Value Management in Design Planning: a systems-based framework for multi-disciplinary team involvement

Mohamad Saifulnizam Suhaimi

BSc. (Hons) Quantity Surveying, Msc. Project Management

Submitted in fulfilment of the requirements for the degree of
Doctor of Philosophy in Construction Project Management

Civil Engineering and Built Environment
Science and Engineering Faculty
Queensland University of Technology
September 2014

Keywords

Case study, Culture, Control Mechanism, Constructability, Creativity, Design planning, Design process, Facilitation, Information, Interview, Institutionalised attachment, Job Plan, Multi-disciplinary, Participation, Value Management, Value Engineering, Visualisation, VM Workshop, System Thinking, Team,

Abstract

Value Management (VM) has proven to provide a structured methodology using specific supporting tools and techniques that facilitates effective decision-making on many types of projects, thus achieving 'best value' for clients. It offers an exceptionally strong approach to exploring project needs and functions in line with client's objectives. The Functional Analysis, and Creativity and Evaluation Phases of VM crucially focus on understanding clients' objectives for their projects and on finding innovative solutions to deliver those projects accordingly. However, the perception of VM as just another cost cutting tool has overshadowed this fundamental perspective causing VM to lose support in the construction industry. This research aims to investigate the VM processes currently being used by project clients and that effects project team participation in VM workshops during the design stage of the projects. The focus of the research is on how issues related to infrastructure design that can improve construction processes on-site are being identified, analysed and resolved through multi-disciplinary team participation.

The research uses a multiple case studies approach that comprises of a survey, interviews and document reviews as the main data collection methods. Five project packages from the on-going Kuala Lumpur International Airport construction project in Malaysia are selected as cases with 25 interviews conducted. Statistical and Content Analyses are used to analyse data collected from the fieldwork exercises. Validation of the findings from this research is achieved through triangulation of survey, interviews and document analysis results including an expert panel review. System-based frameworks with ten attributes were generated from this research. Findings from the case studies observed that project team member's composition in a VM workshop during the design process has minimal influence on improving the subsequent construction process. However, the degrees of interaction, diversity of visualisation aids, certain cultural dimensions and the system thinking approach all have significant influence in maximizing participation among project team members during the entire VM workshop during the design process. The significant outcomes of this research are expected to offer alternative

perspectives for construction professionals and clients to understand the constraints and strategies to implement VM, seen from the perspective of workshop participants.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

CS	Case Study
DoD	Department of Defence
DVM	Design Value Management
FAST	Function Analysis System Technique
KLIA2	Kuala Lumpur International Airport 2
MAHB	Malaysia Airports Holdings Berhad
OGC	Office of Government Commerce
SAVE	Society of American Value Engineers
SMART	Simple Multi-Attribute Rating Technique
VA	Value Analysis
VE	Value Engineering
VM	Value Management
VP	Value Planning

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

QUT Verified Signature

Signature:

Date: 1st September 2014

Acknowledgements

All praises to the almighty Allah SWT, the most gracious and merciful for bestowing me with strength, courage and passion to believe in this pursuit.

My foremost gratitude goes to my principal supervisor, Dr. William Vaughan Coffey for his endless guidance, motivation, enthusiasm and optimism towards my doctoral work in Queensland University of Technology. Personally, he is a lifetime mentor and advisor.

Special thanks to the research team, Professor Martin Skitmore and Richard Sargeant for their guidance and critically challenging my way of thinking. The 'library' incident has changed the way I view qualitative analysis.

To my fellow colleagues and friends whom we have been through the ups and down, I do owe you all this gratitude. You were there when I was down; you were there to keep me on track. It's a priceless friendship.

To my parents, Suhaimi Abdullah and Azimah Ibrahim, your optimism and support throughout my candidature are precious. I believe your prayer has made me here and your wish has been granted. I know both of you wanted me to be an Architect, and I did take this path but from Quantity Surveyor's perspective. Thank you for your love and trust.

To my wife and kids, Dahliah Kamat, Emir Sufyan and Emira Safiya, your sacrifices along these years are something I could only repay with my time. I'm sorry that I've missed our kids growing up, but I believe the path we are taking is for a better course. It's a blessing in disguise that we are yet to discover.

Chapter 1: Introduction

The first chapter of this thesis outlines the background to the research work undertaken and it also contains a description of the fundamental research problem. It then covers the research aim and objectives, the research questions and the overall significance of the research. Finally, it outlines all other chapters of the thesis.

1.1 BACKGROUND AND PROBLEMS

Successful applications of Value Management [VM] in the construction industry have been observed in a number of countries around the world (Norton & McElligott, 1995). VM has proven to provide a structured methodology using specific supporting tools and techniques that facilitates effective decision-making on many types of projects, thus achieving 'best value' for clients (Kelly, Morledge, & Wilkinson, 2002). Shen and Liu (2003) report that much focus has been directed into researching new tools and methods in VM. A number of influential VM researchers have placed strong emphasis on the value of functional analysis, which is considered to be an indispensable factor contributing to the success of VM studies (Dell'Isola, 1982; Zimmerman & Hart, 1982). However, Shen and Liu (2003) in citing Palmer, Kelly and Male (1996) challenged the contribution of functional analysis as the sole factor to VM success and argued that the VM workshop with the prescribed multidisciplinary team participation was also a critical factor.

However, throughout the literature, much of the VM research on workshops, tools and techniques and multidisciplinary team participation focuses on their efficiencies and effectiveness (Leung, Chu, & Lu, 2003). Research into the specific functional roles of individual participants (i.e. the human aspect) in VM studies, and into alternative techniques used to assist VM studies, are relatively limited to date (Singh & Jannadi, 2006). This omission calls for an expansion of research into the contribution of the human aspect to decision-making and levels of participation as important critical factors contributing to successful outcomes of VM workshops Palmer et al. (1996). The phenomenon of particular professions conducting VM as part of their consultancy services has been observed by several researchers (Bowen, Edwards, Cattell, & Jay, 2010; Bowen, Edwards, & Catell, 2009; Bowen, Edwards, Catell, & Jay, 2009; Ellis, Wood, & Keel, 2005; Ellis, Woods, & Keel, 2003) including the effect on team dynamics and facilitation styles (Hunter & Kelly, 2006; Kelly, Male, & Graham, 2004; Male & Kelly, 2004; Yeomans, 1997). The research of Leung et al. (2003) on the participation of individuals and groups in VM workshops is considered as a pioneering study in exploring in some depth the behavioural aspects of participants in VM studies and workshops. Their findings have uncovered another dimension, i.e., human attributes as being a further critical VM success factor.

Therefore, this research is directed at expanding previous studies the human aspects of, and specifically explores the influences and impacts of multi-disciplinary participants on, the creative and decision-making processes of VM workshops conducted during the planning and design stages of a construction project.

1.2 AIMS AND OBJECTIVES

The main aim of this research is to investigate the effects and impacts of the involvement of multi-disciplinary participants in VM workshops, particularly in terms of addressing issues related to the effects of planning and design on subsequent construction processes of projects. It is proposed that through understanding of factors that influence the human interaction and thinking processes in VM during the design development, improved decision-making quality by workshop participants can be achieved. This in turn can lead to the better optimization of construction costs with improved construction processes operating on projects on-site.

The objectives of this research are:

1. *To identify factors that influence participants' involvement in VM workshop during design planning phase of a construction project.*
2. *To examine the form of human interaction and decision-making process between VM multi-disciplinary participants that attempt to solve workshop issues.*

3. *To examine the impact of human interaction and thinking process has on construction processes of projects.*
4. *To develop a framework that governs decision making for design planning of a project from human aspect perspective.*

1.3 SIGNIFICANCE

As has already been stated, this research aims to provide increased awareness and appreciation of the human attributes that can influence VM effectiveness and its impact subsequently on construction project outcomes. The research ultimately is expected to provide a framework through which to understand those critical factors that most influence individuals in performing the necessary creative thinking and decision-making processes that impact on construction project delivery success. The findings are expected to benefit potential VM practitioners and organisations wishing to enhance the conducting of VM study by considering the contribution possible through harnessing the human aspects of the organisation.

1.4 RESEARCH QUESTIONS

In an attempt to achieve the aim and objectives and ultimately address problems of this research, several research questions are designed. These questions are structured to guide researcher in understanding the nature of human interaction and thinking process during VM workshop. The research questions are as follows:

1. *How the design planning process of a construction project is conducted through Value Management workshop?*
2. *What are the factors that influence human interaction and decision-making process of VM workshop participants?*
3. *How does multi-disciplinary participant involvement in a VM workshop affect the outcomes of the planning and design of a project?*
4. *What are the impacts of these interactions and decision process through VM has on the subsequent construction phase of a project?*

1.5 METHODOLOGY

This mixed method research is conducted using a combination of quantitative and qualitative approaches in exploring the human aspects of VM. The qualitative method is dominant in this research as it lays the foundation for the subsequent data collection. The quantitative method is used to support further in-depth exploration of the issues of interest in the research. Triangulation between results obtained from quantitative and qualitative analyses including expert panel review validate the finding made. A multiple case study approach is employed consisting of three data collection techniques - a survey, document review and semi-structured interviews. The quantitative analysis of the survey is conducted using descriptive statistical analysis techniques, while constant comparative and cross-case analyses, and pattern matching methods, are used to analyse qualitative data (i.e. documents, interviews transcripts, site diaries, etc.). The framework developed from this research is validated through in-depth semi-structured interviews among a panel that comprises of VM experts, construction industry practitioners and discipline academics.

1.6 THESIS OUTLINE

Chapter 1 : Introduction and research background

This chapter outlines the research background including an identification of the major research problem, aims and objectives, research questions and a description of the significance of the research. The methodological approaches used for this research are also described. The aim of this chapter is to provide a foundation to understand the entire research process undertaken.

Chapter 2 : Literature review (part 1)

This chapter reviews the extant and current literature on Value Management (VM) starting from its inception right through to the recent applications within the construction industry. Phases of VM Job Plan are explored and compared against various construction practices. . Issues faced in VM workshop organization and in the application of the workshop findings are explored and analysed. Topics covered in this chapter include VM history, intervention points, workshop phases, multi-disciplinary team issues, tools and techniques and approaches to operating workshops.

Chapter 3 : Literature review (part 2)

This chapter reviews the extant and current literature on the building design process of a construction project. The focus of this chapter is to explore the constraints faced by project teams in designing construction projects and the factors that affect the perspectives and contributions of participants to the ultimate specific design. Topics covered under this chapter include constraints encountered in the design process, inconsistencies between project planning and design and subsequent construction issues found on-site, construction documentation and the development of a more expansive learning process through collaborative design.

Chapter 4 : Research methodology and design

This chapter discusses the research methodology approaches applied in this research. The adopted mixed method approach consisting of the quantitative and qualitative procedures is discussed in relation to the overall design of this research. The four main techniques discussed in this chapter are: survey, document review, semi-structured interviews and the multiple case study approach. The application of various software used for data analysis such as SPSS, NVIVO and f4 are also explained. The challenges and potentials risks for this research are also described in the Research Ethics section of this chapter.

Chapter 5 : Case study design

This chapter discusses specifically the design of the multiple case study method employed in this research. While chapter 4 described in general the overall case study approach, this chapter focuses in describing the procedures adopted in actually conducting the case studies. The procedures, processes, pilot study and selection of study case are therefore the main themes of this chapter.

Chapter 6 : Data analysis

This chapter discusses in depth the quantitative and qualitative analyses of the data collected from the case studies. The quantitative section of this chapter analyses survey data collected from respondents of the case studies and uses descriptive analysis techniques that form the basis for the further investigation using a qualitative approach. The latter consists of document analysis, analysis of interview transcripts, site diaries and field notes using constant comparative analysis (CCA), pattern matching and cross case analysis.

Chapter 7 : Discussion and formation of framework

This chapter considers the findings from the data collection and analysis of the research described earlier. Key findings from all data analysed are arranged and discussed according to the majors themes relating to the influence of human aspects on VM workshops. This chapter also discusses the production of the framework to assist future construction practitioner applying VM in their construction projects and the validation process applied to all findings made.

Chapter 8 : Summary and conclusions

This chapter summarises the entire research process undertaken and includes a summary of the key findings made, the methodological settings and analysis, and contribution to the VM extant body of knowledge. The practical values of this research are also discussed in line with the research limitations and potential expansion of this research from the findings made.

1.7 CHAPTER SUMMARY

Chapter 1 has described the fundamental approach taken in conducting this research. The detail descriptions on the procedures, analysis and discussion will be presented in the subsequent respective chapters as summarised above.

Chapter 2: Literature Review

The literature review for this research is divided into two parts. The first part focussed on Value Management concept while the second part on building design planning and processes. In this chapter, literatures on the concept of Value Management will be reviewed with aim to understand the function of VM in construction project. The review will be focussing on the history of Value Management, types of study, phases of VM, tools and techniques, application and current practices by region.

2.1 VALUE MANAGEMENT IN CONSTRUCTION PROJECT DESIGN

Value Management [VM] is defined as a structured, systematic and analytical process that seeks to achieve value for money by providing all the necessary functions at the lowest total cost consistent with the required levels of quality and performance (Standards Australia, 2007). It is a process in which function benefits of a project are made explicit and appraised with a value system determined by the client (Kelly, et al., 2004). Both definitions by AS/NZS 4183 (2007) and Kelly et al. (2004) focuses on VM as a "process" that guides projects to achieve the desired objectives by way of analyzing the functions of a project. The process of analyzing the function of a project incorporates multi-disciplinary effort (Kelly & Male, 1993). The effort are directed towards analyzing the function of projects for the purpose of improving, maintaining performance and ensuring value for money (Barton, 1991) while reducing or maintaining overall life cycle cost.

On the other hand, Male and Kelly (1989) described VM as a philosophy, style of management dedicated to motivating people, developing skills and promoting synergies and innovation with the aim of maximising the overall performance of an organisation. This paradigm exists before the definitions in previous paragraph are made that indicates human factors as driving factor that influence organisation performance. The paradigm of VM as a philosophy enables organisations to adopt a consistent approach towards decision-making, taking into account the needs of the business, the environment within which it is operating, and the people who may be involved (Yu, Shen, Kelly, & Hunter, 2005).

The combination of the process and human factor as philosophy in driving organisation performance is unique in its own way. The system of VM works due to its systematic approach to the decision making process which incorporates a multi-disciplinary representation working towards making explicit the needs of clients.

The following section will be discussing on how these processes and human factor in VM evolve into current practice.

2.2 HISTORY OF VALUE MANAGEMENT

Value Management (VM) is a technique for improving client value in projects, products, processes and systems that has been internationally recognised with history of more than 65 years. VM as it is known in the UK and Europe as well as in Australia [*it is referred to as value engineering (VE) in the United States and Japan*], was first introduced by Lawrence Miles in the 1940s in the US.

Value management begins with an interesting history way back in the United States during World War 2 era. The 'Asbestos Affair' described an era when scarcity of raw materials, labour and component parts to be used in manufacturing has affected production process of the industry. This situation has prompted needs in maximising existing capacity and solution to expand manufacturing production coping with the economic demand. The procurement of raw materials for production at General Electric Company [GEC] is affected by this situation. Inability to secure specific materials and component has increases pressure to the company. Purchase Engineer lead by Lawrence Miles and Harry Erlicher has been assigned to overcome this situation (McGill, 2011). Their approaches in solving issues are through identifying primary functions of each products and components in understanding the essence of the products. Components that do not contribute to the functions of the product are discarded and substituted with other component. Substitutions of components are conducted through generating alternatives that attempt to serve the same or better function against the existing component with lower cost. They succeeded in overcoming shortage of materials through substitution and elimination of components that do not add function to the product. VM is not the term used during this era to describe the process; however it is referred to as "Value Analysis". VA as defined by Male and Kelly (2004) referred to as 'an organised approach to providing necessary functions at the lowest cost'.

Taking from the definition, both Lawrence Miles and Harry Erlicher succeeded in making Value Analysis (VA) a systematic approach in identifying products function by way of substitutions and elimination of unnecessary cost. In 1954, their success has brought the Department of Defence Bureau of Ship to start applying VA across their procurement for manufacturing components and products with aim to improve procurement and delivery of all military purchase and production. According to Male and Kelly (2004), VA is seen as cost validation exercises that do not compromise on the quality output. The introduction of VA into US Department of Defence [DoD] is a blessing when time the government felt that an audible structure of military procurement is necessary to control production and financial. Hence, the name has changed to 'Value Engineering' in reflecting its application within engineering sector where engineers were considered to be the most appropriate person to conduct VE (Male & Kelly, 2004). The formation of Society of American Value Engineers (SAVE) in 1959 established a formal body that governs the development and promotion of VE within the US.

In 1963, the Navy Facilities Engineering Command under the US Department of Defence has taken a step further by introducing VE into the construction sector. Responding to the cost reduction programme initiated by Secretary Mc Namara in 1964, tenders for construction project required VE to be conducted at certain stage of projects by an independent team. This implementation is seen as a cost effective measure by the DoD to ensure construction project receive similar success from the manufacturing sector of the military service.

The application of VE in both manufacturing and construction sector of the US Department of Defence has created a momentum for its application to be extended to other departments within the military service. Numerous documents, procedures, policies, technical report and program have been produced to develop VE program and extending its application across US federal government.

The maturity of VE in the United States has influenced other countries to adopt similar approach towards their own industries. The Japanese established the Society of Japanese Value Engineers in 1967, while the United Kingdom has started to use VE in early 1960's using similar approach in VE but with added twist in term of the managerial aspect of production. In 1966 the formation of UK Value Engineering Association were established and later changed to Institute of Value Management in 1972 (Male & Kelly, 2004). The introduction of VE in the UK experienced a substantial growth in its development and practice mainly in the construction industry and the term has changed to Value Management [VM].

In late 1980's, the UK construction industry has been applying VM in their projects. According to Male and Kelly (2004), VM differs from VE in term of its focus on the outset of VE which is beyond particular components of a product that emphasis on entire product development. Taking this idea, VM subsumes VE as a component part of the whole service (Kelly, et al., 2004). The application of VM in the UK construction industry has been well accepted and lauded by the professionals. The Latham Report (1994) seen VM to be conducive as good practice while Egan Report (1998) shares the same aspiration for collaborative working environment promoted by VM. Both report are highly influential documents in the UK construction industry that promotes good governance, modernisation of industry and benchmarking within professionals in the industry. At the government level, The Office of Government Commerce produces procurement guideline for construction project to carried out VM for project development.

The American through VE history is dominated by engineers who assume roles in leading the VE study. However, the scenario in the UK with specific reference to construction industry is lead by the Quantity Surveyor. The Royal Institute of Chartered Surveyor (Royal Institution of Chartered Surveyor (RICS)) in 1988 has published a research by John Kelly and Steven Male entitled "A Study of Value Management and Quantity Surveying Practice". This publication illustrated practices in North America, and proposed the benefits and potential of using VM in the UK, particularly by the Quantity Surveying (QSR International Pty Ltd) profession. The publication marked the beginning of a serious development of VM as a tool to be used in the construction industry to achieve better value for money and has attracted interest from many sectors of the construction industry across the world (Fong & Shen, 2000). Several countries such as Australia, France, Germany and Hong Kong have benchmarked this initiative. Malaysia has taken the same step to adopt the development and implementation of country-specific VM initiatives.

2.3 TERMINOLOGY IN VALUE MANAGEMENT

The terminology used in Value Management varies across different authors, organisation and context of its application. Chronologically, the birth of VM started in 1947 where the term 'Value Analysis (VA)' was first coined by Lawrence D Miles while he was serving as an Engineer with the General Electric Company in the USA (Barton, 2001). According to Miles (1989), Value Analysis refers to as:

"a disciplined action system, attuned to one specific need: accomplishing the functions that the customer needs and wants, whether those functions are accomplished by hardware, service, a group of people, professional skills, administrative procedures or other at the lowest cost."

Within the context of discipline system, Miles (1989) further assert that it consist of specific mind-setting and problem-solving system that assist anyone to provide more for the customer with lesser cost. The initial term and definition of VA is solely focuses on finding the best possible solution for any specific works/items that serve equal or better performance with lowest possible cost. Kelly et al. (2004) further refine the term VA as "an organised approach to the identification and elimination of unnecessary cost".

