of the integrated approach to perform its intended objectives was greater than 70%, as illustrated in Figure 9.1. This evaluation denoted that the integrated approach of VM and SC during strategic briefing is a very efficacious, practical and effective methodology. However, one expert expressed the view that the quality of conversation, decision making and involvement within the process will affect outcomes. Table 9.5 presents a summary of descriptive statistics for some important aspects of a set of data.
Figure 9.2: Evaluation of approach attributes (Efficacy, Practicality and Effectiveness)

Table 9.4: Integrated approach: statistical parameters

<table>
<thead>
<tr>
<th>Statistical Parameters</th>
<th>Efficacy</th>
<th>Practicality</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.75</td>
<td>3.92</td>
<td>3.67</td>
</tr>
<tr>
<td>Median</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Mode</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>0.45</td>
<td>0.51</td>
<td>0.65</td>
</tr>
<tr>
<td>Variance</td>
<td>0.20</td>
<td>0.27</td>
<td>0.42</td>
</tr>
<tr>
<td>Minimum</td>
<td>3.00</td>
<td>3.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>4.00</td>
<td>5.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Sum</td>
<td>45.00</td>
<td>47.00</td>
<td>44.00</td>
</tr>
</tbody>
</table>

9.7 SUMMARY

The chapter has presented feedback from twelve industry experts possessing significant experience in VM and SC for validating the integrated approach to VM and SC during
strategic briefing. The feedback was obtained through responses on a validation sheet containing open-ended questions and questions evaluated on a Likert scale, all sent by email and post.

The overall feedback was mainly positive and comments provided were considered. Many of the experts contacted considered adopting the framework and mentioned potential benefits from it. In general, the valuation revealed that the developed integrated approach is more comprehensive and has clearer and more detailed foundations underlying its processes and steps. The next chapter presents the conclusions and recommendations of the research.
CHAPTER TEN
10.1 INTRODUCTION

The aim of this research, as explained in Chapter 1, was to develop an integrated approach to VM and SC during the strategic briefing process. It also aimed to define SC issues in the Saudi construction industry and provide a rationale behind its implementation in Saudi Arabia. A further aim was to accelerate the understanding and implementation of the principles of SC through the expansion of VM and its practitioners' experience and skills in the Saudi construction industry. Through this approach, it is hoped that VM can be upgraded to continue its competitiveness, enhance its performance and spread its implementation all over the country in delivering value for money. A final aim has been to improve and promote the technical knowledge and awareness amongst VM practitioners and the general community about SC aspects.

A research methodology was adopted, explained in Chapter 2, to meet the research aim and objectives. Both qualitative and quantitative approaches were employed in the study adopting expert, semi-structured interviews as the main method for data collection. The concept behind the interviews was to purposefully select participants that would best help the researcher understand VM and SC and satisfy the research aims and objectives. The participants (sampling) were not selected randomly as typically found in quantitative approach because the study required people to have a great deal of expertise in VM and/or SC to enable the research to probe for rich and deep information. The literature review has been covered in Chapter 3, 4 and 5, resulting in an analysis of gaps in knowledge that confirmed the research aims and suggested other areas of research.

The current situation of VM and SC in the Saudi contraction industry - in terms of its application, clients' attitudes, barriers to implementation, identification of enablers that could overcome the barriers and improve its implementation, and determination of the level of existent knowledge about both subjects in the Saudi Public Sector - was
covered in Chapter 6. Moreover, this chapter ascertained the current situation of VM and SC in the Saudi public sector in terms of procurement methods, strategies, and policies associated with its implementation. Furthermore, suitable and adaptable SC principles for application within the Saudi construction industry were defined in the same chapter (Chapter 6).

The development of robust background knowledge of the practice of VM and SC within the UK construction industry was covered in Chapter 7. The interviews sought insights into best practices associated with VM and SC through the elicitation of interviewees' perceptions, meanings, definitions and practices. Chapter 7 facilitated the development of an integrated approach to VM and SC for construction projects by: assessing the feasibility of using VM to implement SC principles within a construction project; identifying VM techniques, roles and participants used in the integration; identifying the power and limitations of VM and SC; identifying the drivers of and barriers to VM and SC; defining the processes of developing the framework; defining the mechanisms currently used for implementing SC and VM in projects; using case studies as exemplary projects for practising SC and/or VM in building projects; and investigating whether or not there might be any prejudice to the client from implementing SC through VM.