The success of Value Analysis as introduced by Miles was quick to be absorbed into the US Defence Department where the approach is used as standard procedure in the design and product manufacture. Hence, the term 'Value Engineering' was introduced in the 1950's by the US Defence Department to identify the officer who are specialized with the Value Analysis technique and department who perform engineering process (Barton, 1991; Parker, 1998). According to Miles (1989) it is also a used to be a term to described "qualified engineers in engineering work" during his service with the GEC. Theoretically, the term 'Value Engineering' (VE) as defined by US Defence Department (2013) and US Government Service Administration (US General Service Administration, 2013) is:

"an organized effort directed at analyzing designed building features, function of systems, equipment, and material selections for the purpose of achieving essential functions at the lowest life cycle cost consistent with required performance, quality, reliability, and safety"

The principle of VA and VE on analyzing functions of specific systems/works with aim to produce optimum solution and performance has made this approach increasingly popular beyond the engineering field. The application of VE was introduced in the construction industry in the 1980's in the USA and 1990's in the UK. Hence the term 'Value Management' was coined (Barton, 1991). Barton (1991) further stressed that the introduction of 'Value Management' are not meant to separate the existing meaning of VA and VE from its original state, but merely keeping up with the emerging 'management fad' during such period.

The term Value Management as defined by the Standard Australia (Standards Australia, 2007) is:

"A structured, systematic and analytical process which seeks to achieve value for money by providing all the necessary functions at the lowest total cost consistent with the required levels of quality and performance."

The introduction of Value Management in the construction industry has attracted numerous research and attempt to define VM. However, the Australian and New Zealand Standard on Value Management stated that all three terms "Value Analysis, Value Engineering and Value Management" are considered as synonymous. The Society of American Value Engineer (SAVE) in an attempt to solve the confusion with the term has treated collectively the term as 'Value Methodology' to represent all three terms (SAVE International, 2001).

Considering the chronological history and evolution of its meaning over time and continent, the Value Management (VM) terminology remain consistent. It describe the essence of its process which to increase performance or function of specific work/system by optimizing value added process using specific tools/technique through structured team approach. Therefore, the term Value Management (VM) will be used throughout this thesis to represent synonymous meaning of its process.

.

2.4 VALUE MANAGEMENT IN CONSTRUCTION

The expansion of VM into construction begins in the early 1970's in the United Kingdom. They are seen as the pioneer in the evolution of Value Engineering into Value Management by applying the process and technique into construction industry. The National Exhibition Centre in Birmingham was a landmark project where project management consultant involvements were acknowledge. The need for delivering value for money in a construction project has prompted project consultants to introduce Value Management as part of their services offered. This scenario was experienced in the UK construction industry where project management consultant were engaged and recognized as better way of doing business.

According to Ellis, Wood and Keel (2005), value management has been widely accepted in construction industry as important tool in the management of project. They cited several Government bodies that produce documents on value management that focus as guidance for practitioners offering value management services. Such document includes the British Standard BS EN 12973:2000 (British Standard Institution, 2000), the HM Treasury (1996), Defence Estate Organization (1998), Australian Standard of Value Management (2007), Value Standard and Body of Knowledge (SAVE International, 2007), Value Management Guidelines TAM04-14 (New South Wales Treasury, 2004) and many more. These documents produce guideline on how application of value management in construction can be assimilated.

Value management in construction project contributed significantly in improving the delivery and better value for money. There are various perspectives on how the application of Value management contributed to construction project. According to Ashworth (2004), value management assist to reduce unnecessary cost in construction project. He asserted that project can be design and constructed in many way with each methods attract different costs. In achieving any function, the assessment of alternatives may produce better solution that could be done in many different ways (Government of Western Australia 2005). Defining the right problem and then generates a range of possible solutions are one of the way value management assist in reducing unnecessary cost (Clarkworthy, 2006). Ashworth (2004) observed that there are three categories that contributed to unnecessary cost in construction project which are as follows:

a. Particular building component serves no real function
b. When cost are expended on unnecessary materials
c. Where buidability is not considered at the design stage

The application of value management from the perspective of cost reduction emphasis towards defining the actual resources needed to complete the project with lowest cost possible. It involves the team to study the building components and design that are most economical and serve the necessary function.

The reduction of unnecessary cost in construction is only a fraction of value management contribution. The Department of Housing in Western Australia has different views on what value management is in relation to proposed development projects. The process of value management allows all stakeholders to be involved in the decision-making process that includes selection of designs, refinement of design brief and identification of budget constraint of the project (Government of Western Australia 2005). It also assists in defining what value means to client by agreeing to the project objectives and how it can be achieved (Connaughton & Green, 1996). Its application in this perspective applies at more strategic level of a construction project where all decision made in the front end is assessed even before the design is being put up.

The Australian Standard on Value Management AS4183-2007 (2007) provided an example of situations where value management could be applied in construction project. Table 1 summarizes the scope of value management application that includes:

Table 1 Application of value management in construction project

Strategic project planning	Project scoping
Budgeting	Asset management
Development of client's brief	Project feasibility
Site selection	Procurement selection and administration
Project design and development	Life cycle costing
Material selection	Conflict resolution
Strategic Planning	Constructability

There are no fix rules on which project suitable to benefit from value management application. The structure of value management is versatile and allows for every project to reap the benefits of the process through its application in work processes, systems, programs and any part of construction project activity where key decision are made (Office of Fixed and Asset Management, 1997). The main function of value management liaise in the systematic approach to problem solving that make it applicable to all projects and phases of construction progress.

In term of research, the area of value management has matured over the time and there has been substantial research into the application of VM within the construction industry over the last few decades. According to Bowen, Edwards and Catell (2009) previous research addressed issues such as use of VM in construction (Connaughton & Green, 1996; Dell'Isola, 1982; Kelly & Male, 1993; Kelly, et al., 2004); best practice and benchmarking (Male, Kelly, Fernie, Gronqvist, & Bowles, 1998); VM for managing the project briefing and design processes (Yu, et al., 2005); VM methodologies and techniques (Dell'Isola, 1982; Zimmerman & Hart, 1982),VM in strategic development of infrastructure (Barton & Knott, 1996a; Che'Mat, 2006a);VM performance measures (Lin & Shen, 2007); relationship between VM and quantity surveying (Ellis, et al., 2005; Hogg, 1999); integration of risk and VM (Afila & Smith, 2007; Dallas, 2006a); group decision support systems (Fan, Shen, & Kelly, 2008), group dynamics in VM (Leung, et al., 2003), the implementation of VM in the public sector projects(Kelly & Male, 1999), global development of VM client value systems (Kelly, 2007), VM in alternative dispute resolution (Tanenbaum, 2004); and hard versus soft VM (Green & Liu, 2007).

The structured approach in value management has been the key driver for the demand of its implementation within the construction industry. Section 2.5 will be discussing in details on the structured approach of value management and how systematic problem solving technique is executed. The following section will review literatures on appropriate timing to implement Value management in construction project.

2.5 INTERVENTION DURING CONSTRUCTION PROJECT PHASES

Value management can be implemented at every phase of construction project. The timing to implement value management during different phases of construction project produces different measure of result depending on when it is implemented. Value management is best to be implemented at the earliest possible phase of construction project as it attracts the best opportunity to influence the outcome of the project with minimal cost effect (Barton & Knott, 1996b; Che'Mat, 2002; Dallas, 2006a; Dell'Isola, 1982; Hunter & Kelly, 1998; Kelly, et al., 2004). According to Kelly and Male (2004), authors in value engineering field agree that the maximum cost reduction potential occurs early in the briefing/design phase of a project. The opportunities to influence the outcome normally exist at this stage where planning are made at strategic level on the future outcome of the project. At this stage, all decisions made are on paper and without any physical development, therefore allowing for improvement to be made to the project. The involvement of all stakeholders of the project during the planning phase allows for the proposed development to be reviewed, client’s requirement to be refined and make explicit to all parties. This is where the application of value management will contribute to all decision makers by way of structuring the project objectives and assist discussion to decide on what are important to the project.

The suggested improvement at the early stage of a project may pose greater potential saving compared to the later phase of a project. The cost of change or improvement may increase if value management is implemented as the project progresses past the planning stage. Ideally, value management may be apply during the concept development and the initial design process of a construction project (Government of Western Australia 2005). The potential savings as a result of early implementation of value management is greater than the cost of changes. As the project progresses, the potential savings will diminish and the cost of change will start to increase. This scenario is illustrated in Figure 1 that indicates diminishing opportunity for savings and project progresses.

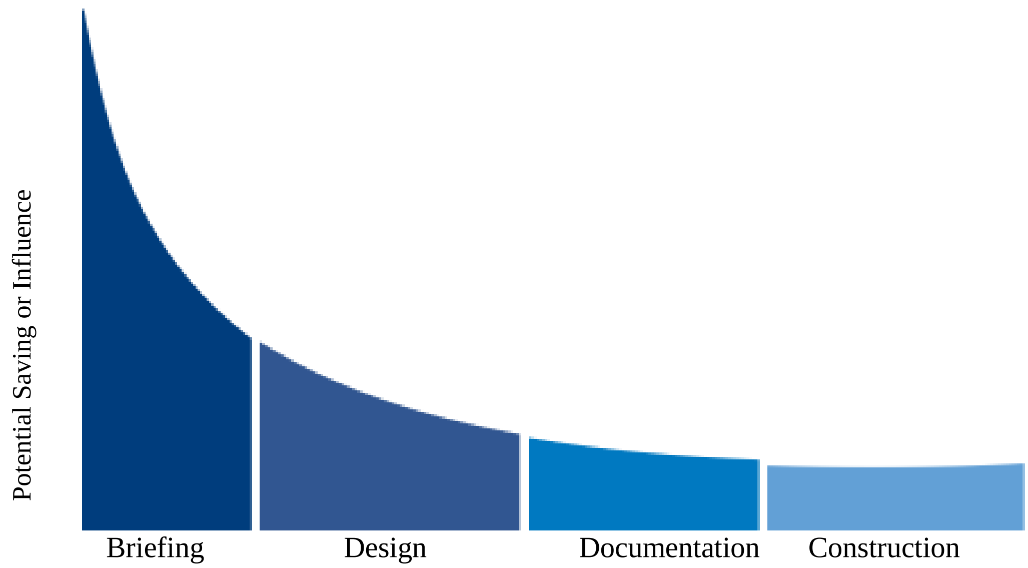

Figure 1 Potential Influence of Value Management (Government of Western Australia 2005)

Several publications have reported and validate the notion of early application of value management in construction project leads to greater potential saving (Male & Kelly, 1989; Barton, 1991; Neasby, Barton & Knott, 1999; Kelly & Male 2004; Potts, 2008). On average, a saving between 10 – 30% can be generated if value management is applied before the construction phase of a project. This is due to the opportunity to make adjustment and refinement of the design and approach for the project. Although saving is possible when value management is conducted during the construction phase, the impact of saving is minimal although there are plenty of opportunities. This is due to the effect of cost of changes that are higher during this stage as compared to the early stage of project. In other word, the cost of change during early value management implementation may involve redesign and changes on the overall planning of proposed development. In contrast, the cost of change during later stage of project may involve physical changes that may have greater cost implications. The decision and resources commitment made during early stage of a project significantly influence later resourcing and expenditure by greater orders of magnitude.

Although the idea of early implementation of value management is well accepted among construction practitioners, Kelly et al. (2004) offers an alternative perspective on value management intervention in construction project. They asserted that early implementation of value management alone do not guarantee positive results if the real problems faced by the project are not well understand. Furthermore, the involvement of appropriate team composition in value management study contributed significantly towards the success of the study. This success could not be achieved if the value management study is conducted in phases where stakeholders are not part of the study team. For instance, the contractor's involvement in value management is made possible once they are appointed after the tendering phase. Prior to that, the opportunity to contribute their expertise to the study is not possible. Therefore, the intervention of value management as proposed by Kelly et al. (2004) provide a strategic key point of intervention during phases of construction project taking into account team composition and actual problem to be solved.

Kelly et al. (2004) have identified 5 key points of intervention for value management study during phases of construction project. Each intervention points have different team composition as illustrated in Table 2. The key points indicate as period where value management intervention is possible. As the progresses, the team composition for value management study changes corresponding to the need of the project. The findings from Kelly et al. (2004) add another dimension to the early implementation of value management in construction project by way of looking at the needs, client’s problems to be addressed and issues faced by each stage of a project. For instance in VM1 where the project is at the pre-brief stage, the client and facilitator are the only team to the study as objectives and requirement of the project are still developing. Compared to VM5, the study only involves the facilitator and independent audit team when all scheme and detail design has been completed. The key intervention point indicates changes in the team composition that correspond to the need of the project progress and context of the issues faced at each phases of the project.

Table 2 Five VM intervention point

	Project Awareness	Client Development	Inception	Feasibility	Outline Proposal	Scheme Design	Detail Design	Production Information	Bills of Quantities	Tender Action
Team Composition	**Pre-Brief**		**Briefing**		**Sketch Plan**		**Working Drawings**			
Client and Facilitator	**VM 1** Built Solution not decided – Level 1 and possible Level 2 issues									
Client, facilitator and independent audit team		VM 2 Built Solution decided procurement path not chosen – Level 1 & 2 issues								
Client, facilitator and project design team		VM 3 Built Solution decided procurement path implied – Level 1, 2 and 3 issues								
Facilitator and project design team						VM 4 Level 3 and 4 issues only				
Facilitator and independent audit team						VM 5 Level 3 and 4 issues only				

The proposed point of intervention for value management as proposed by Kelly et al. (2004) are limited to pre-construction phase of a construction project. The Office of Government Commerce (Office of Government Commerce) on the other hand has applied value management study across the life cycle of seven public sector construction project in their joint case studies with APM Group Ltd and Institute of Value Management UK. There are six key stages of value management implementation in their case studies as summarise in Table 3.

Table 3 Key VM stages (OGC 2007)

Value Management Key Stages	
VM 0	Need Verification
VM 1	Project Definition
VM 2	Brief Development
VM 3	Value Engineering
VM 4	Hand Over Review
VM 5	Post-Occupancy Review

The case study aimed to demonstrate the effectiveness of value management implementation in construction project. The findings from the case studies reported more than the cost reduction as benefits to the value management implementation. Benefits such as improved articulation of value, reduced waste, improved affordability and productivity were reported when value management is being extended to construction phase and beyond (post occupancy phase).

The ideas of value management intervention at earliest possible stage of a construction project as proposed by (Barton & Knott, 1996b; Che'Mat, 2002; Dallas, 2006a; Dell'Isola, 1982; Hunter & Kelly, 1998; Kelly, et al., 2004) may seem to have positive benefits to the project as discussed. However, knowing the needs of the workshops, context of the issues to be address and team composition further add value to the context of early implementation.

The key point of intervention for value management study is subjective and flexible to every project as long as the needs for such study are fully understood. Apart from understanding the strength of early implementation, the mode or approach on how value management is conducted contributed significantly to the much demand for value management. The approaches of value management intervention can be done in several ways that will be discussed in Section 2.6 of this chapter.

2.6 FORMAL APPROACH TO VM

The intervention of value management at key point phases of construction project as reviewed earlier identifies different set of problems to be address and team composition to the study. The varying intervention point and demand for certain set of team members requires specific approach on the application of value management. Kelly (1993) and Kelly *et al.* (2004) in their research on VM approach in the North America continent have identified four formal approaches to VM application in construction projects. Each approach has different method, time and purpose of conducting the study but maintain the investigation of function and value for the project as main objectives. The structure of value management study is the same across all four approaches. The four approaches as identified by Kelly, Male and Graham (2004) are:

a. Charette

b. 40 Hour Workshop

c. Value Management Audit

d. Value Management Change Proposal

2.6.1 Charette

Charette commences after the completion of a client's brief. It is a form of workshop that is conducted involving the client and the design team to rationalise client's brief through the identification of key elements of the spaces specified. It is a compressed design process that aim to produce a concept design (Sankey, 1995). The charette are normally conducted at VM4 intervention point as indicate in Table 2 of this chapter. The involvement of internal design team is to make explicit client's requirement before proceed with the detail design stage of the project. The workshop is led by the facilitator acting on behalf of client to guide through the entire study process. Sankey

(1995) asserted that the client's need, wants and budget should be reconciled at this point of workshop. Kelly et al. (2004) observed that a brief given by a client normally is an amalgam of the 'wish list' of all the parties in his organisation that contributes to the brief. Therefore, a charette is necessary to identify and define the real function of the proposed projects by separating between the needs and wants. Furthermore, Kelly et al. (2004, p.21) describe the charette as "an inexpensive means of examining the client's requirements by the use of function analysis and allowing rationalisation and full design team briefing". The early point of intervention of charette provides feedback to client on physical and economical impact of the project against the needs and budget (Sankey, 1995). In summary, charette is a value management approach that attempt to finalise concept design and ensure a consistent understanding of client's requirement across all project internal team member.

2.6.2 40 hour workshop

Contrary to the charette, the 40-hour workshop utilizes external or independent design team to audit the developed design. The practice is widely used in the United States at the VM5 intervention point as indicated in Table 2 of this section (Fan, et al., 2008). The independent design team is responsible for producing and developing an alternative solution of the design that is technically viable. It comprises of mix multi-disciplinary team that is a reflective of the existing internal design team. Their role in this study provides a fresh outlook at the design. McGeorge and Palmer (2000) observed this approach as having an opportunity of pulling-in additional skill mix and experience to review and improve the design. By contrast, Kelly et al. (2004) argued that the original design team may interpret the exercise as a critique of their design judgment and as adversative action (Kelly & Male, 1993). The 40-hour is a reflective of the time spent by the team to study the design. As compared with Charette, there are no fix time duration for each study. Pickles (1999) observed that the 40 hour duration was not practical or desirable as it demand full time commitment, despite an earlier survey by Kelly and Male (1993) in the US that found that even the 40 hour duration was still not enough if its involved a high degree of complex issues. In contrast, the workshop duration of one day is the norm practiced in the UK (Hunter & Kelly, 2007a). The duration of workshop for this approach although is subjective against the context and complexity of the project, the use of independent team to provide fresh insight provide advantage to the existing design team to review their design.

2.6.3 Value Management Audit

The appointment of facilitator in charette or 40-hour workshop focuses as client's advisor by conducting value management study at key points of intervention of a project life cycle. Their involvement starts at strategic point of project to assist the development of client's requirement. In contrast, the value management audit is a service offered by value engineer/facilitator to large companies to review their project proposal. The intervention points between VM 2 and VM3 are where their contribution are made (Refer Table 2). Their role and task is slightly different from charette and 40-hour workshop. In VM audit, the facilitator act as an independent and external party to the project. The audit is based on the assumption that the client had already finalise their concept and project proposal. Therefore, the audit provides their services by way of auditing the project proposal. The audit team examines the proposal using a similar workshop style adhering to the job plan. The aim of the audit is to ensure a proper direction and that the primary functions of the project are established in advance (Kelly, et al., 2004).

2.6.4 Value Management Change Proposal (VMCP)

A VMCP is a proposal submitted by a contractor to the government, client or private employer after a construction contract has been awarded to them, provided that their contract contains a VM/VE clause (Che'Mat, 2010). Its purpose is to incentivize the contractor to propose contract modifications that reduce cost without reducing product or process performance. It is a post tender change inspired by the contractor (Kelly, et al., 2004) that is different from the former approaches discussed. Leen (2010) in citing Minister of Works Malaysia states that VMCP is a written contractual mechanism which allows contractors, based on their own efforts, to introduce innovation to a project. The savings generated from the accepted proposal, will be shared between the clients and contractor based on an agreed percentage split (Kelly, et al., 2004).

These alternative approaches used in VM share the same common attributes as the more usual workshop and job plan procedures. Even though, these practices resulted from studies undertaken in the US, the application has been applied internationally with some modification to suit local environment and work culture (Hunter & Kelly, 2007a). However, these approaches have received some criticism, which has prompted a need for further research and Kelly et al. (2004) identify that the design liability has always been an issue when an independent VM team in brought into the VM study for review. The original design team has to take full responsibility for all VM solutions proposed by the independent VM team. They (ibid 2004) further argued that, the VM team should take the design liability for any recommendations they make based on their position as qualified practitioners, i.e., they have an ethical responsibility once they start to review a design.

2.7 STRUCTURED APPROACH IN VALUE MANAGEMENT

The systematic approach in value management refers to a process described as the 'Job Plan' (Dell'Isola, 1982; Kelly, et al., 2004; Kirk, Turk, & Hobbs, 2002), 'Value Methodology' by the Society of American Value Engineers (SAVE International, 2007) and 'Work Plan' by Australian Standard AS 4183-2007 (Standards Australia). Although there are various terms across different organization, region and authors, the essence of value management process remain the same. Regardless of the term of terminology, team structures, intervention points and techniques (Hunter & Kelly, 2007a). Male et al. (1998) in his study on benchmarking of value management practice found that the term 'Job Plan' is widely used in construction industry across the US, UK, Australia and Asian regions. Therefore, the term 'Job Plan' will be used in this thesis as a term to describe structured approach in value management process.

The Job Plan is a sequence of decision-making procedures applied by a multi-disciplinary team to improve value through the analysis of project functions. There are several views on the format of the Job Plan across the literature in this field (Parker, 1998). The Job Plan as suggested by Miles (1989) comprises of seven phases which include Preparation, Information, Analysis, Creation, Evaluation, Development and Presentation Phases. Other authors identify only five phases starting from Information, Creativity, Evaluation, Development, Presentation and Feedback (Dell'Isola, 1982; Kelly, et al., 2004; Kirk, et al., 2002) while SAVE International (2007) stipulates six phases. The following Table 4 summarises the value management process from various authors and organisations.

Table 4 Summary of value management process

Value Management Process				
Miles (1989)	Dell'Isola (1982), Kirk, Turk and Hobbs (2002), Kelly, Male and Graham (2004), Norton and McElligott (1995)	Che'Mat (2010) and VM Circular 2009/3 (Economic Planning Unit Malaysia, 2009)	SAVE International (2007)	Australian Standard AS 4183-2007 (Standards Australia 2007)
Preparation				Pre-workshop
Information	Information	Information	Information	Workshop
Analysis		Speculation	Function Analysis	Post Workshop
Creation	Creativity	Judgment	Creative	Post Study
Evaluation	Evaluation		Evaluation	
Development	Development	Development	Development	
Presentation	Presentation and Feedback	Recommendation	Presentation	

Table 4 indicates value management processes that vary across authors and organization. The format of the Job Plan changes and becomes amended in accordance to the needs of the VM study to suit particular projects, however, the essence of the Job Plan relies upon the fundamental process of first getting to know exactly what the problem is, gather relevant information about the problem, find alternative solutions, decide what is the course of action and finally obtain approval for development (Green, 1990). Empirical evidence would suggest that the Job Plan, which is the methodology that drives VM, is little more than a common sense structure that holds effective group decision making together (Stevens, 1999).

In this thesis**,** the five phases of Job Plan format as proposed by Dell'Isola (1982), Kelly et al. (2004) and Norton and McElligott (1995) are further explored and suggested to represent a generic process which reflects the entire systematic approach and has been well accepted (Male, et al., 1998) throughout the international benchmarking of value management studies. This latter finding has been further supported by more recent benchmarking research of VM process by Fong *et al.* (2001) that concludes that a standardised process which identifies best practices across industries should be developed in response to increasing interest in VM.

The implementation of a Job Plan is conducted by way of a workshop format which involves a multi-disciplinary team following the procedures set down in the five step job plan as shown in Figure 2. The team structure will normally comprises of relevant design professionals such as architect, engineers, quantity surveyors, clients and VM facilitators (Leung, et al., 2003). The composition of the team is tailored to suit particular project issues and nature, for instance where constructability and sequencing issues are of a concern, a construction manager may also participate in the workshop (Norton & McElligott, 1995).

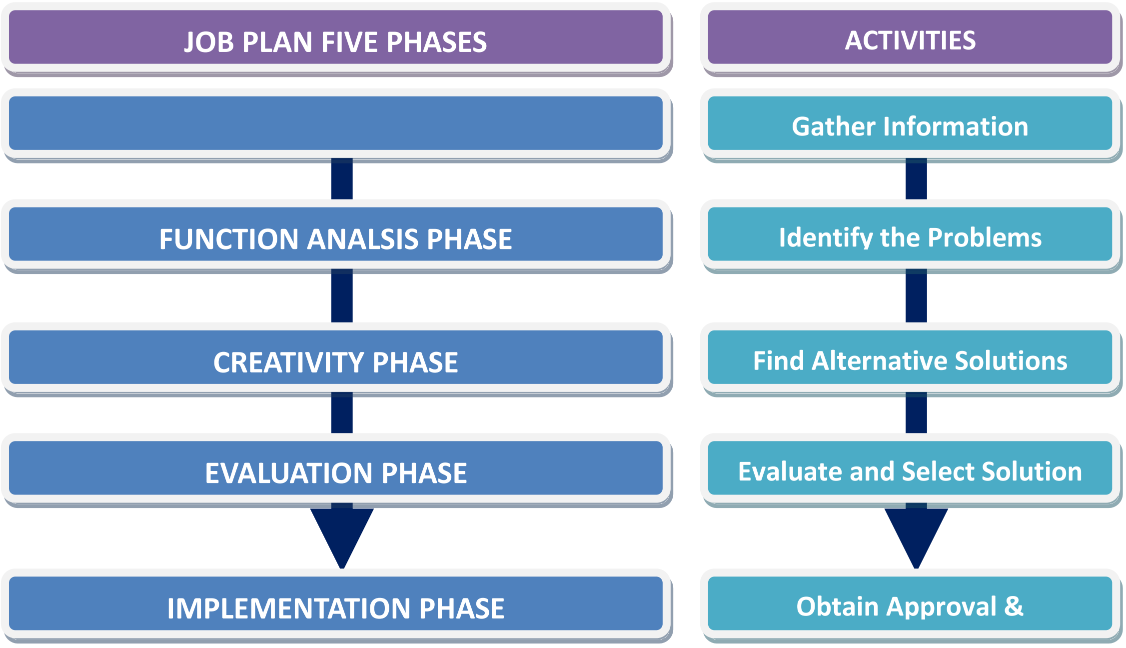

Figure 2 VM Five job plan phases

In summary, the job plan represents a decision-making process from problem identification right through the analysis and solution findings. The five phases of job plan as suggested by Dell'Isola (1997), Male et al. (1998), Kelly et al. (2004) represent standardized process flow that is use in this research for further exploration taking into consideration a study by Male et al. (1998) on international benchmarking of value management. Although practices across the world have different term used with varying numbers of phases, however the process retains a similar process flow. The workshop approach is used to implement the job plan in an environment that combine multi-disciplinary team member. The following sub-section will be discussing on the workshop application in implementing the job plan in value management study.

2.8 VALUE MANAGEMENT WORKSHOP

The job plan is implemented through workshop format that combines involvement of multi-disciplinary project team using set of tools to solve issues through facilitator's guide. According to the New South Wales Treasury guideline of value management, the workshop act as vehicle that bring together stakeholders to the project that were reinforce by their knowledge, contribution and group dynamics (NSW Treasury, 2004).

The workshop format itself varies according to different author's findings and organization. The Society of American Value Engineers (SAVE) in their publication "*Value Standard and Body of Knowledge*" has identified three generic stages of workshop that comprises of pre-workshop, workshop and post-workshop phase (Hunter & Kelly, 2007b). This standard practice of value management workshop stages in the United States is similar with the practice in the Australia and UK. The only exception for these three stages was the definition used by Kelly, Male and Graham (2004) where the pre-workshop stage was termed as 'Orientation or Diagnostic Phase'. However, throughout this thesis, the term introduced by SAVE International and Australian Standards AS 4183-2007 will be used.

2.8.1 Pre-Workshop Stage

The three key stages of workshop in value management provide a sequence of task and key outcome that need to be compiled and completed for the study. The Pre-workshop stage is a preparatory stage where planning and organizing for the workshop is taken place. It concern on what has to be done for the workshop (SAVE International). There are mix compilations of common activities carried out during the pre-workshop stage across the literature reviewed. The SAVE International, Kelly et al. (2004) and Australian Standard AS4183-2007 has compiled a list of common activities during pre-workshop stage of value management study as indicated in Table 5. SAVE International and Australian Standard were both guidance documents used for application of value management in the US and Australia respectively. While the list from Kelly et al. (2004) were based on their findings made from value management benchmarking study.

Table 5 Common activities during VM pre-workshop stage

Ref	Key common activities during Pre-Workshop stage	SAVE International (2007)	Kelly et al. (2004)	Australian Standard (2007)
1	Obtain senior management support and approval to conduct workshop	•		
2	Develop/ determine scope and objectives of study	•	•	•
3	Gather , analyse and distribute project data and information	•	•	•
4	Obtain key documents: Work definition, drawings and specification, reports and project estimate	•	•	
5	Identify and prioritize strategic issues of concern	•	•	
6	Develop study schedule/agenda/format	•	•	•
7	Undertake competitive benchmarking analysis	•	•	
8	Identify, select and appoint workshop participant	•	•	•
9	Obtain commitment from workshop participant to achieve the project objectives	•		
10	Review project cost	•		
11	Invite relevant stakeholders, technical experts, end-users and decision makers	•	•	•
12	Prepare value management brief	•	•	•
13	Organize venue		•	•
14	Prepare facilitation strategy		•	•
15	Brief study group member/workshop participant/facilitator		•	•
16	Agreement on the total cost of the study			•
17	Structuring value problem		•	
18	Interviews		•	
19	Site Tour		•	

Majority of pre-workshop activities are recommended by all key references as indicated in Table 5. However, several activities were exclusive and provide extended views on pre-workshop activities. Obtaining senior management commitment and approval to conduct workshop is viewed as one activity recommended by SAVE International, this view is consistent with Male et al. (1989) finding that client's involvement and authority in value management workshop study is crucial as one of factor that will lead to success of the study. The client's authorities in driving workshop momentum are seen as positive effort in getting participant to be engaged with the study. In addition to senior management approval, the Australian Standard As 4183-2007 asserted that reviewing cost of the study is part of pre-workshop activity that allow client to be aware of the total workshop cost. In contrast, SAVE International focused on reviewing the cost of the project affected by the value management study. Both approach although have different focus and aim, it does indicates that reviewing project cost and cost of conducting value management study are essential to be aware off when organizing a workshop.

Kelly et al. (2004) suggested additional activities that were not highlighted by SAVE International and Australian Standard AS4183-2007. Their suggestions were based on research conducted in the North American and UK practice of value management. The first point refers structuring the value problem at the beginning stage of the pre-workshop where facilitator and client sit down and discuss the aims of the workshop. It enable for identification of the real need for the workshop and making sure the rest activities of workshop preparation (i.e. team selection, gather information, setting agenda etc.) can be done. In addition, interviews and site tours are observed to be the norm in Kelly et al. (2004) works. The interview were conducted with aim to screen potential workshop participants and tours are meant to get the participant familiarize with the project. However, there are exceptions in site tours prior to value management workshop as it may only apply to VM audit approach where the team is external to the existing team.

Activities during pre-workshop phase vary according to the needs and complexities of the project. The main guiding principle that needs to be address is on how good the planning of the workshop is prepared to ensure smooth running of the entire workshop. Throughout the process of reviewing literatures on pre-workshop planning, consideration has been made on clustering together all activities into several generic groups. It allow for clearer classification and better focus to be made when preparing for value management workshop. From Table 5, there are key activities that can be combined and grouped together to form generic activities during pre-workshop phase. The three generic groups are People, Process and Documentation and Agenda as summarised in Table 6

Table 6 Generic groups of pre-workshop activities

People	Process and Documentation	Agenda
Senior management approval and support for workshop	*Key Information gathering, analysis and distribution*	*Develop study schedule/agenda/format*
Selection, interview and appointment of participants	*Undertake competitive benchmarking analysis*	*Organize study duration/period*
Secure commitment from workshop participant to achieve the project objectives	*Review project cost and total VM study cost*	*Develop study scope and objective*
Invite relevant stakeholders, technical experts, end-users and decision makers	*Prepare value management brief*	*Identify and prioritize strategic issues of concern*
Briefing for facilitator and workshop participants	*Structuring value problem*	*Organize study venue*
Prepare facilitation strategy		*Site tour*

The list of activities for this phase of workshop is non exhaustive and rely heavily on the organizer in making sure every aspects is taken care off. Activities during pre-workshop phase as reviewed and discussed provide a basis for practitioner in organizing their future value management workshop. There are no fix rule on what needs to be done for each workshop preparation as it depends on the complexity of the projects, approach of study and key point of intervention. However, discussions with relevant parties ahead of actual workshop phase of the study help to identify priorities and communicate objectives for the workshop (Ellis, et al., 2005).

Literatures reviewed in this section summarises key activities that is sufficient to support pre-workshop preparation and entire value management workshop. In summary, the pre-workshop phase act as preparatory works that includes background information collection, study scope, cost overviews, setting agenda and appointing workshop participants. The next step in value management phase is the workshop phase where the central problem solving and decision-making activities were made.

2.8.2 Workshop Stage - Information Phase

The workshop phase of value management study is the heart of the study where actual dynamic of discussion and structured approach to problem solving guided by facilitator were made. This is where the actual workshop starts and involvement of all participants are important. The workshop is led by facilitator appointed by the client to lead the workshop participants throughout the study process. As discussed in Section 2.7 of this chapter, the Job Plan of the workshop follow the five phases (i.e. Information, Function Analysis, Creativity, Evaluation and Implementation) as suggested by Dell'Isola (1982), Kelly et al. (2004) and Norton and McElligott (1995) in describing the entire workshop phase process. The workshop phase of value management study is continuity from the pre-workshop phase where preparatory work and activities as summarized in Table 6 has been completed.

The objective of this phase is to establish a good understanding of the project, its design and operation, the functions of the project itself and to determine areas with the greatest potential for savings and needed improvements (Norton & McElligott, 1995). SAVE International (2007) suggest that understanding of constraints that influence project decision is crucial during this stage of workshop. Kelly et al. (2004) have underlined several objectives that need to be address during information stage:

a. Team development for workshop participant including introduction of facilitator
b. Ensure facilitator, client and workshop participants understand the strategy and approach of the workshop
c. Briefing on study aims, objectives and scope of study by the facilitator

All project team members involved will be informed on the issues that have prompted the study. Briefing will be given to workshop participants by the VM facilitator on the objectives of the study. Information that surrounds the project will be analysed. A presentation by the designers (Che'Mat, 2010) and other relevant stakeholders (SAVE International, 2007) during information gathering is required to update the workshop participants to bring them to the same level of understanding of the project situation. By the end of this phase, a mutual understanding is reached regarding the fundamental issues of the project under study by the project team.

SAVE International (2007, pg. 14) in their guideline has underline generic activities that can be conducted during information phase of value management study. However, several activities as suggested were overlapped and contrast with the Kelly et al. (2004) suggestion. In Kelly et al. (2004), site tours are conducted during pre-workshop phase of the study while SAVE International (2007) suggest to be conducted during information phase. According to Australian Standard AS4183-2007 2007) and Kelly et al. (2004), workshop preparation such as setting agenda, venues, dates and other logistical needs were conducted during pre-workshop phase. This contradicts with SAVE International’s suggestion where all logistical planning activities should be done during information phase. The contrasts of activities are also extended to gathering and distribution of information for the workshop purposes where SAVE International suggested on both pre-workshop and information phase.

The discrepancies on what activities should be conducted during information phase are meant to be as guide for future workshop organizer. Although SAVE International’s (2007) approach may be different from Kelly et al. (2004) and the Australian Standard AS4183-2007, the basic principles for information phase is to make sure every workshop participants has the same level of understanding.

In an attempt to make all workshop participants achieve a consistent level of understanding of the workshop information and objectives, a presentation by the workshop participants about the project background and issues were made (SAVE International, 2007). Project team that was invited as workshop participant will play their role in presenting their part of the works. In normal construction project, the designers, engineers, quantity surveyors, clients and facilitator will make the presentation (Che'Mat, 2010). The topic of presentation varies according to the need of the study, stages of project where the study is conducted, availability of information and issue that need to be address.

Dell’Isola (1982) has suggested several basic questions that need to be ask during information phase of the workshop. These questions aimed at making information presented to be more in-depth and ensure consistent understanding among workshop participant is achieved. The basic questions as suggested by Dell’Isola (1982) are as follows:

a. **What it is?** - *Refers to the context of project understudy*.
b. **What does it do?** - *Refers to the functions of the project understudy.*
c. **What does it cost?** - *Refers to the cost of the project understudy*.
d. **What are the cost/worth ratio?** – *Refers to the cost divided by worth ratio of the project understudy*
e. **What are the needed requirements?** – *Refers to the basic requirements of the project understudy*.

These questions as suggested by Dell'Isola (1982) provide a basis for analyzing the fundamental function of the project. The analysis of such fundamental function is conducted during presentation made by the workshop participants and guided by the facilitator. The outcome of activities and processes involved during information phase will brings workshop participants to a basic level of understanding of the project, including tactical, operational, and specifics of the subject (SAVE International, 2007). Fundamental questions address during this phase of a workshop will be use during the next stage (Function Analysis) where more in-depth exploration of the project functions are analysed.

2.8.3 Workshop Stage - Function Analysis Phase

Function analysis is a systematic process of identifying functions and their associated cost and assessing the necessity of those functions based on established criteria for the project in the simplest possible way (Spaulding, Bridge, & Skitmore, 2005; Steven, 2004). It helps in identifying the scope of the project by showing the logical relationships of all functions (Canadian Society of Value Analysis, 2013). It is regarded to the quintessence and the heart of value management (Stevens 2004; (Kelly, et al., 2004; Male & Kelly, 1989; McGeorge & Palmer, 2000; Singh & Jannadi, 2006)

The function analysis phase explores project functions through analysis conducted by workshop participants using range of tools and techniques guided by the facilitator. The objective is to establish the functions of the proposed project, and to understand project from a function perspective; i.e. what must the project do, rather than how is the project currently conceived (SAVE International, 2007). Depending on the intervention point of value management study, function analyses conducted during early stage of a construction project provide foundation to identify project problems and offer possible solution for best value for money (Kelly, et al., 2004).

Function analysis phase involves workshop participant working together to identify and define functions of the project using sets of tools and techniques. Various techniques have been developed to identify the functions of a project and ultimately assess their relative significance (Standards Australia, 2007). Techniques of function analysis such as verb and noun abridgment, function diagramming and classification (Kelly, et al., 2004) , **FAST** [Function Analysis System Technique] developed by Bytheway (1965), or **SMART** [Simple Multi Attribute Rating Technique] developed by Green (1994), Spatial Adjacency Analysis (Male et al. 1998) and Space Function Analysis (Che'Mat, 2004) are normally used to define functions of a project.

One of the basic set of techniques used in function analysis is the verb/noun abridgment and function classification (Parker) or active verb plus measurable noun (Borza). The techniques involves participant to identify and define the function of particular project or components of the project by giving appropriate noun and verb to differentiate and make explicit the function. Example in Table 7 below indicates an example of function analysis of a fire fighting system using verb/noun abridgment:

Table 7 Example of verb/noun abridgment analysis (Source: Parker 1998)

Component	Verb	Noun	Primary	Secondary
Fire alarm system	Make	noise	•	
	Detect	fire	•	
	Protect	building		•
Pull boxes	Break	circuit		•
Bells	Make	noise	•	
Conduit & wire	Transmit	signal		•
	Transmit	Power		•

The application of verb/noun abridgment test allow for project function to be define in the simplest term by adding the function classification to the component of the project. The classification between 'Primary' and 'Secondary' function provide a distinction to the function through criteria setting for evaluation of problems, reviewing and analyzing them determine any improvement, elimination, or creation to meet the project's goals (SAVE International, 2007). A function that exists to support the method of performing the primary function is considered as secondary function (Parker, 1998, p.65). It offers focus to the workshop participant to identify what actually project needs along with their supporting functions.

Further extending the verb/noun abridgment analysis, the application of functional diagramming is essential during function analysis phase. In 1964, Charles Bytheway introduces a technique of function diagramming that is termed as "Function Analysis System Technique" or FAST (Parker, 1998). FAST provide a graphical representation of how functions are linked or work together in a project to deliver the intended primary and secondary functions (Borza, 2011). It is a method of stimulating organized thinking about any subject by asking thought-provoking questions (Parker, 1998).