The integrated process was presented in Chapter 8, resulting in a more comprehensive approach that resembled excellence methodology in the way it performs sustainable value through achieving VM and SC principles during strategic briefing. This approach was evaluated and validated through feedback from experts possessing a great deal of experience in VM and/or SC (described in Chapter 9). Finally, the main conclusions of the research are discussed in Chapter 10, together with benefits and limitations of the developed integrated approach and suggestions for possible future work in research.

10.2 VALUE MANAGEMENT

VM is a means to cope with the most difficult aspects associated with achieving value for money in a project. It takes account of both internal and external considerations. VM
concentrates on the creation of a suitable environment to bring the key stakeholders and decision makers together in one place at the earliest stages of a project so as to reach consensus on the project objectives and the achievement of value for money in the project. VM enables all stakeholders to identify and accomplish these objectives with the efficient use of resources. It has been broadly agreed that VM should be applied as early as possible in a design so as to ensure the benefits of its advantages and avoid the re-design process and its obligations (Dell'Isola 1997; Kelly and Male et al 2004; Zimmerman 1982).

The study findings explored how the implementation of VM in some organisations mainly depends on the initiative of owners when a project faces impediments to construction. The dominant causes of these are when the cost of a project exceeds its budget or when an owner needs to make a balance between quality, cost and performance in the project. It has also been discovered that most VM studies implemented in Saudi construction projects were applied at the end of designs or in pre-final stages. It also appears that there is wide knowledge and experience of VM, whereas the knowledge of SC within the construction industry would appear to be a problem across the Saudi construction sector. These findings can be explained as having resulted from VM being known in Saudi Arabia for more than three decades, whereas SC has yet to be implemented in the Saudi public sector.

10.3 SUSTAINABLE CONSTRUCTION IN SAUDI ARABIA

SC is about realising a balance between the following issues: economic growth and progress, natural resource conservation and environmental protection, and social equality promotion. Sustainable development is thus about minimising the negative impacts whilst improving the environment to ensure a better quality of life for the current and future generations. It implies using renewable natural resources in a way which does not eradicate or degrade them. It also implies using non-renewable natural resources at a rate slow enough to ensure an orderly societal transition to new alternatives.
The Saudi government has made great efforts towards protecting the environment by introducing a number of regulations and policies, and by participating in a number of global conventions over the past few years. General environmental regulations and rules for implementation have been issued and approved, climatic research and reports have been produced, meteorological, environmental and air pollution measurements are being conducted, and the implementation of sustainable development is handled by collaboration between a number of ministries and agencies in the public and private sector. The Saudi government has also signed a number of international environmental protection conventions.

This study has also identified SC principles in Saudi Arabia and explored the most important reasons behind its implementation demand. Furthermore, it has identified the barriers that could hinder SC application and introduced enablers that could overcome these obstacles. The identified solutions could help accelerate the understanding and implementation of SC dimensions in the Saudi construction industry. The results of this research indicate that the most important issues of SC were energy and resources conservation, as well as land use regulation and urban planning policies, which are justified by that fact that energy and resources are of increasing concern in Saudi Arabia. On the basis of the findings of the study and related literature, it is clear that the lack of awareness of SC principles within the Saudi Arabian construction industry would appear to be a problem across the country. Moreover, most governmental agencies in the Saudi Arabia have a long way to go, before they can effectively implement SC principles.

10.4 THE INTEGRATED APPROACH

The main achievement of this research has been the development of an integrated approach to VM and SC during strategic briefing in construction projects. This approach is a more comprehensive and sustainable value methodology for implementing SC principles at a strategic level in construction projects. This integrated methodology serves as the vehicle to integrate the sustainable principles into the functions of the project and the client’s requirements. It also enables clients to identify
their needs and requirements, in addition to the objectives of the project with emerging SC issues through the project components as a whole system at all levels. Tools and techniques to create sustainable solutions were developed and suggested within the research.

Additionally, the developed integrated approach has been validated by experts in the area. The integrated approach provides a robust methodology for achieving best value through its combination of two important processes: SC - with its three principles environment, social and economic; and VM techniques. The approach was employed with tools and techniques associated with both subjects that are already in use in the industry, or with the tools suggested within the integrated approach itself, thus increasing its applicability and probable adoption. The approach comprises eight stages integrated with SC factors: Planning, Stakeholder Briefing, Information, Innovation, Evaluation, Development, Decision-Building and Implementation. The integrated approach is proposed to be implemented in four stages: Planning, Stakeholder Briefing, Workshop, and Building-Decision and Implementation.