FAST technique operates by directing workshop participant to discover all relevant information through issue analysis and structuring such information into graphical way that leads to the recognition of the primary objective of the project (Kelly, et al., 2004). The discovery of information through analysis is conducted through group discussion, brainstorming (Male & Kelly, 2004) and interaction assisted by the facilitator. The role of facilitator is to guide workshop participants to discover information as much as possible and in turn directing them to focus on the primary objective of the project. By asking workshop participant to define function of the project, a collective pool of information on project function can be achieved through team effort. Defining the function of the project is done by asking the How/Why questions to workshop participant in establishing the relationship between primary/secondary functions and objectives of the project (Borza, 2011). Each function identified will be written on random sticky notes. Using FAST diagram technique, those sticky notes will be rearrange/reorganize to visualize the link and relationship between the function and project objectives. Figure 3 indicate an example of a FAST diagram adopted from (Borza, 2011).

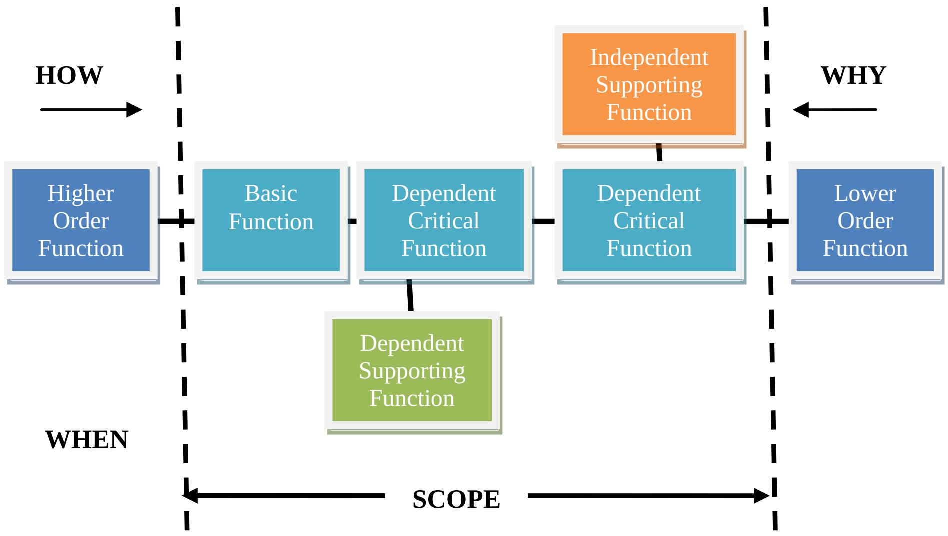

Figure 3 Example of FAST diagram

This phase focuses the team on validating that the project satisfies the needs and objectives of the clients (SAVE International, 2007). Parker (1998) cautioned that functional diagramming using FAST technique has no 'right' or 'perfect' diagram, however it rely on the facilitator's and workshop participant's interpretation of the issue analysis. He further suggests that FAST diagram is just tool that serve to:

1. Organize random listing of functions
2. Identify basic functions and scope of study
3. Visualize the problem of the study for better understanding
4. Test the function through the system of determinate logic
5. Stimulate creativity (Borza, 2011)

The output from this phase is a FAST diagram that depicts a relationship between functions, project objectives and scope. The relationships from the visualization summarize the entire information system required for the workshop to proceed to the next stage. The Information system such as problems to the study, project priorities, relationship of functions (primary versus secondary) and explicit definition of functions of each components of the project will be used during Creativity Phase. These relationship links is carried forward to the next phase of the workshop (Creativity Phase) in order to explore solution to problems identified.

2.8.4 Workshop Stage - Creativity Phase

There are two approaches in solving problem that are analytical and creative (Mandelbaum & Reed, 2007; Parker, 1998). Creative problem solving is an idea-producing process that focuses in generating as much possible solutions to particular issue. Fong (2002) states that creative problem solving in value management brings in qualitative technique that specifies ways to think about the problem and its constraints.

Creativity phase, alternatively termed as the Speculative Phase (Che'Mat, 2010; Dell'Isola, 1982; Miles, 1989), Ideas/Options Phase (NSW Treasury, 2004), this stage has the objective of compiling an abundance of ideas regarding alternative ways to perform the various functions highlighted and discovered during the Function Analysis Phase (Dell'Isola, 1982; SAVE International, 2007). It brings together workshop participant to discover solutions to function relationship discovered during previous phase of the workshop. Discovery of solution in a form of alternate designs, methods, systems or processes to assist to accomplish basic functions and enhance optimum solutions for design problems (Dell'Isola, 1982; Parker, 1998). Output from Function Analysis phase in a form of FAST diagram and summary of function analysis are used during this phase to assist in finding possible solution. Ellis et al. (2005, p.487) stresses that identification of issues, problems and value mismatches from previous phase is crucial for a starting point in creativity phase.

Creative problem solving, ability to think creatively, indulging in an ‘out-of-the-box’ thinking are indispensable elements of a value management study (Ellis, et al., 2005; Mandelbaum & Reed, 2007). The process requires active participation from workshop participants to produce solutions while facilitator guide through the problem solving. Workshop participant are required to actively involve in discussing solutions for identified problems using sets of tools and techniques. The application of tools and techniques varies according to facilitator’s strategy and need of the issue to be solved. Facilitator’s role in value management workshop during this phase is to guide workshop participant by way of setting the parameters of discussion, controlling participant’s ideas generation and managing team process (Kelly, et al., 2004).

This phase use creative thinking techniques to guides and stimulates workshop participants in discovering ideas and solutions to a problem (Ashworth & Hogg, 2007; Parker, 1998). There are varieties of techniques that are used during this phase of a workshop. The aim of using these techniques is to assist workshop participant and facilitator to gather and generate as much possible solutions. Table 8 indicates a summary of creative techniques used during Creativity Phase in value management workshop.

Table 8 Creative thinking techniques in Creativity phase

Ref	Creative techniques in Creativity Phase	Parker (1998)	The Institute of Value Management (2013)	Mandelbaum and Reed (2007)	Kelly, Male and Graham (2004)	Dell’Isola (1982)	Save International (2007)
1	The Two Cardinal Ground rules	•					
2	Brainstorming	•	•	•	•	•	•
3	Gordon Technique	•				•	•
4	Check listing Technique	•		•			
5	Synetics Technique	•					•
6	Morphological Analysis Technique	•		•		•	
7	Attribute Listing Technique	•		•			
8	Evaluation Comparison Technique	•	•				
9	Phillips 66 Buzz Session Technique	•					
10	Crawford Slip Writing Technique	•					
11	Excursion/Metaphors		•				
12	SCAMPER Technique		•				
13	Nominal Group Technique						•
14	Theory of Inventive Problem Solving (TRIZ)						•

Dell’Isola (1982) suggests that brainstorming technique is the foremost approach in Value Engineering. This technique expanded into Value Management where authors and researchers suggested similar techniques in their publications (Economic Planning Unit Malaysia, 2011; Ellis, et al., 2005; Fong, et al., 2001; Kelly, et al., 2004; Mandelbaum & Reed, 2007; Parker, 1998; SAVE International, 2007; The Institute of Value Management, 2013). A study conducted by Ellis, Wood and Keel (Ellis, et al.) in leading cost consultant in the UK found that brainstorming technique is the most universally used compared to other approaches.

Brainstorming technique is a form problem-solving approach that stimulates participants thinking in finding solution to specific issues. Osborn (1957) stress that brainstorming is a method of group problem solving that attempt to increase quantity and quality of ideas through group members. It works on the principle of the more and wilder the ideas, the better opportunity to improve identified ideas (Diehl & Stroebe, 1987). In value management workshop, brainstorming technique is used by participant to generate ideas and alternatives to serve functions as identified during Function Analysis phase (Dell'Isola, 1982). Creative thinking techniques offer assistance to a mental process in which past experience is combined and recombined to form a new combination which will satisfy need (Parker, 1998). Facilitator play an important role during this phase in creating a positive environment among workshop participant (Economic Planning Unit Malaysia, 2011). Using brainstorming technique, participant are required to generate as much possible ideas that push beyond their normal problem solving patterns towards innovation without fear of any criticism (Diehl & Stroebe, 1987; Norton & McElligott, 1995; Osborn, 1957). There are rules that need to be adhered when using brainstorming technique. Participants are required to reserve their judgment and criticism of the suggestions until the creativity phase is complete (Ashworth & Hogg, 2007; Che'Mat, 2002; Diehl & Stroebe, 1987; Economic Planning Unit Malaysia, 2011). Generation of ideas and solutions are recorded by the facilitator as preparation for next phase of the workshop. Depending on the size of team composition, workshop that has large participant, it will be conducted in parallel session. This allow for participants to break into several groups and focus on specific issues (Dell'Isola, 1982).

Facilitator’s involvement during creativity phase contributes significantly in controlling the team process and discussion (Dell'Isola, 1982; Kelly, et al., 2004). There are no time limits as to how many ideas generated that are sufficient and when this phase will end. However, workshop agenda set during the pre-workshop phase set a limit on time allowed for ideas generation. According to Fong, Shen and Chen (2001), the effectiveness of the brainstorming process can be access through numbers of ideas generated ratio against the numbers of workshop participant. They assert that the more numbers of ideas generated, the more effective the workshop team. Despite numbers of ideas/solutions contribute significantly to this phase, control and leadership of the facilitator is crucial in ensuring workshop participants work within given period of time.

Accumulation of ideas that could improve value of the project is the output of this phase. Judgment and evaluation of all ideas generated as a result from brainstorming process will be carried forward to Evaluation Phase (SAVE International, 2007).

2.8.5 Workshop Stage - Evaluation Phase

Ideas generated during Creativity Phase are not allowed to be comment, criticized, judge and evaluated (Ashworth & Hogg, 2007; Che'Mat, 2002; Diehl & Stroebe, 1987; Economic Planning Unit Malaysia, 2011). This control aim to allow for free flow of ideas among workshop participants and eliminate mental blocks to creativity (Parker). All judgment and evaluation to ideas were only be made during Evaluation Phase (Dell'Isola, 1982; Kelly, et al., 2004; Miles, 1989). The Evaluation Phase also termed as the Judgment Phase (McGeorge & Palmer, 2000), or Analytical Phase (Dell'Isola, 1982) is directed towards evaluating all of the ideas generated from the Creativity Phase based on the agreed set of criteria and functions of the project. The objective is to reduce the quantity of ideas that have been identified, to a shortlist of those ideas having the greatest potential to improve the project (SAVE International, 2007). Ideas are refined and reviewed to a workable solution and further analysis (Dell'Isola, 1982).

According to study conducted by Fong et al. (2001) on value management framework, they found that there are two stages in Evaluation Phase that are critical in value management study. The first screening refers to the preliminary filtering of ideas from Creativity Phase that has not been evaluated. Ideas that are feasible will be kept and remaining will be discarded. The second stage is the critical evaluation of shortlisted ideas/solution using set of tools or techniques. The filtering process aimed to reduce ideas that do not add value to the existing problems of the study.

Dell'Isola (1982) suggested a technique of comparing the merits of each ideas using advantage and disadvantage classification. Ideas listed are compared and weighted against their potential advantages and disadvantages it has on the project. Ideas that have more advantages indicate potential solution and are selected for further evaluation (Dell'Isola 1982, p.47). Comparisons based on merits are seen as straightforward evaluation to discard non-value added ideas. However, Parker (1998) attempt to reinforce Dell'Isola's approach by introducing 'Feasibility Ranking' approach prior to merits comparison. In this approach, evaluation criteria were established by workshop participant as guideline to filter the proposed ideas. Using these criteria, workshop participants are required to rank the ideas against the priority of the project. Setting of evaluation criteria varies accordance to project needs, however, Parker (1998) suggested five factors that need to be considered when setting these criteria:

a. State of the art of the idea
b. Cost to develop the idea
c. Probability of implementation
d. Time to implement
e. Potential Benefit

SAVE International (2007) further adds that discussion on how ideas affecting project cost and performance of the project are essential to be part of the assessment criteria. It assists to clarify and categorize ideas into shared common understanding among workshop participants.

Ideas that resulted with the least rank will not be considered for the next phase of evaluation. Further evaluation is conducted to shortlist ideas that have potential impact against the established criteria. There are contradicting approaches between method introduced by Dell'Isola (1982) and Parker (1998) on the next step after screening process. The former suggested evaluation using weighted comparison technique while the latter taking strategic approach by assessing using the merits comparison termed as 'T Comparison'. The process is similar to what has been introduced by Dell'Isola (1982), except for additional step of filtering non-value added ideas through ranking approach (Parker). Apart from merits comparison, Ellis et al (2005) the ‘leave it’ approach and coloured dots techniques are found to be used among East Midlands UK cost consultant (Green & Liu, 2007). The ‘leave it’ approach work on the basis of ’10 second rule’ where ideas that do not obtain any support by workshop participant within 10 second will be deleted. While the coloured dots technique work in similar characteristic with merit comparison where participant will rank their preference of ideas by placing coloured dots on their preferred ideas.

Filtered ideas are further evaluated in the second stage of this phase using set of tools and techniques. The weighting technique is found to be commonly used technique during Evaluation phase of a workshop (Dallas, 2006b; Dell'Isola, 1982; Fong, et al., 2001; Green & Liu, 2007; Male & Kelly, 2004; Male, et al., 1998; Miles, 1989; SAVE International, 2007). The weighted techniques also termed as criteria weighting technique (Fong, et al., 2001) is a technique that combined numerical sorting scale and evaluation criteria as method to assist in decision-making process. This technique uses workshop participant’s involvement in setting evaluation criteria bases on project function requirement defined during early phase of workshop. These criteria are used as basis to conduct numerical assessment through ranking or point’s distribution that has high correlation with the established criteria. Techniques such as Multi-Criteria Decision Making (MCDM) (Koskalan, Wallerius, & Zionts, 2011), Simple Multi Attribute Rating Technique (Smart) (Edwards & Newman, 1982; Green, 1994), Simple Additive Weighting Method (SAWM) (Chen, Chang, & Huang, 2010), Paired comparisons (Dallas, 2006b; Dell'Isola, 1982; Parker, 1998), Distribution points (Dallas, 2006b), Life Cycle Costing (Dell'Isola, 1982; Kelly, et al., 2004; Land, 1997) and Analysis Matrix (Dell'Isola, 1982) are used to select the optimum solutions for further development.

Apart from weighting technique, the analytical hierarchy process (AHP)(Chen, et al., 2010; Saaty, 1999; Triantaphyllou & Mann, 1995) and Data Mining (Shen, Guo, Zhang, & Liu, 2008) also offers alternative to decision making process through more complex yet dynamic process.

The outcome of this phase produces a focused list of solutions that warrant quality time being spent to develop value-based solutions that can be implemented into a project, or a project feature (SAVE International, 2007). The selected solution will be taken into the next phase (i.e. Implementation Phase) for further refinement and development.

2.8.6 Workshop Stage - Implementation Phase

The implementation phase is where development of shortlisted solutions are made. This phase also referred to as “Recommendation Phase” (Che'Mat, 2010; Che'Mat, 2002; Che'Mat & Malaysia Airports Holdings Berhad, 2008; Economic Planning Unit Malaysia, 2011) or ‘Proposal Phase’ (Dell'Isola, 1982). The shortlisted solutions derived from the Evaluation Phase will be further developed into a workable document, Action plan and VM report to be presented to a client (Che'Mat, 2010; NSW Treasury, 2004). Documents such as drawings, specification, calculations, estimates, cost comparison, Cost-Benefit Analysis (Dell'Isola, 1982) and vendor information are included to support the ideas. A Development and Risk Management plan is developed for each alternative so as to ascertain the programming need for the solutions to take place (SAVE International, 2007). The outcome of this phase will produce a comprehensive report (i.e. value proposal) to ensure that the client and other key stakeholders understand the rationale of the proposed alternatives and also to generate interest that will sanction implementation.

The overall implementation of the Job Plan phases reflect the sequenced nature of a structured decision making process which demands the involvement of a multi-disciplinary team in a workshop environment. The workshop provides a platform for gathering together all project team members to discuss and debate alternative courses of action. There are different ways in which the workshops can be conducted in VM, which are discussed in the next section.

2.8.7 Post-workshop Stage

Post-workshop phase focuses on planning for decision to be made on the selection of value proposal by workshop participants. Workable documents developed during previous phase (i.e. Implementation Phase) are further improvised and presented to the Management level of the project for decision-making purposes (Che'Mat, 2010; Kirk & Leung, 2005).

In study conducted by Ellis et al.(2003), they found that post-workshop phase is significant to ensure success of value management study. It intends to close the loop from recommended proposal to implemented proposals by ensuring all value alternative is accepted by management level or higher authority of the project (Dell'Isola, 1982; SAVE International, 2007). At this phase, there are also tendencies where ideas that need further improvement (Ellis, et al., 2005) as involvement of Management level may invite differing views. Fong, Shen and Cheng (2001) further add that obtaining Management commitment and approval of the proposal is crucial as it provide possible fund and resources for change to be made.

The Economic Planning Unit Malaysia (2009) and New South Wales Treasury (2004) outlined standard activities that need to be conducted during this stage:

a. Making selection and decision on the proposed ideas/solution/Value proposal
b. Conduct coordination meeting between project team
c. Obtain commitment from stakeholders and project team
d. Setting up execution plan for the selected proposal
e. Coordinate design and final documentation
f. Identify people responsible for each activity/task
g. Indicate time frame (for each activity) for further evaluation and decision
h. Specify finalisation date
i. Critical path method of the proposed solutions

The outcome of this is the determination on what changes can the proposed solutions made to the existing project along with the execution plan (SAVE International, 2007). The execution plan spell out roles and responsibilities of the project team including appropriate information on coordination task to implement the project.

In summary, the three phases of workshop (i.e. Pre-workshop, workshop and post-workshop) encapsulate a series of a structured decision making process. Starting from identification on the need of study based on project problems, then to problem-solving process and finally decision making process. Throughout the workshop process, variety of tools and techniques are being used to assist workshop participant in making decision and attract active participation. The application of term used in Job Plan phases varies across different practitioner, authors and organization. However, the essence of structured approach in problem solving remains the central part of value management study. Similarly, the application of tools and technique relies heavily upon the facilitator's knowledge and skills to attract active participation from workshop participant. There are no standard tools or techniques that will suit every project undertaking value management study. Exception is given on the Function Analysis technique phase where the process of defining project functions at strategic level of the workshop using How/Why diagram is the heart of value management.

2.9 VALUE MANAGEMENT TOOLS AND TECHNIQUES

Functional analysis is at the heart of Value Management (Kelly, et al., 2004; Male & Kelly, 1989; McGeorge & Palmer, 2000; Singh & Jannadi, 2006). It separates VM from other management techniques due to the way in which it is used to define the critical functions of a project and make explicit the client's project objectives. There is a wide body of literature that discusses on the function analysis application and benefits (Dell'Isola, 1982; Green, 1994; Kaufman, 1990; Kelly, et al., 2004; Male & Kelly, 1989; Male, et al., 1998). However, there is not much literature that describes any research conducted on other VM techniques applied in other phases of job plan. The Creative Phase provides an opportunity for the study team to generate ideas and solutions to problems through the use of several complimentary techniques. Parker (1998) has identified several techniques to assist with ideas generation such as Two Cardinal Ground Rules, Gordon technique, Check listing, Morphological analysis, Attribute Listing technique and Evaluation Comparison technique. However, these methods have been drawn from the creative mental process philosophy field and have as yet not been fully researched for use in the field of VM. Dell'Isola (1982) suggested brainstorming, while Mao *et al.* (2009) argued that brainstorming is lacking in proper direction of problem solving and has low efficiency in generating innovative ideas and later introduced their own Theory of Inventive Problem Solving Technique [TRIZ] as an alternative technique for use in the creative phase.

In summary, Singh and Jannadi (2006) and Mao et al. (2009) observed that much of the research into VM tools and techniques are focused towards the effectiveness of function analysis and its alternatives. However, limited research is conducted on how effective the understanding and application of tools and techniques among workshop participants. A study conducted by Ellis et al. (2005) found that workshop participants are easily being turn down due to their inability to understand and apply techniques introduced by the facilitator. This leads to poor participation and involvement during workshop problem-solving process. Despite the limitation of understanding the techniques and tools used, there are no studies that come close to validate findings made by Ellis et al. (2005). Participant's knowledge and skills are among critical success factor in value management study.

2.10 MULTI-DISCIPLINARY STUDY TEAM

Value Management is an organized and facilitated team activities that comprises of individuals with related job function of a project understudy (Male & Kelly, 1989; Shen & Liu, 2003). Team was engage and performs a collective work facilitated by facilitator to solve particular issue of the study. It attempts to explore client's value system of the project through wider perspective (Fong, et al., 2001). According to Syer and Connolly as cited by Foley and Macmillan (2005), team identities are built upon clear vision, having prioritised team needs and taking ownership of the problem faced. Kelly et al. (2004) and Construction Excellence (2004) characterized team as having shared commitment by all members with collective performance and complimentary skills working together to achieve team's goal.

The Construction Excellence (2004, p.4) has underlined six aspects of team working together which as follows:

i. Promotion of team identity
ii. Development of a shared vision and common goals
iii. Effective communication among team members

iv. Encouragement of collaboration and full participation
v. Facing, negotiating and resolving conflicts head-on if and when it arises
vi. Important of periodic self-reflection on the team process

The characteristics and aspects of VM as team activities are reflected in the involvement of multi-disciplinary team as member to the study. The teamwork spirit is emphasize during the workshop especially in the decision process (Dell'Isola, 1982). It involves participants from wide range of individuals that normally consist of owner (client), user, consultants, project manager, contractors, specialist and facility managers (Kirk, et al., 2002). Each individual provides specialized knowledge and skills, and each one of them understands the roles and responsibilities of fellow team members (Spatz). Belbin (1993, p.23) in his work on 'teamwork' has suggested nine (9) roles of a team member which span across different varying function such as follows:

i. ***Plant***: Creative, imaginative and having capability to solve difficult problems
ii. ***Resource investigator***: Extrovert, enthusiastic and communicative
iii. ***Coordinator***: Mature, confident and good chairperson
iv. ***Shaper***: Challenging, dynamic and having thrives on pressure
v. ***Monitor Evaluator***: sober, strategic and discerning
vi. ***Teamworker***: Cooperative, mild and perceptive
vii. ***Implementer***: Disciplined and reliable
viii. ***Completer***: Painstaking, conscientious and anxious
ix. ***Specialist***: Single-minded, self-starting and dedicated

The above list are non-exhaustive or absolute in nature, however, it gives a broad idea of an ideal team configuration. The interaction between team members in VM workshop are unique in nature where their participation and commitment are based on collaborative approach with each member offering different skills set, experience and tacit knowledge. This can only be achieved with the inclusion of a multi-disciplinary team involvement.

Multi-disciplinary team composition are found to be one of the key factors that contributed toward the success of Value Management studies (Dell'Isola, 1982; Kelly & Male, 1993; Norton & McElligott, 1995). This attributes is listed in one of VM benefit on the UK public sector project (British Standard Institution, 2000). The contributions of multidisciplinary team bring together a collective pool of experts that are dependent on project characteristics and objectives of VM study (Palmer, et al., 1996). Having a mixture of team members allow for wider perspective of solution and foster creativity to be derived from one single issue (Clark, 2009). Kirk, Turk and Hobbs (2002) in their research on decision-making in design process assert that the inputs obtained from various individuals are far explicit and better in addressing complex issues. This includes areas such as sustainability, life cycle cost, operational effectiveness, flexibility and engineering performance. Zhang and Ng (2012) claimed that large amount of valuable knowledge lies within a construction team member. They are involved in creating and applying expert knowledge towards construction process. The interaction among team members enhances each other's creativity, innovation, problem-solving, morale and job performance (Burke, 2007). In applying this notion in term of project design, Clark (2009, p.1482) claimed that contribution from various team member are recognized of having influence "*on the appearance, the behaviour, the efficiency, the serviceability and ultimately, the cost of the development".*

Taking from another perspective, Leung et al (2003, p. 3) observed that various project team backgrounds brings in distinctive psychological motives, personal values and project goals into the decision-making process. These attributes add value to the multidisciplinary team that influences the final outcome of VM study and increased team morale (Spatz, 2002). They are in the opinion that the social behavioural context of an individual is indispensable in relation to team dynamic within workshop environment (ibid 2003).

Despite the notion of engaging multi-disciplinary team brings in more diversity of experise into the project, Construction Excellence (2004) and Cooley (1994) as cited by Foley and Macmillan (2005) stressed that the amalgamation of team members does not guarantee a workable or effective team even with their complimentary skills (Burke, 2007). This in turn may result in mediocre performance that stem from disorganization. This is due to the nature that each individual approaches problems in different perspective and manner (Parker, 1998).

Daddow and Skitmore (2005) cautioned that lack of ownership of the project among workshop team could affect the effectiveness of VM studies. Apart from having multi-disciplinary team of participants as part of critical success factor, there exist another layer of dependency factors that affect team success. The dependency on having multiple representative teams does not guarantee success to the study if it fails to garner expected cohesiveness and dynamics from the team. Kelly et al. (2004) stress that team dynamic and processes in VM are affected by several factors that influenced the output of VM study. These factors include team size, membership role, team norms, goals, coherence, leadership and external environments (Kelly, et al., 2004). Bowen et al (2009) research on the South African practice of VM analysed team dynamic as part of VM effectiveness measure. They observed that leadership and definition of roles and responsibilities among workshop participant plays important factors in ensuring effective VM study. Team composition, cohesion and goal setting are also significant in their findings as contributor to the dynamic team process. Shen and Liu (2003) further suggested on several attributes of personalities that add value to team composition such as open-minded, creative, positive attitude and strong desire to be innovative.

The human factor in VM is indispensable. Their dynamic involvement attracts an array of experience to the workshop process. The outcome of the workshop is highly influenced by the way human factors are being handled and interact during the workshop. The dialogues, creative problem solving and decision-making process are part of the team process toward which VM study. The empowerment and ownership of each individual in VM study towards the project are crucial. Membership roles of VM team are able to influence behaviour, dynamic and outcome of VM study (Male & Kelly, 2004). Their ability to present and take up ideas for further implementation influence the effectiveness of the workshop (Kelly & Male, 2002).

2.11 ISSUES IN VALUE MANAGEMENT WORKSHOP

Value management workshop provides a foundation for multi-disciplinary participant to interact and discuss on possible solutions for the study. The combination of human factor and appropriate tools and techniques allows for dynamic in the interaction of problem solving and decision-making. Planning, organizing and controlling the value management workshop enable smooth running of the workshop. However, despite numbers of publications and guidelines on the conduct of value management, there are rooms for improvement of the workshop organization. The following sub-section will be reviewing literatures and issues faced in value management workshop as well as their challenges.

2.11.1 Pre-workshop Planning

Although much has been suggested by literature on the list of activities for pre-workshop, there are limited information on the timing of such preparation should take place before the workshop. Kelly et al. (2004) suggested that facilitator should compile and distribute all information pertaining to the workshop ahead of the workshop phase. This will allow for workshop participant to make necessary preparation from the distributed information. However, the duration and period as to when this should be done are not mentioned in their finding. Although the timing of such information distribution is subjective matters that depend on each project, some sort of practical guidance should have existed to assist future workshop organizer. The absence of such information leaves the decision to distribute the information in the hand of the facilitator to decide on the timing.

Secondly, the selection and appointment of workshop participant is important during this phase of a workshop. The appointments were made on the basis value management study approach (i.e. VM 1- VM5) as discussed in Section 2.6 where either internal or external project team is selected for the study. The involvement of either internal or external team to the workshop does have an impact to the dynamic of the workshop team performance.

2.11.2 Workshop Tools and Techniques

Ellis et al.(2003) in their research of leading cost consultants in the UK found that seventy per cent of facilitator use some form of function hierarchy (i.e. FAST Diagram, SMART techniques functional hierarchies) to assist with decision-making. However, they further found that FAST diagram is considered as difficult tools to use by the workshop participant during the course of their study. They assert that the techniques applied in value management study need to make sense to participants and also assist them in making comfortable with the analysis (Ellis, et al., 2003).

The difficulty in understanding FAST diagram as observed by Ellis et al. (2005) only stem from participants' inability to make sense of the techniques used. According to SAVE International, the degree of FAST validity directly dependent on the capacities of the workshop participants. Consensus is the most important output in multi-disciplinary workshop participants using the FAST analysis (SAVE International n.d).

Similar observation is made in the Australian construction industry where lack of FA application in the VM process (Spaulding, et al., 2005). They further contend that FA is misused or avoided due to lack of knowledge by either the participant or facilitator (Fowler 1997, p.92; Fong 1998, p.7; Shen 1997, p.261; Green and Popper 1990: iii, ix; McGeorge and Palmer 1997, p.4; Clark 2000, p.7; Fong and Ashworth 1997, p.7; Angelo 2002, p.71; Barton, 1991: 138; Neasbey et al, 1999, p. 232; Mansour, 1999; Gough 2000, p.1) as cited in (Spaulding, et al., 2005).

2.11.3 Workshop Timing

There are raising concerns on the duration of value management study duration. Male et al. (1998) and Kelly et al. (2004) found that one of approach in the US practice of value management is the 40-hour workshop where external and independent team is invited as participant to the workshop. The 40-hour spread across five workshop days where each stages/phase of workshop is carried out in single day. Pickles (1999) through Value Engineering, Analysis and Management

Academic Community (VEAMAC) debate observed that workshop participants did not feel that five days workshop was practicable. This is due to the concern on the conducive working environment and continuous high intensity of discussion during the course of workshop. Similarly, Ellis et al. (2005) observed that there is a trend in reducing the duration of the workshop among cost consultant in the UK. They found that half or 1 day session are the norms, while anything more than that is a little too long. While this finding are limited to the cost consultant in the UK in particular East Midlands, the result indicates the need for a shorter time to be spent in value management workshop (Hogg 1999 as cited by Green and Liu 2005).

In contrast, Hunter and Kelly (2007) found in studies on value management workshop in the US and UK that their respondent spent an average between three to five days for a workshop in achieving client's objectives. Nevertheless, they observed that although such duration is possible to yield results for the client, there are respondents who feels that committing for a three day workshop is just '*not compatible with the demands on senior management*'. The response may not be significant enough to conclude that longer workshop time leads to successful objective attainment, but suffice to consider on the limit in how much time each individual can commit participating in a workshop.

Thiry (2001) in his study found that problem exist in the conduct of workshop where client demand for shorter and more focuses value management study, in contrast, the complexity of situations under study make it harder to press for shorter workshop duration. Ellis et al. (2005) further add that shorter workshop will keep the cost down as client is concern on the number of workshop participant and time spent. Citing finding from one of their interviews, the respondent state that "*it's a horror of having 16 people sitting round the table – this is costing me money!*" (Ellis et al., 2005 p. 489).

Kelly and Male (2001) in responding to the pressure for shorter workshop duration state that "*the pressure….has led to research into techniques which are more efficient in seeking value goals at key stages in the process"* as cited by Hunter and Kelly (2007, p.5). Hunter and Kelly (2007) in their study on effectiveness of shorted value management workshop found a disparity between the need for shorter workshop duration against the need of achieving workshop objectives. One of their respondent were cited saying that " *having time is crucial to the success of the process, so I would definitely not advocate one-day workshop except when the subject is very well defined"* Hunter and Kelly (2007, p.6). On the other hand, different respondent react different by saying that one day workshop is good enough achieve significant benefits and view that getting more time will it impossible to retain the right people together.

This problem has become a dilemma for practitioner to implement value management. The competing needs between the duration of workshop in keeping the cost down and allow senior management involvement against achieving workshop objectives demands for better improvement in the current workshop organization. While Kelly and Male (2001) suggest for research to improvise current technique to save time, Ellis et al. (2005) offered different perspective solve the issues through effective planning. Ellis et al. (2005) suggested that should function analysis is conducted between the facilitator and the client during pre-workshop, time could be save when the phase move into workshop where participants are only required to provide their ideas generation and evaluation rather than thinking about solving the function analysis of the project. This suggestion stem from Ellis et al. (2005) findings that most respondent find it difficult to understand the tools use during the workshop that lead to time spent in making sense out of the process.

There are two sides of views looking into the workshop duration issue based on literature reviewed. The client's side are keen in getting the best value out their investment for value management study but press for shorter time to save cost and other related commercial pressure, while on the hand, practitioners in value management feels that more time need to be spent in getting the best value and function out of the study matter.

This problem continuously demands for improvement in the current workshop organization, be it on the tools and techniques as suggested by Kelly and Male (2001) or the planning part of the workshop (Ellis et al. 2005). However, there is no strong correlation reported on the link between times spent on workshop against the outcome achieved at the end of the study.

2.11.4 Workshop Performance

Kelly and Male (1993) observed that success of majority of VM studies in the United States are measured on the percentage saving the study achieved. This observation is echoed by Lin and Shen (2007) and Chen, Chang and Huang (2010) studies where they found that performance of VM studies and workshop are often being measured by the savings generated and functions enhanced as a result from the study. They are in the opinion that the amount of saving itself is insufficient to judge the overall performance of VM workshop. The conduct of the workshop itself is critical and it includes attributes such as team origination, VM methodology implementation, facilitators and participants (Chen, et al., 2010; Palmer, et al., 1996). Palmer et al. (1996) further argues that the degree of success goes deeper and were also influenced by participants personalities, facilitator competencies, study timing, information, clients and interaction during the study. The assessment of components and attributes of VM workshop itself are critical in providing appropriate guide for VM success.

A study conducted by Shen and Chung (2000) has listed and rank 15 difficulties faced by VM workshop participants during study process. Out of 15, there are 5 most frequently encountered problems faced such as difficulty in information collection, difficulty to analyse suggestion made by others, difficulty to proceed with evaluation process, poor participation and difficulty to share or disseminate information in briefings. Lack of information was ranked the most frequently encountered problem during the workshop where limited time given to prepare for the workshop was the root cause of this issue. Although this findings were made in the context of Hong Kong construction industry, the nature of the issues faced are applicable toward general VM approach which is similar regardless of different terminology, team and techniques (Hunter & Kelly, 2007a). Although their suggestion in minimising these issues were the application of IT tools during the workshop, their findings also indicate on the need for more attention to be given on human aspect of VM studies.

On the other hand, in term of workshop organisation itself, Hunter and Kelly (2007) found that there is increasing pressure from clients that demands for shorter VM workshop. This issue was initially highlighted by Thiry (2001) on the dilemma faced in VM where the client demand for more focussed VM study while on the other hand the complexity of the issue being assess continually increased. A comparative study between the UK and US on duration spent on workshop found a large disparity whereby the US spent on average between three to five days while the UK only one day (Hunter & Kelly, 2007a). The disparities on the time spent were due to the conduct of the workshop itself whereby the in UK team working together to solve issues while in the US, a separate working condition is practiced.

The acknowledgement of different working culture and approach taken in organizing VM study, the pressure for shorter version of VM study has increases researches on more effective workshop conduct to reduce time (Hunter & Kelly, 2007a; Lenzer, 2001; Thiry, 2001). However, the aforementioned pressure on time comes from the client sides while the different view was observed from the participant side. Shen and Chung (2000) reported that their study participants often complained that they do not have sufficient time and information to analyze problems and make decisions. The limited time provided by the organiser to even prepare information packing for briefings often affect the entire workshop process that end up decision being made without thorough consideration. Again this issue has been raised by Thiry (2001) who argued on the 'lack of sense making time' in the workshop that will trigger participant to existing paradigm. He further contends that allowing for sense making time in workshop allows for broader paradigm of thinking that lead to collaboration between participants, thus making the outcome of the workshop more prevalent.

The VM workshop performance measure as studied by various researchers (Chen, et al., 2010; Fong, et al., 2001; Lin & Shen, 2007; Male, et al., 1998; Shen, Lin, Kelly, & Sun, 2006; Shen & Liu, 2003) has explored various attributes and frameworks to assist in achieving success in conducting VM study. Throughout the process, it is observed that human factors and time dimension of a VM workshop are highly regarded as key issues that require continuous improvement. Although numerous effort and comparison with sufficient recommendation made in term of optimising workshop time, the human factor also demand special attention as it is part of the main driving force of VM study. Thus, the following sub-section will explore the human factor dilemma faced in VM study.

2.11.5 Team Performance and Participation

A study conducted by Leung and Wong (2000) found that effective participation throughout the process of VM is an essential characteristics. They further contend that VM participants are influenced by both internal and external factors in making decision for the study outcome. The concept of 'participation' in VM as introduced by Leung et al. (2003) emphasises critical attention on the human factor with VM workshop environment. It involves the notions of "involvement", equalization of influence and power sharing among participants throughout the workshop process (Heller and Yurk 1969; French et al. 1960). High degree of correlation between participation and decision-making in the VM process are observed in Leung et al. (2003) study in the Hong Kong construction industry. The participation level of VM workshop participants as described in their study demonstrated behavioural attributes of participants does affect the decision-making process and overall organisational behaviour outcome. In relation to behavioural attributes, Shen, Chung and Shen (2004) in his study found that there is lack of participation and interaction among participants in VM workshop in Hong Kong. He observed that pressure to confirm, dominations of individuals, poor team spirit and shyness are among the contributing factors.

Despite attention made on the participation during VM workshop, the findings itself are confining within the behavioural context of the workshop participants that mainly consist of attributes such as job satisfaction, job commitment, team cohesiveness, decision quality and conflict resolution. Little attention has been made on factors that influence the behaviour of each participant has while participating in VM workshop.

In term of workshop participant itself, Shen and Liu (2003) found that "professional experience and knowledge of the participants" are recognized as one of important CSF for VM study. They further stressed the absence of adequate professional experience or knowledge will hamper the effort to ensure smooth running of VM process. This issue is proven by Ellis et al. (2005) who found that VM workshops participants having trouble understanding FAST diagram and making sense out of it during the workshop. The knowledge and experience are important factors. Their credential increases the credibility of the VM proposal they made as result of the creative and decision-making process. The same is reflected in Daddow and Skitmore (2005) results of their study on VM practice in Australia, where the quality of output produces during VM study are affected by team that placed insufficient experience graduates on a decision making experience.

Shen and Liu (2003) imply that it is not mandatory for all VM team members to posses' good knowledge and experience in VM but possession of such attributes add credential to the entire VM process. They further suggested measure to minimise the issue by conducting special induction course to workshop participants prior to the actual workshop. Findings and suggestion made by Shen and Liu (2003) are confining within the Hong Kong's practice of VM. However, relatively similar issue is being observed in the Malaysian construction industry where lack of VM knowledge and practice were still the main problems faced during the VM workshop (Jaapar, 2008).

2.12 VM IN DESIGN PROCESS

The application of VM may be used at any stage of project development, however, the application at the earliest stage of a construction project offers the most benefits (Barton, 1991) and greater potential for cost reduction (Male & Kelly, 1989). This is due to the fact that opportunities for making changes reduce as the project progresses, and the cost of making such changes increases (Potts, 2008).

Green (1994) advocates that structured process in VM is a dialogue and debate among team of designers and decision makers during an intense short-term conference. Ashworth (2004) claims that the main purpose of VM is to reduce unnecessary costs as projects can be designed and constructed in many different ways and each different design attracts particular costs. Where two different design satisfy the main client requirements, then the difference between the costs of these designs can be described as an unnecessary cost. However, Kelly and Male (1991) argued that the total economic management of projects involves considering both cost and value. Eliminating unnecessary cost alone does not contribute to the entire goal of VM that is the achievement of better value for money.

Within the context of early design, VM is perceived primarily as an aid to the briefing process rather than a technique for cost reduction (Kelly, et al., 2004). Green (1994) stresses that VM makes no pretence in finding optimal answers; however it concerned with establishing a common decision framework around which the design team can think and communicate. Constructing a shared perceived reality is the key-driving factor in VM which is oriented through a team-based approach in designing (Green & Liu, 2007).

In solving design problems, Green (1994) advances the idea of 'hard' versus 'soft' systems thinking, where the former is predominantly concerned with the identification of optimum solutions to known technical problems, whilst the latter is concerned with determining multi-perspective human problem situations.