The findings of the study, undertaken in the Saudi construction industry, explored the idea that SC is not a major consideration and many people who work in the Saudi Public Sector have little experience in sustainable development. In addition, the policies and legislations of SC have not yet been established in the country. On the contrary, VM has been used in Saudi Arabia for more than three decades and people are familiar with its technique. This enables the people who work in the VM Sector to possess good experience in VM; added to this, it is mandatory in all governmental projects funded by the Saudi government. However, there are a number of barriers illustrated in Chapter 6 that could impede or delay VM implementation in the Saudi Public Sector which were taken into account in the development of the integrated approach to overcome these challenges.

The notion adopted in this research behind developing this integrated approach was using VM as a road map for promoting and establishing SC principles in building projects, as well as improving SC awareness within the Saudi construction industry.
Additionally, the experience and skills of VM practitioners could be exploited to accelerate the understanding and implementation of SC principles in construction projects. The principles and techniques of VM can provide the required whole life quality during the process of developing a project, which will provide the best value from a whole life perspective.

10.5 BENEFITS OF THE INTEGRATED APPROACH

The major achievements of this research were to develop an integrated approach to VM and SC during strategic briefing and define SC principles in the Saudi construction industry. The approach is a synergic sustainable VM methodology to implement VM and SC principles and overcome their roadblocks in the Saudi construction industry. The proposed approach is intended to be applied at the earliest stages of design in construction projects. The potential gains from the integrated approach can be postulated as follows.

- The definition and acceleration of the understanding and implementation of principles of SC in the Saudi construction industry. This is planned to happen through VM and the experience and skills of its practitioners, who have worked in the Saudi construction industry; this will help establish sustainable development in the country.

- The ability of the key stakeholders to put into action the consideration of SC principles at the strategic level of projects. The consideration can be achieved through the following steps: creating a good environment; bringing the key stakeholders into one place; educating them about SC principles and VM; and introducing to them the benefits and drivers from implementing VM and SC associated with the key stakeholders. This should help shift thinking of stakeholders from short term to long term, from cost to value, from shareholders to stakeholder and from local to national to global.

- The integration of the principles of SC into VM will come up with a hybrid approach of VM to continue its competitiveness in delivering its objectives and
services, in addition to promoting and spreading its implementation throughout Saudi Arabia. This also should help to improve and promote the technical knowledge and skills of VM practitioners about SC aspects.

- The encouragement of the need to take into account environmental prosperity and social promotion at the earliest stages of projects.

- The implementation of both VM and SC as part of a single exercise will provide a better opportunity for implementing the value for money in the project and thus save time and money.

- The construction of new projects that have the most advanced sustainable technology that conform to the highest profitability and satisfy the requirements of users and investors.

- The framework can be globally used in the construction industry and not limited to the Saudi construction industry.

10.6 RECOMMENDED FUTURE WORK AND RESEARCH

Based on the research and conclusions addressed, future work and research is also recommended as follows.

1. The scope of the integrated approach to VM and SC is limited during strategic briefing; it could be expanded to consider and include other phases of design stage and construction process. The consideration of sustainable value approach through the whole life cycle of a project will allow a more integrated and holistic approach. Qualitative research could be employed, resulting in modifications to the integrated approach and quantitative research might be required to confirm and validate the modifications.

2. Further research is required to develop a holistic framework for legislation policies and guidance associated with the implementation of SC principles and VM in the Saudi construction industry.
3. Developing solutions to implement SC in the Saudi construction industry requires further research, which could involve developing two legislative frameworks in initiating the process of entrenching SC in the Saudi construction industry. These frameworks can be classified into two broad categories. A general framework would focus on sustainable urban development, education, training programmes development, change management, motivation, incentive and rewards. A more specific framework could then focus on SC principles, guidance for showing the implementation of these principles in the construction industry, and adaptation evaluation tools. They would both need to focus on reducing any conflict of interest that could occur between the Saudi governmental agencies, in addition to determining authority and duties for each agency.

4. The research explored a number of VM studies on selected projects in Saudi Arabia. These studies were not considered and implemented while constructing these projects. Further research is required to investigate deeply reasons and barriers that prevented its consideration and implementation.