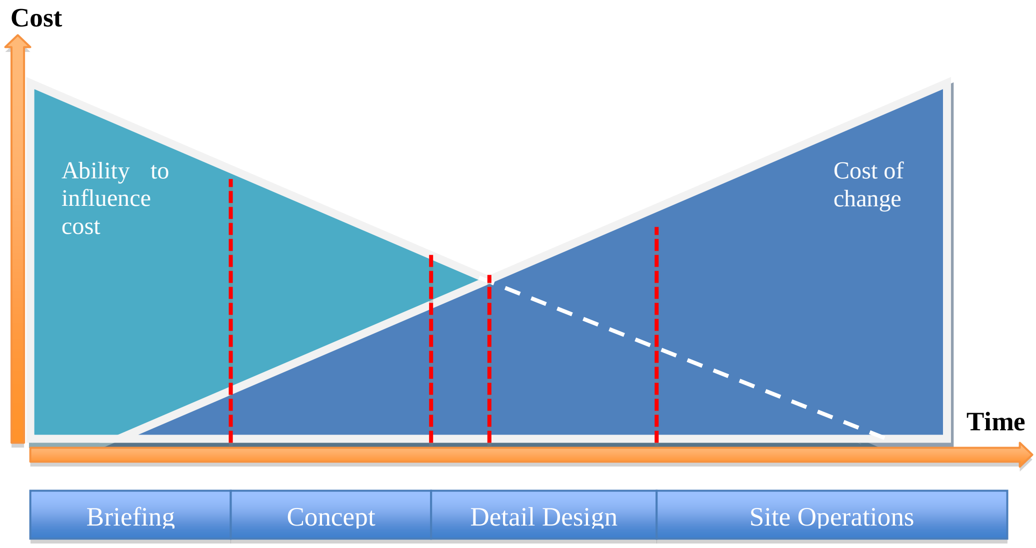

Figure 4 VM potential to influence cost (Neasby, Barton and Knott 1999)

Combination of both types of systems thinking is crucial in delivering a building which serves not only the client requirements but also those of the end–user. Although it may be argued that one type of systems thinking is more important than the other (Ellis, et al., 2005), the underlying principle at stake lies in defining what the actual project function is to be by the end of the day. Therefore, VM is used to develop a shared understanding of the design problem, to specify the design objectives and to integrate a team consensus about comparative approaches and alternative courses of action based on the problem identification (Leung, 1998; Green, 1994; Liu and Leung 2002).

The inclusion of multi-disciplinary teams in VM studies provides a strong foundation for clearly defining design issues that address or involve construction cost optimization. It ensures that the decisions made are balanced, explicit and accountable. Leung (2003) suggested that participation of all team members is an important element of VM in terms of assisting experts in getting the best value for the project. The spirit of ownership is fundamental in this research, which forwards the idea of greater multi-disciplinary involvement during the design stage of a project. The role of the multi-disciplinary team is perceived to contribute greater opportunities for design improvement through transfer of shared knowledge of construction technology during the design stage of a project. This idea further extends the work of Green (1997b) and Fan and Shen (2010) on the use of group-decision support systems in VM which examine multi-disciplinary team.

2.13 VM IN MALAYSIA

Realizing the unprecedented benefits of VM, it was introduced into the Malaysian construction industry in 1986 within the private sector (Jaapar and Torrence, 2008). The application of VM transcends across various sectors in the Malaysian economy with majority being in the construction sector. However, the application has not been widely practised in Malaysia as observed by Jaapar, Endut, Bahri and Takim (2009). Despite the introduction of VM in the early 1980's, the momentum of its application was slow within both on private and public sectors. Minimal formal training and practice of VM methodology within working Environments are among observed factors that have contributed to slow acceptance within the industry (Jaapar et al. 2009). The level of awareness and appreciation of VM as an essential toolset for better value for construction projects during the 80's and 90's may have also been due to the lack of a formal body to govern and promote the application of VM rigorously in the Malaysian market. Through government encouragement, the Institute of Value Management Malaysia (IVMM) was established in 2000 with the aim to promote VM within the Malaysian economic sector and create awareness of its potential benefits among construction industry professionals in particular. After nine years of concerted effort to establish VM within the Malaysian sector, the government through its Economic Planning Unit (Office of the Deputy Assistant Secretary of Defense for Systems Engineering) introduced a "Value Management

Guideline Circular 3/2009" to be applied to the public sector projects and programme. This circular makes it mandatory for all Government contracts exceeding RM50 million of budgeted cost to apply VM as a measure to increase value for such contracts (Economic Planning Unit Malaysia, 2009). This mandatory requirement for VM to be utilized by the construction industry set a new benchmark for other Malaysian industry sectors to follow after numerous successful VM studies were conducted demonstrating value added potentials in construction projects.

2.14 SUMMARY

The evolution of Value Management from its inception in early the 1940's has matured and developed overtime. Although various terminology has been introduced throughout the years and continents, the essence of VM remain the same that is to provide best value for money through collective team efforts and structured process. The approach of Job Plan and workshop phases in VM introduces opportunity for increasing creativity and better decision-making process, which in turn improve team working together for the project understudy.

Throughout the literature reviewed under this topic, it is observed that the aspects of VM organisation are divided into two broad components that are people and system. Various authors and organisation have researched both components extensively; however it is observed that there are still room for improvement from issues identified. Taking into consideration Pasquire and Maruo (2001) observation on VM practice across UK, US and Japan, the system in place are the same but the culture, experience and way of thinking that make VM different. Therefore, the improvements in VM are seen as continuous pursuit in trying to 'localise' the application to suit one particular organisation. The application of VM in construction project design that involved people will be further explored in the next Chapter of this thesis on construction design process.

Chapter 3: Literature Review (Part 2)

3.1 BUILDING DESIGN PROCESS

According to (Cyon Research, 2003), design is an iterative process through which a set of requirements such as – physical, aesthetic, performance, and so on – are creatively manipulated, resulting into a design. Design can be seen as a generic activity, and it appear to be real differences between the end products created by designer in various domains.

Building design is one of range of design disciplines and according to Gray and Hughes (2001), building design is a process of human interaction and consequently , the outcomes contain the interpretations, perceptions and prejudices of the people involved. The process is a complex interaction of skills, judgment, knowledge, information, and time (Mao, Zhu, & Irtishad, 2007); aimed at satisfying the client's requirements by manipulating constraints such as statutory obligations, technical feasibility, environmental standards, site conditions and cost (Ferry, Brandon, & Ferry, 2003). It requires problem finding, and problem solving, deduction and the drawing of inferences, induction and the creation of new ideas, analysis and synthesis (Lawson, 2006). This holistic approach combines structural, material, environmental requirements and social expectations into the best possible physical solution under a particular set of circumstances.

From the perspective of a new project, the designer's preliminary work can be based on very limited information that may be sufficient to justify putting forward ideas for consideration. However, it is unusual to find that the finished design materializes effortlessly, translating initial ideas into reality without any revision (Tunstall, 2007). Inevitably ideas change as possibilities are added or discounted, which affect how the outcome of the building design will be delivered (Lawson, 2006). Building design and construction are not abstract processes undertaken in individual isolation (McGeorge, 1988), they are both reliant on a collective approach to developing and managing information. The process comprises contributions from many specialists.

The time taken to incorporate the information depends on the amount, its quality and its importance to the generation of the total design.

The rapid progress through both the design and construction phase of new buildings creates pressures for project management control, arguably beyond the capability of the individual building designers (Tunstall, 2007). This scenario requires a collaborative design effort in meeting clients' objectives for their projects. According to Lawson (2006), the designer can see from the drawing how the final design will look, but unfortunately, not necessarily how it will work. Best and Valence (1999) argued that it is not feasible to expect a single person to be able to address all aspects of the design and development process. Mosey (2009) further emphasized that even the very best design consultants cannot have at their fingertips all the detailed knowledge available to the specialist contractor who can put to use their research and development departments and the operational experience of their on-site project teams. Thompson (1999) argued that designers in designing facilities often faced various constraints throughout the process of integrating various form of information and requirements.

The constraints that exist are entirely internal to the system or object being designed, or may be linked with some external factor not under designer's control. Lawson (2006) has identified four types of constraints faced by designers during the design process, which are as follows:

3.1.1 Radical Constraint

Radical constraint deals with the 'primary' purpose of the object or system being designed. For instance in the design of a hospital the radical constraints are those related to the health care system that the hospital is there to implement. It is influenced by the need to achieve a desired level of expectation and standards of certain systems in order to be fully operational. The way in which buildings are designed is informed by a complex range of personal and professional ideas and understandings (Wright, 2004) ; and a range of healthcare policies which sit alongside assumptions about what health will be like and what services will be needed in the future; such considerations can range over a tremendously wide set of issues and are generally thought to be very influential from the beginning of the design.

3.1.2 Practical Constraint

Practical constraint deals with the aspect of the total design problem. The reality of producing, making or building from a design, in other words, the constructability issue imposed by the design. The constraints are not exclusively concerned with the construction of the process being designed as they also embrace the technical performance of the building during its working life. The challenge faced by the designer is to ensure that what has been designed can be constructed and will last for a certain life span and with a certain degree of durability.

3.1.3 Formal Constraint

Formal constraint deals with the overall visual organisation of the object being designed and regulates how the designer thinks and expresses an understanding of the client's requirement with regards to the end product of the building. What seems to be aesthetically sound and function from the designer's perspective may not be what the client is expecting.

3.1.4 Symbolic Constraint

Symbolic constraint shares almost similar attributes to those of formal constraint, the only difference lies in the expressive qualities of the design to achieve specific effects. Expressive qualities in the context of symbolic refer to the end product of the design which represents a mix of organization, revolution, thinking or power.

Gray and Hughes (2001) simplified the constraints by grouping them into two broad categories; internal and external constraints. The internal constraints are built up upon the self imposed constraints by the designer in meeting the client requirements such as translating a brief into a design and incorporating various requirements. On the other hand, external constraint deals with matters beyond the control of the designers such as changes in statutory requirements, environmental factors, construction process etc. These are the boundaries within which the designer normally works, although some designers seem to be less constrained than others and their imagination allows them to make creative lateral leaps that identify new solutions (Gray & Hughes, 2001).

The constraints present a barrier to the designer in producing effective design solution. The competing needs that exist between the visual effect of design and the practical solution for construction of the project resulting from it in turn leads to a contribution from other parties in providing information or feedback to assist with the design process. The fragmentation of the design process has led to common scenarios of separation in designer's role, and between design and construction process (Lovins & Browning, 1992). The traditional method of procurement has been criticised for its separation of the design and construction process, which has hindered communication between, coordination of, and integration amongst the design and construction team (Lopez, Love, Edwards, & Davis, 2010). However, Love (2002) in his study on design errors found no significant difference between various procurement methods on either the causes or cost of errors. Lawson (2006) stressed that separating the responsibility for the design of these uncoordinated elements will inevitably lead to clashes during construction. Eley *et al.* (1995) on his observation of the traditional approach to design has identified several flaws within the process which are:

i. Functional Isolation of consultants

Lovins and Browning (1992) refer to this flaw with regard to the phenomenon of different disciplines using different measures and vocabularies to work around the design. Rounce (1998) further elaborated that the isolation of works among consultants' leads to one major cause for faulty design, i.e., individual consultants working in isolation cannot draw on the momentum that can be generated by group working, and there is little opportunity for achieving agreed decisions on optimum solutions to design problems. However, Emmit (2007) disagreed with this notion claiming that not all designers are able to participate in the process in the same way or at the same time continuously.

ii. Design Parameters Disregards the Effect of others

Berry (1995) as cited in Best (1999) states that unless the building services engineer is involved from day one, the chances of making any significant contribution to the overall design process are practically ‘zero’. Many basic parameters in design are set in advance by the designer prior to inviting other consultants and specialists to contribute their parts. This becomes a major contributing factor to the industry’s poor performance due to its fragmented nature, which in turn has resulted in a lack of coordination and integration between the different disciplines involved in various stages of the project procurement (Anumba & Evbuomwan, 1997; Love, Skitmore, & Earl, 1998). In addition, Stukhart (1987) found that in some operations, design details are not complete or need to be amplified during construction, either to assist the performance of contract or to amend specifications via the change process.

iii. Lack of communication and coordination between consultants

The ease and efficiency of communication between key personnel will influence the quality of the design and the effectiveness of the project. The inability to coordinate design information can lead directly to increased construction costs, unnecessary changes to the design, rework and programme overruns Emmit (2007). Gambatese and McManus (1999) in evaluating delay in construction projects made a significant finding which was that ineffective coordination during the design phase leads to delay during the construction phase. Emmit (2007) found that 40 per cent of building defects can be traced back to decisions made at the conceptual and detailed design phase of the project. The decisions made during those stages are affected by poor coordination of work packages and inadequate communication between project participants.

iv. Lack of client and user involvement in the design process

Wright (2004) observed that the design for a school building, which was supposed to challenge the existing concept for a high quality, effective school for the future came from a design brief written only by the designers. She (ibid 2004) argued that school design should develop out of a process of engagement between the educational community (including pupils, parents, and local residents), designers and those who will build the school. Not obtaining full stakeholder input during the design of the project diverts the real intention of the designed facility for the future. Good interaction between the clients and designers in translating the brief into a design can contribute to a more sustainable construction and respond to the recent challenges of improving the industry's performance (Egan, 1998) as cited in (Dimitrijevic, 2004).

3.2 INCONSISTENCIES BETWEEN DESIGN AND CONSTRUCTION

The findings of Eley *et al.* (1995) also offer a review of the consequences resulting from flaws in the design process due to its fragmented nature although this review is not exhaustive. However, research conducted by Manzoor, Pheng and Assaf (2006) has further identified several causes of inconsistencies between design and construction which are affected by the fragmented nature of the design process [Refer **Appendix A**].

The results from this study (Manzoor et al., 2006) suggest that the late involvement of contractors in design development, the communication gap between constructor and designer, insufficient working drawing details, lack of coordination between parties, lack of human resources in design firm, lack of designer's knowledge of available materials and equipment, and incomplete plans and specifications were considered as the most important causes of the project design and construction interface inconsistencies. However, the findings did not produce any justification that the involvement of contractors in design does affect design and construction. Findings made by Manzoor et al. (2006) does raise a concern on the need to study the integration of multi-disciplinary teams into the design process to address such issues. The designer may see the inconsistencies from the coordination and communication viewpoint while the contractor may see them from the perspective of the practicality of the design to be built. A case study conducted by Panciuk (2008) reported that the risk of cost construction will be high if the following activities are not properly highlighted during the early design stage of a project:

a. Did not advise on the completeness of the drawings

b. Did not guarantee prices

c. Did not participate in the use of a contingency fund

Andi and Minato (2003) offer another perspective on these issues by looking at the deficiencies derived from the design document; they opined that the early decision forum among key project participants would yield a better ‘value-for-money’ construction project. Their work specifically examined the impact of design document quality on the construction process and they posit that the result of these quality deficiencies has contributed towards several poor performance attributes of projects such as rework, cost overrun, time delays, change orders, accident, disputes and profit fluctuation. In addition Tilley, Wyatt and Mohamed (1997) further found that increases in requests for information (RFI), coordination and scheduling problems add to the list of effects attributable to design document deficiencies.

Andi and Minato (2003) reported that 25 per cent of the design defects contribute towards cost overruns in construction projects while 40 per cent of leads to design changes. Both indicated an alarming figure, which is deeply rooted in defective design faults. Defective design does not exclusively result from the lack of skills and ability of the designer to perform, however, it should be viewed in a more broad perspective which includes availability of information, human resources, time limitation and contribution by construction experts etc (Best & Valence, 1999).

3.3 CONSTRUCTION DOCUMENTS QUALITY

Often, the quality of design documentation produced by consultants is deemed to be inadequate for its intended purpose considering the proclivity for errors to arise (Love et al. 2008; Tilley et al. 1997 as cited in Lopez *et al.*, 2010). Fox *et al.* (2001) as cited in Lopez et al. (Lopez, et al., 2010) have revealed that often information contained within design documentation is contradictory and subsequently requires changes to be made. Design documentation quality is of major concern to contractors who rely on the information provided to them (Love *et al*. 2000) as cited in Lopez et al. (2010). A survey conducted by Nikkei Construction involving 79 Japanese contractors showed that 44 per cent experienced a significant number of design document problems (Annon, 2000) as cited in Andi and Minato (2003). The major problems identified were constructability, conflicts in structural design, inadequate temporary work designs, improper construction methods, and differing site conditions information and the common ground for these particular issues mentioned was whether or not the design could be well executed by the contractor. The issues stemmed from communication failure on part of the designer in transmitting a clear and concise design and associated information on a project to be built. Communication failure in this context is not exclusively confined to verbal and written sets of instruction/documents, but also extends towards the position, capacity, skills and knowledge of the designer in delivering quality design documents.

Failure in providing quality design documents was seen as hampering efforts to speed the construction process and increasing the risk of construction costs rising due to the need for rework because of changes made to the original design. Thirty (30) design document problems were identified by the Andin and Minato (2003) study, however, only nine were selected for this research and are those most focused on the conflict which exists between design and construction that has an impact to cost optimization. The nine design document problems are:

1. *Impractical construction methodologies and detailing*
2. *Design not adaptable or incompatible to site conditions and restrictions*
3. *Design with lack of understanding of the project delivery process*
4. *Contractors have to rely on specification notes, where drawings actually required*
5. *Documents lacking clarity and forcing contractors to interpret requirements*
6. *Documents issued with insufficient details and dimensions*
7. *Insufficient design coordination causing clashes between services elements*
8. *Documents issued with conflicting information*
9. *Materials or products specified contrary to manufacturer's recommendation.*

Transmitting clear and concise information for construction is crucial to ensuring smooth process flow. The design documents problems highlighted previously indicate a communication breakdown between the designer, on-site construction personnel and contractors in achieving mutual understanding of the project needs. For instance, impractical construction methodologies and detailing appear to indicate that the design was produced without having adequate knowledge of construction operations which leave the contractor to try and resolve the practicalities of building from designs that are difficult or even impossible to construct on site. This is supported by findings from Andi and Minato (2003) in which designers surveyed acknowledged that ‘lack of construction knowledge’ had been a major problem for them leading to production of impractical designs. On the other hand, lack of design coordination also has an influence on the problem where there is a need for bridging of the gap between the designer and contractor.

Coordinating the collection, processing, storage and transmission of information is essential in minimising defective design. Taken this initiative, clients need to consider the opportunities for both the designer and contractor to learn from each other. Close coordination between designer and contactors during design stage needs to be increased (Andi & Minato, 2003). The integration of both parties concerning the resolving of design issues will assist greatly in promoting a positive prospect in terms of cost optimization, enhanced quality and increased construction speed.

Best (1999) suggested the establishment of a multi-disciplinary team at the earliest possible stage of the design and development process as one of the beneficial options for addressing constraints faced in design. As a consequence, when all facets of building design are addressed in an integrated environment, the solutions to questions from any connected individual can be optimized as part of the whole design, rather than being made in isolation and without reference to the impact of such decisions on the rest of the design. Lenard (1997) suggested that the idea generation in construction relies on teamwork and a multi-disciplinary approach. This is supported by the findings of Hollowman and Hendrick (1971) who observed that group interaction contributes to an increase in the adequacy and accuracy of decision-making. An open approach to problem-solving with more participants' input encourages innovation in design and allows input from a wider range of sources on questions concerning aspects such as new materials, components, and techniques.

3.4 EXPANSIVE LEARNING IN DESIGN

In the theory of expansive learning according to Engeström's (2002) as cited in Iordanova *et al.* (2010) "*...joint design activity is characterised by a community of multiple points of view, traditions and interests*". Understanding the design process and knowing what information is required for specific design activities is important in order to effectively utilize construction knowledge in design (Pulaski & Horman, 2005). According to Song, Mohamed and Rizki (2009) information that can be articulated in written form, such as guidelines and rules, is referred to *explicit knowledge* while knowledge that exists only in the experience of the experts e.g., (technical skills, intuitions, and insights) is referred to as *tacit knowledge.* According to Nonaka and Takeuchi (1995) as cited in Pulaski and Horman (2005), a research in the field of knowledge management found that approximately 80 per cent of what individuals knows is in the form of tacit knowledge.

Polanyi (1962) as cited in Lam (2000) argues that a large part of human knowledge is tacit and this is further confirmed by Hanlon and Sanvido as cited in Song et al. (2009) that 83 per cent of construction knowledge is not written down in any form, but lies in the experience of the experts themselves. Lam (2000) further stresses that the transfer of tacit knowledge requires close interaction and the building up have shared understanding and trust among project teams.