5. Further research is required for developing suitable Critical Success Factors (CSFs) and Key Performance Indicator (KPIs) for VM and SC implementation in the Saudi construction industry.
REFERENCES
REFERENCES


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Grahl, C.L., 2007-last update, value engineering and sustainable design: using intelligent design tools to create a world-class federal courthouse [Homepage of Environmental Design + Construction], [Online]. Available: http://www.edcmag.com/CDA/ArticleInformation/coverstory/BNPCoverStoryIt em/0,4118,65426,00.html [June, 2007].


Intelligent design tools to create a world-class federal courthouse [Homepage of Environmental Design + Construction], [Online]. Available: http://www.edcmag.com/CDA/ArticleInformation/coverstory/BNPCoverStoryItem/0,4118,65426,00.html [June, 2007].


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Appendix A: Publication

Seven papers were published from this research and their references are as follows.


Appendix B

Interviews questions and questionnaire conducted in Saudi Arabia

A. Respondent Information

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<td>( ) years</td>
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<tr>
<th>Type of projects</th>
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B. Value Management

Section 1: To determine the existing practice of value engineering in the Saudi Public Sector.

1-1. Based on your knowledge, how frequently are VM studies performed in the Saudi public projects?

☐ Always ☐ Often ☐ Occasionally ☐ Rarely ☐ Never

1-2. What is the typical value of building projects that VM is usually applied to?

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1-3. Who is usually responsible for leading VM process?

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1-4. At what stage of the project are VM studies usually performed?

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1-5. Please clearly define the normal processes of VM workshops?

Please give a good example and bad example for applying a VM study.

Section 2: To establish clients’ attitude towards VM in the Saudi Public Sector.

1-6. Based on your knowledge, how important is the VM application to the Saudi Public Sector projects?

☐ Very important ☐ Important ☐ moderate ☐ Unimportant ☐ Very unimportant

1-7. How do you rate the knowledge of people who work in the sector of VM?

☐ Very good ☐ Good ☐ Fair ☐ Poor ☐ Very Poor

1-8. How satisfied are you with current VM practices?

☐ Very satisfied ☐ Satisfied ☐ Neutral ☐ Dissatisfied ☐ Very Dissatisfied

1-9. What benefits have there been from the implementation of VM on their projects?

1-10. What drawbacks have there been from the implementation of VM on their projects?

Section 3: To assess the potential application of value management within current procurement in the Saudi Public Sector.
11. Which procurement systems are used in your organization? (e.g. traditional, design and build, and management).

12. Which are the benefits and drawbacks from implementing VM within the current procurement system?

13. Which procurement system do you think is appropriate for implementing VM in the Saudi public sector projects? Please tick the appropriate scale.

<table>
<thead>
<tr>
<th>No</th>
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<td>Management system</td>
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</table>

Section 4: To identify the barriers and enablers of applying value engineering in the Saudi Public Sector projects.

14. What are the barriers that can/do impede the VM application?

15. What are the enablers and incentives that can/do encourage the VM application?

16. What steps government or the Saudi Public Sector organizations should take to improve the VM performance?
1-17. Can you kindly rate the frequency and potential impact of the following barriers for applying the VM study in the Saudi Public Sector projects? Please tick ✓ the appropriate scale.

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<thead>
<tr>
<th>No</th>
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<td>Lack of teamwork</td>
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<td>4</td>
<td>Lack of knowledge/technical understanding</td>
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<td>Lack of client commitment</td>
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<td>12</td>
<td>Team conflict/different goals</td>
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<td>13</td>
<td>Choosing on the basis of lowest price.</td>
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</tbody>
</table>

Section 5: To develop appropriate value engineering terminologies for the Saudi Public Sector.

1-18. Who should be involved in the VM process?

- 267 -
1-19. Can you kindly rate the frequency and potential impact of the following tools for applying the VM study in the Saudi Public Sector projects? Please tick ✓ the appropriate scale.

<table>
<thead>
<tr>
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<td>Information Gathering Technique</td>
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</table>
C. Sustainable Construction

Section 1: To determine the existing practice of sustainable construction in the Saudi Public Sector.

2-1. How frequently is sustainable construction performed in the Saudi Public Sector projects?
   - Always
   - Often
   - Occasionally
   - Rarely
   - Never

2-2. What is the typical value of building projects that sustainable construction study is usually applied to?

2-3. Who is usually responsible for leading sustainable construction in projects?

2-4. At what stage of the projects are usually performed sustainable construction assessments?

2-5. Please clearly define the normal processes of sustainable construction assessments.

2-6. Please give a good example and bad example for applying sustainable construction.
Section 2: To establish clients' attitude towards sustainable construction in the Saudi Public Sector.

2-7. Based on your knowledge, how important is sustainable construction implementation to the Saudi Public Sector projects?

- Very important
- Important
- Moderate
- Unimportant
- Very unimportant

2-8. Based on your knowledge, how do you rate the knowledge of people who work in the sector of sustainable construction?

- Very good
- Good
- Fair
- Poor
- Very Poor

2-9. Based on your knowledge, how satisfied are you with the current practice of sustainable construction in the Saudi Public Sector?

- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very Dissatisfied

2-10. What benefits have there been from the implementation of sustainable construction on their projects?

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2-11. What drawbacks have there been from the implementation of sustainable construction on their projects?

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Section 3: To assess the potential application of sustainable construction within the current procurement in the Saudi Public Sector.

2-12. Which procurement systems are used in your organization? (e.g. traditional, design & build and Management)

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- 270 -
2-13. What are the benefits and drawbacks from implementing sustainable construction within the current procurement system?

2-14. Which procurement system do you think is appropriate for implementing sustainable construction in the Saudi Public Sector projects? Please tick ✓ the appropriate scale.

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<thead>
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Comment:

Section 4: To identify the barriers and enablers of applying sustainable construction in the Saudi Public Sector Projects.

2-15. What are the barriers that can/do impede sustainable construction in the Saudi Public Sector?

2-16. What are the enablers and incentives that can/do encourage sustainable construction implementation in the Saudi Public Sector?
2-17. What steps government or the Saudi Public Sector organizations should take to establish or improve sustainable construction performance in the Saudi Public Sector?

2-18. Can you kindly rate the frequency and potential impact of the following barriers for applying sustainable construction to the Saudi Public Sector projects? Please tick ✓ the appropriate scale.

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<th>No</th>
<th>Description</th>
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<td>Choosing on the basis of lowest price.</td>
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</table>
Section 5: To develop appropriate terminologies for sustainable construction for the Saudi Public Sector.

2-19. What are the sustainable construction dimensions that are important to be taken into account in the Saudi Public Sector building projects? Please tick ✓ the appropriate scale.

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<tr>
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Appendix C
Interviews questions conducted in the UK

A. Interviewee Information

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<td>Experience in VM (years)</td>
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<td>Experience in SC (years)</td>
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B. AN INTEGRATED APPROACH TO VM & SC FOR CONSTRUCTION PROJECTS

i. To what extend do you agree that Value Management could be used as a vehicle to implement sustainable construction principles within a building project?

ii. Identifying VM phases, roles and involvement for people:

1. How could Value Management be used as a mechanism to promote or achieve more sustainable construction in a building project?

2. How can the VM process be modified to reliably accomplish the implementation of SC more efficiently? (What are the important roles of VM process for integrating SC)?
   - Planning
   - Information
   - Function Analysis
   - Creativity
   - Evaluation
   - Development
   - Presentation
   - Implementation

3. What are the important roles of the following people in a VM study to consider SC in building projects at early stages of projects?
   - The client
   - The facilitator
- The team members
- Other stakeholders

4. Who are the affected stakeholders whose attendance is very important to consider SC?
5. What is the best stage of a building project design for considering SC through VM?
6. What approaches of VM should be used to integrate SC? Soft and/or hard VM?

iii. Identifying power and limitations of VM to achieve SC:
1. What are the strengths of using VM techniques and tools to achieve SC in building projects?
2. What are the limitations/barriers of using VM techniques to achieve SC in building projects?
3. What are the cost and/or time implications of undertaking the integration of SC & VM?
4. Have there been benefits or cost to a client? Have these been measured?

iv. Identifying drivers and barriers of integrating Value Management & Sustainable Construction:
1. What are the drivers to clients and/or projects for integrating VM & SC?
2. What are the enablers that can/do encourage the integration of VM & SC?
3. What are the barriers that can/do impede the integration of VM & SC?
4. What are the drawbacks of the integrating of VM & SC?