3.5 SUMMARY

Building design process in a nutshell is not a simple process that works on the isolation of designer. It expands towards collaborative working environment that demand active interaction between project team to increase value and practicality of the design. The constraints faced in the design process revealed a concern on the existing nature of construction design from designers' point of view. It leads to possible inconsistencies between design documents and actual construction on-site if not tackle at the beginning of the process. The concept of expansive learning and collaborative working in design are seen to have potential benefit to existing Value Management application. The application of VM involves creative, problem solving and decision making process that involves multi-disciplinary team. Similar traits are observed in these two concepts. However, the infusion of both concepts into VM workshop practice is yet to be explored in this research.

The positions of both concepts are expected to bring in new perspective on VM application in design. Therefore, the method of exploration of these combinations will be further discussed in the next Chapter of this thesis.

Chapter 4: Research Design

4.1 INTRODUCTION

The understanding of how people view an object or event and the meaning that they attribute to is what is important (Rubin & Rubin, 2005). Such understanding of social context lies within the interpretivist/constructivist philosophy. According to Rubin and Rubin (2005), constructivists expect people to examine actions through different philosophical lenses and come to somewhat different conclusions about meanings rather than just accepting them literally. Furthermore, both authors assert that, constructionists often pay attention to the shared meaning held by groups of individuals in common organisational settings such as the workplace. This paradigm is appropriate as a perspective in this research in that the researcher is attempting to understand the shared reality of participants in VM workshop.

The application of VM in reviewing the design of a project involves a combination of people, processes and documentation. The integration of all three of these attributes contributes greatly towards the VM workshop outcomes that will subsequently assist the construction on-site. Therefore, this research is designed to accommodate and analyse all three components that make a VM workshop effective in reviewing design.

In this research, a multiple case studies are the main method being used to explore the research problems and address research questions. An on-going construction project of an international airport in Malaysia with multiple contract packages is selected as cases for this research purposes. The aim of using case studies methodology for this stage of the research is to expand the propositions of VM as a structured approach to decision-making and multidisciplinary team effort as being highly beneficial in construction projects. The focus of the case study is on projects that have experienced VM workshops in their pass projects. This allows for researcher to investigate the conduct and practice of VM workshop through accessing information associated with the VM workshops. Details discussion on case study design is presented in Chapter 5: Case Study Design.

Three methods are used to access and collect data on the planning and implementation of the VM workshop. The three methods comprise of document analysis, a survey and semi-structured interviews. The data collection phase starts with document analysis followed by survey and ends with a series of semi-structured interviews. Methods are designed and arranged in a continuous flow to ensure that all information is obtained in a logical manner for further analysis and framework building.

The following section will discuss the research plan and measures used in this research in detail, and the plan is designed to obtain all necessary information to answer the research questions and achieve the study objectives.

4.2 RESEARCH PLAN

This research focuses on three essential attributes to be applied to the application of VM when used for reviewing project designs that can be used to improve subsequent construction processes on-site. The investigation in this research encompasses all activities of the VM workshop starting from initiating a workshop until reporting the outcome for construction site implementation. The three attributes examined consist of people, processes and documentation and are chosen because each directly affects how VM workshop is being conducted and the success of the workshop outcomes and subsequent construction project execution.

People attributes in a VM workshop affects how participants contribute and react towards discussion of a design's development. Contribution in this instance refers to the willingness of participants to engage with, and participate in the discussion, their cooperation throughout the workshop process and the factors that influence their degree of contribution. On the other hand, this research also tries to understand participant's reaction towards certain issues faced in a VM workshop.

Processes attributes generally dictate how the VM workshop will be structured, organized and managed towards a goal of reaping the full benefits from the collaborative intellectual and technical contribution of all workshop participants. The aim of studying these attributes is to investigate existing VM workshop processes and whether they are designed to capably handle design development discussion or further improvement to existing process is required.

Documentation attributes establish the need for a VM workshop, required documentations and documentation of outputs. It provides a comprehensive understanding of the aims of workshop and how the end result is reported for use in improving the follow-on construction process on-site.

This research is designed to capture and address all three attributes in four stages as follows:

Pilot Study Phase

Stage 1 : Pilot Study on general VM Workshop

Case study Phase

Stage 2 : Document Review

Stage 3 : Survey

Stage 4 : Semi-structured interview

The details of these four research phases are as follows:

The document review stage aims to collect and analyse all documents and written artefacts that govern the planning and conduct of VM workshop from the selected case studies. The purpose of this stage is to focus on documentation attributes that are the foundation of a more comprehensive understanding of VM and VM workshop practices that need to be established before embarking to the next stage of the research. Documents such as VM reports, policies governing the application of VM, circulars, drawings and Bills of Quantities are reviewed in this process. These documents will be used to form an understanding, as well as to validate and augment evidence from actual VM workshops conducted (Yin, 2009). A detailed list of documents considered will be discussed further in this chapter.

One of the factors examined in the document review is an extracted list of participants for VM workshop of the case study. The name lists are extracted from the several VM report produced by the end of VM and is used to identify and select potential respondents from for the subsequent stages of this research (i.e., the survey and interview). The second stage of this research focus on distributing a survey questionnaire to all VM workshop participants within the selected cases under study. The survey aims to capture respondents' perceptions and general information on the conduct of any VM workshop they have experienced from the selected case studies. Information drawn from the survey analysis will be used to assist in developing interview questions to explore in greater depth the existing and preferred scenarios for reviewing project designs through the use of VM workshops.

The document review information and results from survey analysis are inter-connected to create a chain of understanding on how design development progresses in the VM workshop. The third stage of this research aims to explore the latter in further detail through interviewing selected respondents from the survey to obtain further in-depth details on their experience as VM workshop participants from the selected case studies and collecting and analysing their perceptions on VM workshops and triangulating and validating the findings from the previous stages of the research stage (i.e. document review and survey).

Data collected from each stage of this research are analysed in accordance with the most appropriate analytical methodology to suit each approach. The analyses adopt two major analysis techniques – pattern-matching and explanation-building (Yin, 2009). Results from each individual data analysis from each stage of the research are combined to support, triangulate and validate the overall analysis results. The document review data from all selected cases are analysed using a content analysis method in establishing a valid and practised structure demonstrating VM workshop conduct, while a descriptive statistical analysis and statistical software are used to analyse the survey results in order to configure sets of attributes as a solid basis to generate interview questions. Interview data is analysed using qualitative analysis techniques and software to identify any patterns and attributes present corresponding to those proposed in the research objectives.

Outcomes from both the pattern-matching and explanation-building techniques are used to develop a framework to be used by construction practitioner for improving the existing practices of planning, organising and implementing VM workshops in the design development stage of a construction project. The framework is expected to set a new standard for the conduct of VM workshops with a specific focus on tackling many of the issues facing participants and clients in reviewing designs of projects.

This section summarizes the philosophy of the research and the overall structure and rationale of the research plan. A summary of all processes is illustrated in **Figure 5** that provides an overview of the entire research process of this study. The following section of this chapter will discuss into details each component of the processes.

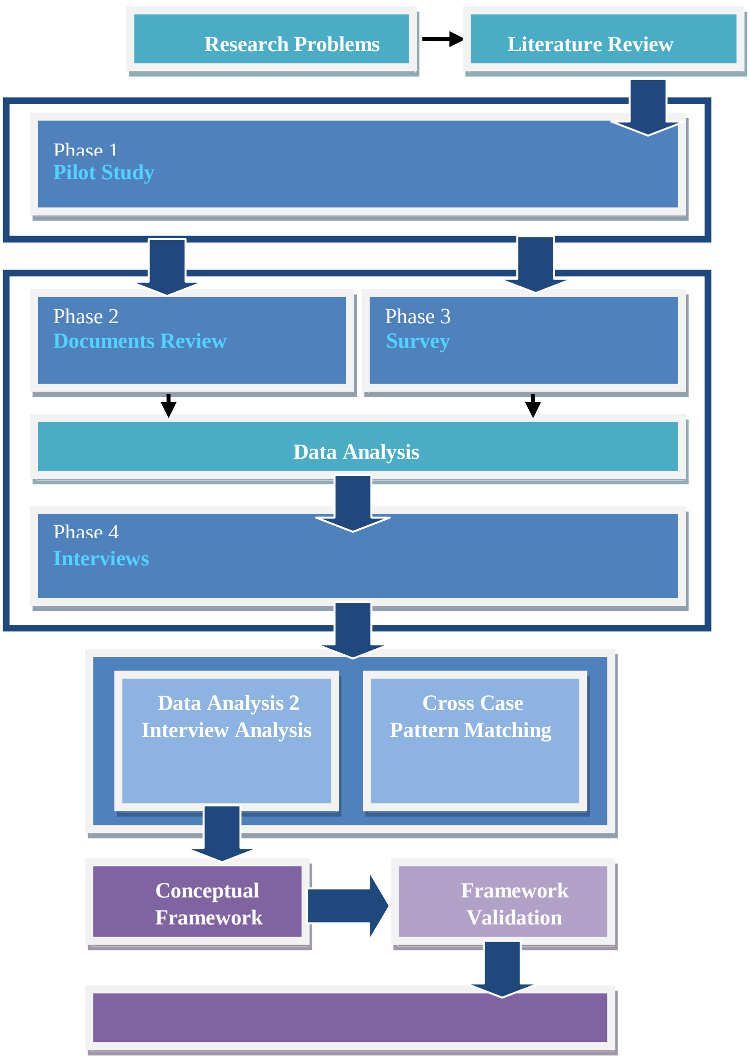

Figure 5 Research Process

4.3 SELECTION OF RESEARCH METHODS

The selection of research methods corresponds with the three attributes considered by the study that focus on people, processes and documentation during the overall application of a VM workshop in the design stage of a project. Yin (2009) has identified six sources for evidence collection in the case study. The sources include documentation, archival records, interviews, direct observation, participant-observation and physical artefacts. Each of these sources has its own advantages depending on the defined case criteria. The strength in case study data collection is the opportunity to use many different sources of evidence (Yin, 2009). In this research case study, three sources to organise and collect data in achieving the research objectives are selected. The methods selected are document reviews, survey and interviews. The remaining three sources are not included in this research due to feasibility of executing the approaches. There are no physical artefacts required to support answering research questions while direct observation and participant-observation are only applicable for study that require on-going investigation on the conduct of VM. This research only focuses on project with past VM experience.

4.3.1 Document Review

The documentation attributes of a VM workshop refer to the written documents that guides, governs and influence the conduct of VM workshop in construction project. According to Yin (2009), documents are used to corroborate and augment evidence from other sources. The main reason for the selection of document review as a method for the first stage of this research is to establish a more comprehensive understanding of the application of the VM workshop within the selected cases.

4.3.1.1 Types of Documents

The early planning stage of this research considers various selected types of documents that are reviewed and subsequently analysed. The VM workshop documents reviewed are as follows:

Value Management Report

The VM report is a document that reports on the chain of events that occur, key recommendations that are made directly resulting from the VM workshop and also proposes the next course of action based on such recommendations. This report is prepared by the VM Facilitator at the end of the workshop and distributed to all parties of the workshop. It forms part of the variation to the contract as it contains recommendations to be presented to Client/Project owner for approval. Approval and acceptance of recommendations made in VM report will be communicated to all project parties for their necessary follow-up action. Depending on the stage of advancement of the project these actions may have different repercussions, if the project has not started, any changes proposed may affect it in terms of it's planning, while for an on-going project, the changes may be in the form of a Variation to Contract. Information that this research collects from this reports are as follows:

- *Project Background*
- *Study Objectives*
- *Discussion Issues*
- *Job Plan Activities*
- *VM Recommendations (containing the 'Action Plan')*
- *Supporting Documents*
- *List of Participants*

Project Background

This section provides a summary of details of a construction project that has undertaken a VM workshop. It contains information pertaining to the progress of the project, parties to the contract, contract value, nature, size and complexity. The information will be used to obtain an overall understanding of the nature of the project under design review.

Information on the progress or status of the project will be used to ascertain the timing for the VM workshop to be conducted within a suitable time frame. There are no limitations on timing to conduct VM workshops, be it during Pre-contract stage or

Post Contract Stage of the project. However, according to Kelly et al. (2004), the earlier the VM workshop is conducted in the project time frame, the larger the opportunity to improve the project performance in terms of cost savings and value improvement to the project. Identifying the timing of the workshop will assist researcher to ascertain on the precise type of workshop being used (i.e. Value Planning, Value Analysis or Value Engineering) in each of the selected cases and making inferences as to its selection suitability.

Information on contract value, size and complexity of the project provides a basis to assess the nature of the project. This information is then used to select appropriate cases for the research and to ensure consistency of such projects. Inconsistency on the nature of the project, such as different complexity, can indirectly influence the conduct of the VM workshop in terms of the number of participants, size and nature of the facilitation team, duration of workshop and multi-disciplinary involvement.

However, information concerning contract values of projects is not the focus of this research. The researcher will use contract value information only to obtain an estimate of the percentage of potential savings generated by the end of VM workshop in order to observe cost-saving trends. The actual contract value will remain confidential in this thesis, as it is not of relevance in this research.

Study Objectives

Study objectives are part of the information central to the VM report. These objectives underline the real need for the VM workshop to be conducted for the project. The objectives also have an influence on the focus direction of the workshop and so this information is important to the research. It is also is essential for the assessment of the achievement and results obtained from the workshop process.

Discussion Issue

In addition to the study objectives, the discussion issue in the VM report also guides the main direction of the workshop process. This information is obtained through developing a summary of the Functional Analysis results in the report that are driven from investigating the required functions and needs of the project under consideration. For instance, if the workshop objective is to study the prime decisions for building a new community park in an existing housing area, the analysis will assess all aspects of primary and secondary functions and basic needs for the park project to be built in the existing area. Such analysis may result in a decision being proposed for the park to be built, postponed, re-designed or relocated, depending on the needs of the project. From examining the discussion issues, an understanding can be gained of why a particular direction was taken in the workshop to solve certain issues and also to ascertain the consistency of workshop process.

Workshop Agenda

The agenda provides vital information on the duration and outline issues to be covered in the VM workshop. It indicates duration taken for each of workshop phases (Job Plan), the date of the workshop, venue and any activities beyond the Job Plan phases. Information on stage duration is important for this research as it indicates actual time spent for conducting the interrelated phases of the workshop. As the VM report is prepared after the completion of workshop, the time-frame reflected in the report represents actual time spent rather than time planned to be spent. This will assist the researcher to understand and make inference on the amount of time spent by workshop participants to solve certain issues gauged against the complexity of the project. The date of the workshop will indicate whether the workshop was conducted pre or post contract within the project lifecycle.

Job Plan Activities

The Job Plan of a VM workshop forms crucial information in this research as they form a precise record of the actual sequence and nature of activities and events occurring during the workshop process. It provides a primary source of information for the researcher to identify and capture an approximate real-time simulation of the workshop environment as if actually being a part of the workshop thus assisting the researcher to visualise workshop processes apart without the need for being a direct observer or participant-observer to the workshop. The sort of information collected and relevant to this study such as Problems identification, Function Analysis, Brainstorming, Evaluating Ideas through the use of weighted matrices and recommendation development activities are important components of the VM report.

As each stage of the Job Plan is unique and has its own milestones, achievement of such milestones and completion of such processes may be traced through thorough reading of the VM report. Apart from using such information to establish an overall understanding of VM workshop implementation in the case study, it will be used to create interview questions for seeking of further clarification and validation of the events that actually took place.

Such information is essential to allow comparisons to be made between real life practice and the theoretical literature on VM workshops. Making comparisons forms part of the document review analysis, however, understanding how VM workshops work within the chosen case study is the major task of this research.

Tools and techniques used

There are many and various tools and techniques available to be used in a VM workshop. The VM workshop process involves a mixture of techniques to be implemented such as, problem-identification, creative-thinking, problem-solving and decision-making in achieving the study objectives. An extraction of information from the Job Plan activities also allows the application of tools and techniques use during the workshop to be ascertained. This information will assist the researcher to identify sets of procedures and methods undertaken by workshop participants in solving particular issues in the workshop. The suitability of the tools and techniques used in this workshop will be assessed from the perspectives of the participants and workshop facilitators and compared against the literature reviewed.

Value Management Recommendation

The ultimate aim of VM workshop is to produce solutions and recommendations for approval and subsequent action by the Client/Project Owner and other stakeholders of the project. VM recommendations are not always the final solution to the project issues and subsequent studies, or at least discussion amongst client and stakeholders may be necessary. There are instances where client's representatives were present in the workshop and therefore recommendations emanating from the VM workshop are considered as being conclusive for immediate action. The final VM report prepared will consist of recommendation(s) for (a) particular issue(s) of the study and also will contain the proposed action plan. This information is important in assessing consistency between the objectives of the VM workshop, the processes followed and techniques applied against the recommendations made.

Supporting Documentation

In assisting workshop participants to make their decisions, the workshop requires some additional information to guide and assist participants with their consideration of issues of the agenda. Supporting documentation and information for the workshop can be in a variety of forms such as drawings, contract documents, cost estimates, sketches and diagrams, financial reports and many more. There no fixed requirements for the type and amount of supporting documentation to be used in VM workshop and ultimately the decision lies with the facilitator, the participants and workshop organiser to determine.

As this research is focusing on design development within the VM workshop environment, drawings, contract documents, specification, sketches and presentation slides are among important information that will be reviewed. This information will be used as evidence of the specific reference made by the workshop participants to various supplemental information to assist them to review and improve the design of the project. Input such as changes made to drawings and specifications, construction and installation methods chosen, or performance enhancement systems applied to the project will be examined and analysed against all other aspects of VM workshop implementation.

Participants List

The list of participants involved in all stages of the workshop will be drawn from the VM report and will contribute significantly to the data analysed in this research.

There two major contributions that could be generated from such information. Firstly, the list of participant indicates the level of multi-disciplinary involvement in VM workshop. Assessment of participant numbers, expertise of representatives, client involvement, builders' involvement and facilitation team used can be established from this list.

Secondly, as the list contains the names and job titles of the participants of the workshop, it provides a potential pool of respondents for engaging in the follow-up survey and interviews in the next stages of the research. However, there is a risk for the researcher in drawing research respondents from the VM workshop reports list and that is of insufficient participant information being contained in the report, which may affect the efficacy of the subsequent survey and interview process. This risk is minimised through engagement with officer from the case study provider's organisation. This engagement allow for researcher to obtain further contact information from the participants list.

The VM report provides a good starting point to understand the entire workshop process of the selected case study in that it describes the actual events that occurred during the workshop from the report writer's perspective. However, this information cannot be taken as conclusive evidence to justify fully that it represents the actual step-by-step practices and processes followed in the VM workshop. Further investigation through survey and interview will assist to validate and develop further explanations on the nature of the workshop.

Value Management Manuals & Guidelines

A reputably sourced VM Manual is a set of guidelines for the conduct of VM workshops. There are many published VM manuals or guidelines, which target specific regions, disciplines or are specific to a more local context of VM application. For instance, the Society of American Value Engineers (SAVE) has its own set of guidelines that sit within a publication known as the *Value Methodology Body of Knowledge* (2004) this provide a framework for general application of VE in the US, while at the same time the US Department of Defense (DoD) has its own publication referred to as the *Value Management Manual* (1983) that focuses on the

VE to be carried out within the DoD. The publication of VM manuals and guidelines varies across the regions and is dependant on the context of application. Therefore, this research will be reviewing VM manuals and guidelines used specifically in the Malaysian local context. Based on literature review, the Malaysian Government has a VM manual enshrined in its *Value Management Circular 3/2009* (Economic Planning Unit Malaysia, 2009) hereafter referred to as 'the VM Manual' and used for the purposes of this research.

Value Management Circular 3/2009

This document is authored by the Economic Planning Unit (Office of the Deputy Assistant Secretary of Defense for Systems Engineering) Malaysia and published by the Prime Minister Department, Government of Malaysia. It describes in details steps to be taken in conducting a VM workshop from the workshop organisation stage up to the production of the VM report. It also includes information on tools and techniques that could be used to assist in the VM workshop process. The document comes in two language formats i.e. Bahasa Malaysia and English. For the purposes of this research, the English language version will be used.