v. Defining processes of developing the framework:
1. What are suitable processes that should be followed for developing framework for VM & SC?
2. What would be your advice/recommendations to achieve SC via VM in building projects?
3. What are the techniques and tools of VM that have been useful to integration?
4. What is the best stage of building projects at which VM & SC should be performed?
5. How it can be implemented SC via the VM study without prejudice to a client?
6. Are there any functional/methodology/layout aspects that you have thought they are effective to integrate VM & SC?
7. How can VM promote SC in a project?
C. SUSTAINABLE CONSTRUCTION

i. Identifying drivers and enablers of Sustainable Construction:

1. Why do building projects need to be sustainable? Proof of that?
2. What are the drivers/benefits for the following people from implementing SC in building projects? (Why clients should apply SC in their projects?)
   a. The clients?
   b. The occupants/users?
   c. The project?
   d. The contractor
   e. Other stakeholders?
   f. The team members?
3. What are the enablers that can/do encourage SC implementation in building projects?
4. What are the steps/procedures that clients should take to implement SC in their building projects?

ii. Identifying barriers and challenges of Sustainable Construction implementation in building projects:

1. What are the barriers that can impede SC implementation in building projects?
2. Are there any drawbacks from implementing SC principles in building projects?
3. Why some clients are reluctant to implement SC in their building projects?
4. How can you interpret the perception of sustainable buildings cost more than ordinary buildings? Are there any figures of proof?

iii. Defining mechanism of implementing Sustainable Construction in building projects:

1. Who is usually responsible for implementing SC in building projects?
2. What are the processes used to implement SC in building projects?
3. Who are the key stakeholders for considering SC in building projects?
4. What is the size of contract value of building projects that SC study is usually applied at?
5. At what stage of the project that SC is performed?
6. Are you aware of any guidance for SC in building projects? If yes, can help me to get access?
D. CASE STUDY

i. Could you please give a good example for implementing SC via VM in construction projects?

1. How would you describe the processes of implementing SC via VM?
2. At what stage of the project was performed the integration of VM & SC?
3. What mechanisms have been used to capture stakeholders’ requirements?
4. Who was responsible for leading a VM study?
5. Who was involved in the study?
6. How many VM studies were performed in the project?
7. What are the issues or agenda discussed in that study?
8. What was the contract value of the project?
9. Who were the stakeholders that their attendances were very important for succeeding in the VM study?
Appendix D

Validation form adopted to validate the Integrated Approach to Value Management and Sustainable Construction during Strategic Briefing.
An Integrated Approach to Value Management and Sustainable Construction during Strategic Briefing

The proposed integrated approach was developed to facilitate and accelerate the implementation and understanding of sustainable construction principles into building projects. It incorporates sustainable construction principles into the value management process during planning stage of building projects. The main attributes of the proposed approach are as follows:

1. The proposed approach should be applied in the outline of processes in the pre-design stage (strategic briefing study), comprising six stages: planning; stakeholders briefing; information, innovation; evaluation; and development – which are divided into two stages planning stage and workshop.

2. The workshop will be participated by affected stakeholders of the project at a senior level, such as the client organisation, the end user, the facility managers, finance representative and the design team.

3. The number of people involved in the workshop will depend upon size and complexity of the project, as well as the duration of the workshop.

4. The study should be led by a qualified, experienced and skilled facilitator and sustainability advisor. The incorporation of sustainable construction principles into value management processes and a number of participants will place significant demands on facilitation skills.

5. The expected outputs of the VMSC workshop at planning stage (pre-design) should be as follows:
   a. Raised awareness of top management, design teams and other stakeholders about sustainable construction and value management.
   b. Obtaining client’s buy-in for considering sustainable construction principles implementation in the project development;
   c. Identified client requirements;
   d. Estimated project budget;
   e. Initial concept and scope of works; and
   f. Consensus of stakeholders on the important SC issues.

6. The design stage will follow based on the information identified and approved by decision makers in the VMSC workshop.
I am a PhD student at Loughborough University in the United Kingdom. I am undertaking research aimed to develop "An Integrated Approach to Value Management and Sustainable Construction during Strategic Briefing". After a thorough review of relevant literature and conducting interviews regarding VM and Sustainable Construction, an integrated approach to implement sustainable construction through VM during strategic briefing was developed. It comprises eight stages held at the strategic brief stage of construction projects and considers sustainable construction principles in its three dimensions: environmental, social and economic. The framework aims to shift the thinking of stakeholders from cost to value, from short term to long term and from shareholders to stakeholders. Each stage has a number of steps to be followed to integrate the principles of sustainable construction during the strategic brief stage. This questionnaire aims to improve and evaluate the framework in terms of assessing the followings:

- the logic between the stages within the framework;
- the comprehensiveness (adequacy and relevance) of the different processes in delivering the goal of the framework;
- the extent to which the tasks/activities under each stage covers or explains the stage; and
- the overall efficacy, practicality and effectiveness of the framework.
1. Please evaluate the proposed integrated approach to Value Management and Sustainable Construction Principles. Please suggest other components you consider useful? (see over for the detailed information).
2. Please rate the importance of each step for each stage of the proposed integrated approach to consider sustainable construction principles at early stages of a project. Please add any missing steps you see important and rate their importance. Please remove any unnecessary or redundant step.

### Planning stage (1)

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Degree of importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Appoint a qualified and experienced facilitator</td>
<td>Very high</td>
</tr>
<tr>
<td>2.</td>
<td>Clarify objectives of the study</td>
<td>High</td>
</tr>
<tr>
<td>3.</td>
<td>Agree on the total cost of VM and SC Study</td>
<td>Moderate</td>
</tr>
<tr>
<td>4.</td>
<td>Appoint a sustainability advisor</td>
<td>Low</td>
</tr>
<tr>
<td>5.</td>
<td>Select appropriate team members</td>
<td>Very low</td>
</tr>
</tbody>
</table>
| 6.   | Do stakeholder analysis<br>
Identifying project stakeholders<br>
Identify of requirements and expectations<br>
Prioritising stakeholders<br>Involve stakeholders | Very high |
| 7.   | Synthesising information | High |

### Stakeholders Briefing Stage (2)

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Degree of importance</th>
</tr>
</thead>
</table>
| 1.   | Building knowledge and understanding<br>
Introduce SC and VM principles<br>Introduce benefits and drivers<br>Clarify sustainable value<br>Set up the scope and objectives of a project | Very high |
| 2.   | Motivate team members | High |
| 3.   |  | Moderate |
| 4.   |  | Low |

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### Information Stage (3)

The aim of this stage is to integrate sustainable construction principles into functions of a project and to develop understanding of the project based on information in addition to identifying relationships, attributes and value drivers.

<table>
<thead>
<tr>
<th>1. Gather information</th>
<th>2. Finalise project objectives</th>
<th>3. Analyse functions</th>
<th>4. Build sustainable value criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>identify and define functions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>classify functions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>develop function relationships</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>assign weighting to functions</td>
<td></td>
</tr>
</tbody>
</table>

### Innovation Stage (4)

The main aim of this stage is to use innovation techniques to generate as many ideas as possible for achieving each function selected in the study within the scope and objectives of the project.

<table>
<thead>
<tr>
<th>1. Writing down all idea and comments</th>
<th>2. aiming at quantity rather than quality</th>
<th>3. excluding criticism and assuming each idea will work</th>
<th>4. leaving judgment until the evaluation stage</th>
<th>5. eradicating the word “impossible” from the collective dictionary</th>
<th>6. allowing the imagination to roam free</th>
<th>7. using piggybacking</th>
<th>8. cross-fertilising ideas</th>
<th>9. letting everybody talk and contribute</th>
<th>10. avoiding interruption</th>
<th>11.</th>
<th>12.</th>
</tr>
</thead>
</table>
### Evaluation Stage (5)

This stage is to combine ideas and concepts produced in the previous stage and to evaluate them based on the project objectives to produce proposals for the next stage.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Build shared understanding of each idea</td>
</tr>
<tr>
<td>2.</td>
<td>Discuss how each idea affect project, value and sustainability</td>
</tr>
<tr>
<td>3.</td>
<td>Eliminate unworkable, redundant and irrelevant ideas</td>
</tr>
<tr>
<td>4.</td>
<td>Rank the ideas within each category according to SC evaluation criteria using such techniques as indexing, numerical evaluation, evaluation matrix, paired comparison and team consensus</td>
</tr>
<tr>
<td>5.</td>
<td>Identify a champion for each group</td>
</tr>
<tr>
<td>6.</td>
<td>Use performance measurements for ranking the grouped ideas</td>
</tr>
</tbody>
</table>

### Development Stage (6)

This stage is to determine and prepare the “best” option(s) based on sustainable construction criteria to achieve value for money.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Determine and prepare doable scenarios and evaluate the whole scenario</td>
</tr>
<tr>
<td>2.</td>
<td>Make an initial assessment concerning the feasibility</td>
</tr>
<tr>
<td>3.</td>
<td>Conduct benefit analysis and implementation requirements</td>
</tr>
<tr>
<td>4.</td>
<td>Develop estimated initial whole life cycle costs</td>
</tr>
<tr>
<td>5.</td>
<td>Generate sketches and information needed</td>
</tr>
<tr>
<td>6.</td>
<td>Establish action plan for those ideas recommended</td>
</tr>
<tr>
<td>7.</td>
<td>Ensure that ideas recommended are implementable, workable sustainable and reliable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Degree of importance</th>
<th>Very high</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
<th>Very low</th>
</tr>
</thead>
</table>

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### Decision-Building Stage (7)

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Prepare presentation and supporting documents</td>
</tr>
<tr>
<td>2.</td>
<td>Make sure the people who attend the presentation are the same who attended Stakeholder Briefing Stage.</td>
</tr>
<tr>
<td>3.</td>
<td>Exchange information with the project team</td>
</tr>
<tr>
<td>4.</td>
<td>Use a rigorous decision-making process</td>
</tr>
<tr>
<td>5.</td>
<td>Ensure top managements has full and objective information so that make right decisions</td>
</tr>
<tr>
<td>6.</td>
<td>Plan expected execution schedule</td>
</tr>
<tr>
<td>7.</td>
<td>Ensure decision can be obtained from decision-makers.</td>
</tr>
<tr>
<td>8.</td>
<td></td>
</tr>
</tbody>
</table>

#### Degree of importance

- **Very high**
- **High**
- **Moderate**
- **Low**
- **Very low**

### Implementation Stage (8)

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Review the preliminary report</td>
</tr>
<tr>
<td>2.</td>
<td>Work out and update drawings and specifications and validate benefits of implemented ideas</td>
</tr>
<tr>
<td>3.</td>
<td>Establish action plans for accepted options and document the raison d'être for the rejected options</td>
</tr>
<tr>
<td>4.</td>
<td>Obtain commitments for implementing accepted options</td>
</tr>
<tr>
<td>5.</td>
<td>Set a timeframe for reviewing and implementing each option</td>
</tr>
<tr>
<td>6.</td>
<td>Ensure that SC principles become embedded in all ideas</td>
</tr>
<tr>
<td>7.</td>
<td>Agree on performance measurement with project</td>
</tr>
<tr>
<td>8.</td>
<td>Track sustainable value achievement resulting from implement ideas</td>
</tr>
<tr>
<td>9.</td>
<td>Sign off the implementation plan and follow up</td>
</tr>
<tr>
<td>10.</td>
<td>Track benefits</td>
</tr>
<tr>
<td>11.</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td></td>
</tr>
</tbody>
</table>

#### Degree of importance

- **Very high**
- **High**
- **Moderate**
- **Low**
- **Very low**
3. Please rate the importance of Value Management stages to consider sustainable construction at early stages of a project. Please add any missing stages you see necessary and rate their importance.

<table>
<thead>
<tr>
<th>The Integrated Approach Stages</th>
<th>Degree of importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>The aim of this integrated approach is to achieve sustainable construction principles thorough Value Management workshop at early stages of building projects</td>
<td></td>
</tr>
<tr>
<td>1. Planning Stage</td>
<td></td>
</tr>
<tr>
<td>2. Stakeholders Briefing Stage</td>
<td></td>
</tr>
<tr>
<td>3. Information Stage</td>
<td></td>
</tr>
<tr>
<td>4. Innovation Stage</td>
<td></td>
</tr>
<tr>
<td>5. Evaluation Stage</td>
<td></td>
</tr>
<tr>
<td>6. Development Stage</td>
<td></td>
</tr>
<tr>
<td>7. Decision-Building Stage</td>
<td></td>
</tr>
<tr>
<td>8. Implementation Stage</td>
<td></td>
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<tr>
<td>9.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
</tr>
</tbody>
</table>

4. Based on your experience, please indicate the approximate time required to conduct the workshop for medium building project? .................................. Day(s)

5. Please rate the degree of the following aspects of the framework and provide your comments you might have.

A. Efficacy
   Will the integrated approach produce the intended result? Not Slightly Moderately Very Extremely
   Efficacious Efficacious Efficacious Efficacious Efficacious

Your comments if any:

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