Since the document is issued by the Malaysian Government, the specific audience for this document are the Government's Ministries and Department of the public sector. Apart from the details of the VM workshop, it also outlines the requirements for all future Government projects and programmes budgeted to exceed Ringgit Malaysia 50 million (AUD 16M as at November 2013) to go through a mandatory VM study. However, the application of this document is not restricted to the public sector alone, private sector project clients/owners who wish to conduct VM workshops in their organisations also refer to this document, as the procedures of the workshop processes outlined are generic in nature.

Information from this government publication (ibid 2009) such as phases of the workshop, the preparation of workshop, forms used in recording milestones in each workshop phase, tools and techniques are the main input that will be used in this research.

Based on the literature review, only this document is being used across all Government sectors in Malaysia in conducting VM workshops. However, this research does not limit the review to this document alone and other types of VM manuals and guidelines are reviewed in addition.

Policies and Procedures

This research also includes policies and procedures of the selected case study organisation under examination. The aim of reviewing this form of document is to identify the procedures and processes practiced by the selected project/organisation when applying VM workshops. Information sought is in terms of the rationale for the original requirement to conduct a VM study and is essential in this research as it provides a central understanding of what drove the need to conduct such workshop and how the decisions made could affect the overall project design and outcomes.

No specific policies and procedures have been identified in advance at the outset of the data collection. This is because the review of specific policies and procedures needs to correspond to the selected project or organisation, therefore this document will be specified and explained in the description of the data collection process of the case study.

Drawings and Specification

Drawings and specifications used in the workshop are reviewed and examined in detail in this research, mainly to provide clear evidence on the areas of design development that took place in the VM workshops under consideration. According to Tunstall (2000), the written project specification normally defines information such as construction materials and elements while drawings will project the visual appearance of the design. He (ibid 2000) further asserts that there are two forms of communication that design associated with construction could supply; firstly on the overall appearance or forms of the design and secondly on explanation as to how design parts are arrange and constructed. Both the visual and written form of design and construction elements are essential information to this research as they help to describe the nature of the VM workshop. Information such as forms, design, sizes, complexity, systems and construction methods can be ascertained from drawings and specification to provide the degree of complexity that VM workshop faced in its consideration of the design development.

According to Tunstall (2000), there are four levels of drawings that are most often used in any construction project. Such drawings include sketch drawing, outline design drawing, schematic drawing and construction drawing. The selection of drawings for the purpose of this research corresponds to the selection of cases and progress of each case study project. No specific types of drawings haves been set in advance prior to data collection and the actual drawings reviewed will be discussed in the data collection process section of this thesis.

Contract Document

The contract document is the written core of every construction project. It contains comprehensive information about the project in term of design, contract clauses, specification, bills of quantities, parties to the contract and terms and conditions of the project. In this research, the contract clauses are reviewed in relation to where they apply specifically to the conducting of a VM study. The aim for reviewing this section is to identify clauses that make VM study mandatory, timing of the workshop and parties affected. In the US, the applications of VM in the majority of construction projects are included as part of contract clauses. The inclusion of VM in the contract is refers to as "Value Management Change Proposal (VMCP)" as discussed in literature review chapter. Therefore, this research aims to identify such information in the contract document that assists in understanding the entire scenario of the project.

Other documents

This research also includes other forms of documentation to be used in constructing the research study and to support inferences. Documents such as minutes of meetings, email correspondences, letters and other forms of written communication related to VM workshops are reviewed. However, such documents are treated as secondary documents to provide a supporting function to this research.

4.3.1.2 Sources of Evidence

Obtaining documents to be used in this research required careful planning to permit easy access and ensure retrievability of all documents. There were risks which needed to be considered when obtaining permission to access documents. In this research, there are two categories of documents that required a different approach in obtaining access.

The first category is the VM Manual and procedures, which are considered as low risk in terms of access. Although these documents are meant for use on public sector projects, they are made available for public reference especially to the private sector and tertiary education sector. This document is available for purchase at specific government departments in Malaysia. The only risk imposed by this category is the availability of stocks of the document for purchase by the public. However, the researcher has secured a copy of the VM Manual at the early stage of this research.

The second category consists of the case associated documents. This category applies specifically to the selected case study of this research. Documents under this category are considered as high risk in terms of access and retrievability. The high risk is associated with the access and approval given to the researcher on the selected case study. Contrary to the first category, documents under this category are not available for the public to purchase, borrow access or making any copy. It can only be accessed by parties of the project organisation and has only very limited opportunity for sections to be reproduced for the public reader. The forms of documentation in this category are considered as confidential. Therefore, approval of selected cases for this research was obtained by the researcher in order to minimise the risk of non-access to all documents needing to be reviewed under this category.

4.3.1.3 Document Audience

The documents selected for review in this research have a specific audience and each document is prepared to suit certain conditions of application and may be restricted to use in a certain context. Identifying the audience of documents and the limits of its application and availability assist the researcher to develop further understanding of the case study context and to avoid making misleading conclusions around certain issues. The following table indicates a summary of the documents audience used for this research:

Table 9 Summary of documents audience

Ref.	Documents	Audience	Limitation
1	Value Management Manual	Private organization – Internal Staff	Restricted use within organization – Non confidential
2	Value Management Circular 3/2009	a. Malaysian Government Ministries and Department b. Private Sector	Regional Context – Only applies to Malaysia – Non confidential
3	Policies and Procedures	Private organization – Internal Staff	Restricted use within organization– Confidential
4	Drawings and Specifications	Private organization – Internal staff and parties to project	Restricted use within organization– Confidential
5	Contract documents	Private organization – Internal staff and parties to project	Restricted use within organization– Confidential
6	Minutes of Meeting	Private organization - Internal staff and parties to project	Restricted use within organization– Confidential
7	Letters and emails	Private organization - Internal staff and parties to project	Restricted use within organization– Confidential
8	Written communication (i.e. Site Instruction, Site memo etc)	Private organization - Internal staff and parties to project	Restricted use within organization– Confidential

4.3.1.4 Access to Documents

Access to all documents mentioned earlier corresponds to the document categories specified in *Section 4.3.1.2 Sources of Evidence* of this thesis. The procedures taken in this research to gain access to both categories of documents described earlier are not limited to documentation alone. However, the process starts with an application being made to the organisation of interest of interest to conduct a case study for this research. Obtaining approval to access cases for this research in turn provides the opportunity to access documentation specified in the earlier section of this chapter.

The process of obtaining approval and negotiation to gain access to cases will be discussed in detail in Chapter 5 of this thesis.

4.3.1.5 Selection of Documents

In general, selections of documents for the purpose of this research have been determined through the literature review and case study design. The literature review guides the researcher to identify generic sets of documents that could be reviewed to form a basic understanding of VM application. The case study design focuses specifically on construction project documents, which are related to VM and other associated activities undertaken during design development.

There is risk that the researcher has to bear when making selection of documents suitable for this research. Risks associated to access and availability has a high influence that could affect the document review process of this case study. Similar to 'Access to Documents' (Section 4.3.1.4), selection of documents is highly dependent on the approval given to access cases for this research.

4.3.1.6 Recording of information

The process of reviewing documents for this research requires recording procedures that capture all necessary information. The researcher has designed a specific template in Microsoft Excel format to store and record information from the selected documents. An example of this template is attached in **Appendix B** of this thesis.

There are three methods to record documented information selected at the outset of the research. Such recording methods are through hand-written notes, photocopying and photography. However, permission to record all information for this research was required to be obtained from the selected case study organisation to ensure there will not be any breach of ethical conduct in this research.

A case study journal was chosen as a medium in this research to record all additional information to support the case study process. This journal is also used to record and store site-notes from the document review process.

4.3.1.7 Interpretation and potential bias in documentation

According to Yin (2009), there is a mixture of advantages and disadvantages of employing this method (i.e., a document review) in a case study. The table below indicates the strength and weaknesses of using documentation as source of evidence.

Table 10 Strengths and weaknesses of documentation (Yin 2009)

Source of Evidence	**Strengths**	**Weaknesses**
Documentation	Stability of information	Retrievability issue
	Unobtrusive information	Biased selectivity
	Contain exact reference of the event	Prone to reporting bias
	Broad coverage of event	Accessibility issue

While cautions have been made by Yin (2009) in accordance to weaknesses of using documentation as source of evidence, there are measures taken in minimising the impact of such weaknesses in the case study conducted in this research.

Documents selection

The selection of documents as discussed in earlier sub-sections highlighted that case study design is one of the determinant factors towards its successful application. The design of the case study takes into account all aspects of VM application and implementation used to determine and address the needs of a project. It is understood that pre-selected documents for the case study are prone to be considered as ‘introducing a bias’ to the research, or as ‘limiting the boundary of documents to be reviewed’. However, in order to minimize this, the selection of documents was kept flexible in terms of accepting suggestions and recommendations from the approving organisation of the case study. Once approval was given to access cases, further discussions were held with the approving officers of the study organisation to confirm on all necessary documentation available to be accessed for the case study.

Documents interpretation

The application of the VM philosophy/method is not specifically in the hands of any particular profession. In other words, no profession working specifically in the construction industry could claim that VM belongs solely to their professional bodies or practices. It is a universal methodology and although the focus of VM based on literature reviewed appears to be somewhat prone towards cost cutting (Ashworth, 2004; Ellis, et al., 2005; Ellis, et al., 2003; Green & Liu, 2007), this does not mean that VM is associated with the Cost Engineering or Quantity Surveying professions. The researcher recognizes the risk of bias if the study is undertaken purely from the perspective of a specific profession's point of view. As this could critically affect the focus and direction of this research in attempting to create a more neutral platform for investigating VM application by diminishing the stereotypical cost cutting perspective.

Therefore, in order to overcome this potential bias, the next stages of this research, which are the survey and interviews are amongst the measures taken to reduce the risk of data misinterpretation.

Reporting Bias

Reporting bias refers to the way information contained in VM workshop-related documents is presented and reported. In minimizing this risk, the researcher used the same method as described in the earlier section *Documents Interpretation.*

In summary, the document review process for this research is designed to accommodate all consequences that could interrupt a smooth data collection process.

4.3.2 Survey

The second phase of data collection of this research is the survey conducted among VM workshop participants of the selected case study. The aim of this survey is to establish some form of understanding on the practice of VM workshop of the selected case study among workshop participants and to validate information obtained from document review process.

In order to establish a comprehensive understanding of VM workshop practices, the survey is designed to seek information and perceptions from VM participants on how VM workshops are organized and managed throughout a typical construction project lifecycle.

4.3.2.1 Selection of survey method

The questionnaire survey is selected as method of data collection due to its ability to capture the views and opinions of a large audience and garner a higher response rate within a short period of time. However, there are some risks associated with the use of this method that are taken into consideration when selecting this method. Specific risks identified are as follows:

a. Low response rate if survey distribution methods are not properly planned.
b. The use of a variety of distribution methods in order to obtain higher response rate could have financial implications on the researcher's limited funds.

4.3.2.2 Types of Investigation

This research is conducted using an exploratory approach with the aim of investigating phenomena and identifying variables within the application of value management studies and workshops (Fellows and Liu 2008).

4.3.2.3 Unit of analysis

The unit of analysis in this survey questionnaire is individuals who have participated in value management study workshop of the selected case study. Therefore, the VM workshops participants are the unit of analysis

4.3.2.4 Time Horizon

This research is designed as a cross sectional study where data are collected from one single point in time over a selected period. The data collection for the survey was conducted upon completion of the value management studies and workshops of the selected case study.

4.3.2.5 Sampling Technique and design

Sampling for this research is designed using non-probability sampling and is based on the nature of case study selected represented by construction professionals involved in the value management studies and workshops. Heterogeneous sampling is used to select the participants for the case study. The sample is based on value management workshop participants of different professional backgrounds.

4.3.2.6 Questionnaire Design

The questionnaire is designed to consist of open and close-ended questions. The aim of combining these two approaches is to allow for respondent to select their preferences while responding and giving their own suggestion at the same time. The questionnaire comprise of four sections.

Section A

This section collect information on respondent's profile that include their professional background, working experience, past experience in Value Management workshop and current position with the case study. The aim of this section is to understand the demographic profile of respondents to the survey.

Section B

This section collects information on Value Management workshop organisation within selected case studies. The section is further divided into three sub-sections that focus on objectives of value management workshop, workshop information and workshop participants. The aim of this section is to capture information on value management workshop planning and management.

Section C

This section collect information on respondent’s preference on the outcome of value management workshop of the project they have been involved. This section focuses on key outcomes areas of the workshop. This section aim to understand respondent’s view on the outcome of value management workshop they attended.

Section D

This section provides an opportunity for respondent to give their suggestion or comments on their experience as participant to value management workshop. The aim of this section is to obtain any additional suggestion for improvement and feedback as a result of their experience in value management workshop.

The sample of the questionnaire is attached in Appendix C of this thesis.

4.3.2.7 Types of Question

The design of the survey question uses two approaches that are open ended and close-ended types of questions. Close-ended question is designed for respondent to respond their preference based on set of answers/options given. Open-ended questions allow for respondent to provide answer on their own term. This allows tapping from respondent’s level of knowledge and experience of issues in value management workshop (Bryman 2012). Section A, B and C of the survey uses close-ended questions approach with several questions includes an open-ended approach. Section D focusses entirely on open-ended format for respondent’s to record their feedback or comment of the issue.

According to Bryman (2012), when using self-completion questionnaire, consideration should be place on the type of question asked to the respondents. In the design of this survey question, there are several types of question involved. The following Table 11 indicate the type of questions design according to the questionnaire sections:

Table 11 Questionnaire question types

Ref	Section	Type of Question
1	Section A – Respondent Background	***Personal Factual*** – Focuses on respondent's personal background related with the research.
2	Section B – Workshop Organisation	***Personal Factual*** – Focuses on respondent's personal experience as participant in value management workshop. ***Questions about attitudes*** – Focuses on respondent's attitudes toward issues using Likert scale. ***Questions about knowledge*** – Focuses on respondent's knowledge about the VM workshop organisation.
3	Section C – Workshop Outcome	***Questions about attitudes*** – Focuses on respondent's attitudes toward issues using Likert scale.
4	Section D - Suggestion	***Questions about knowledge*** – Focuses on respondent's knowledge about the VM workshop organisation.

4.3.2.8 Scale of Measurement

The questionnaire design has incorporated several scale of measurement that corresponds to the type of questions asked. The scale of measurement includes a combination of nominal and ordinal scale of measurement. Table 12 indicate a summary of scale used in against the type of question the question design.

Table 12 Questionnaire scale of measurement

Ref	Section	Type of Question	Scale of measurement
1	Section A – Respondent Background	*Personal Factual*	*Nominal Scale*
2	Section B – Workshop Organisation	*Personal Factual* *Attitudes Questions* *Knowledge Questions*	*Nominal Scale & Ordinal Scale*
3	Section C – Workshop Outcome	*Knowledge Question*	*Ordinal Scale*

The nominal scale of measurement is used for questions that focus to classify things into certain categories. This scale is used on question where respondents are required to place their preference based on set of answers/options that lead to specific categorisation of information.

The ordinal scale is used to measure respondent's attitudes towards issues surrounding the value management workshop organisation. In the ordinal scale, a Likert scale of measurement is being used to measure respondent's attitudes. In this questionnaire, a five-point scale of measurement is being used to assess respondent's attitudes. The rating scale designed for Section B and C on attitudes questions of this questionnaire are as follows:

5 = *Strongly agree*
4 = *Agree*
3 = *Neutral*
2 = *Disagree*
1 = *Strongly disagree*

The Likert type of questions in this questionnaire is designed to allow for respondents to place their attitude preference on sets of statement related to specific topic. The scale is used to measure their agreement level of the issues being asked.

4.3.2.9 Questionnaire validation/Pilot test

The completed questionnaire design requires testing and validating and so pre-testing using a pilot version of the survey was conducted to ensure that the instrument functions well. This process is important to ensure the questionnaire is free from any ambiguity (i.e. terminology, long questions, double-barrelled questions). Furthermore, it allows researcher to determine the adequacy of instructions given to respondents in completing the survey (Bryman 2012).

There are several processes involved in setting up pilot-testing for the questionnaire, which can be divided into two broad categories a) selection of respondents and b) setting up the criteria for assessment.

Selection of respondents

The selection of respondents to respond to the pilot test is made from a measureable group similar to the overall survey population. According to Bryman (2012), taking a small sample comparable to the overall population is crucial to reflect the depth of understanding and breadth of the responses from the pilot test. The selection of respondents in this research is made from professionals involved in the construction industry that have some level of experience and knowledge about VM.

Identification of potential respondents was made through use of the list of registered members of the Institute of Value Management Malaysia (IVMM). The IVMM is a professional body that regulates the registration and conduct of Value Management in the Malaysia. Registered members consist of professional construction practitioners, academicians, civil service officers and professional in other related fields. Members are required to possess a certain level of knowledge and experience of VM prior to being registered as a member.

The selection of respondent from IVMM for the pilot study is comparable to the population intended for the full study. A total of 5 respondents agreed to provide their review and test the questionnaire. The following Table 13 indicates the background of respondent who participated in the pilot test:

Table 13 Pilot test respondent profiles

Respondent	**Professional Background**
Respondent 1	Value Engineer
Respondent 2	Academician (Quantity Surveying)
Respondent 3	Contractor (Civil Engineering)
Respondent 4	Quantity Surveyor
Respondent 5	Architect

Setting Up Assessment Criteria

Assessment criteria to determine reactions to the survey were prepared and handed to respondents as a guide when responding to the questionnaire. The aim was to provide them with instructions and areas to be reviewed. There are eight (8) aspects that the researcher was interested in examining when conducting the pilot test. Table 14 indicates a summary of assessment criteria for the pilot test.

Table 14 Pilot test questionnaire assessment criteria

Ref	Criteria	Description
1	Language	Clarity of question. Free from grammatical errors.
2	Terminology	Acceptable use of technical term in Value Management
3	Flow of questions	Appropriate flow of questions and questionnaire design
4	Ambiguity	Questions are free from any double-meaning/double-barrelled
5	Leading questions	Questions are from directing respondent to a particular direction or answer
6	Sensitive / Negative questions	Questions are free from any sensitive issue that may affect respondent’s feeling, emotion, reputation and background.
7	Time to complete	Time to complete the questionnaire is reasonable
8	Questions options	Answers/options given for each questions are reasonable and within the knowledge of respondents.

The relevant assessment criteria were distributed to respondents along with the questionnaire. An example of the checklist is attached in Appendix D of this thesis.

4.3.2.10 Revision to questionnaire

Feedback from respondents was compiled and grouped under specific assessment criteria. Comments and suggestions were studied in order to address improvements to the questionnaire. Not all comments were taken on board. Suggestions that are unrelated to assessment criteria were discarded.

Based on the feedback, the majority of suggestions were focused on the terminology (Criteria 2) and options given for each questions (Criteria 8). In Criteria 2, majority of respondents were having a conflict between the term “Value engineering” and “Value management”. Some respondents preferred the term ‘value management’ as it described the entire process of value creation while some view “value engineering” more suitable to be used when design is an object of the study. This conflict is identified through their comments that suggest both terms being used in the survey to avoid confusion, such as “value engineering/management”. Although this suggestion has potential to minimise confusion for respondents, a decision was made to remain with the “value management” term throughout the survey. This decision is based on a) literature reviewed that indicates the term ‘value management’ is more suitable to address the specific objective of this study and, b) value engineering is more specific to the ‘hard’ technical approach of cost cutting rather than the ‘soft’ approach in problem solving.

In Criteria 8, the majority of respondents suggested more options to be given for each question with aim to maximise response opportunity. This suggestion was made particularly for questions where VM tools and techniques were the focus. This suggestion was incorporated into the questionnaire for improvements as it reflects first-hand additional information designed to bring in tools and techniques that respondents may have experienced. Other improvements were made on the arrangement of questions order and rephrasing for ease of response.

4.3.2.11 Method of distribution

The distribution of questionnaire for this research was conducted using three approaches - postal distribution, email and face-to-face. The use of three approaches aims at increasing response rate by allowing respondents to access the survey in the most convenient way.

a. Postal Distribution

   This method was conducted by posting the questionnaire to the registered address of potential respondents. Each respondent received the following content:

   i. An Invitation Letter
   ii. A copy of “Participation Information Sheet for QUT Research Project”
   iii. A copy of Questionnaire
   iv. Researcher’s self-addressed envelope with stamps

b. Email Distribution

   A soft copy format of the questionnaire was converted into Microsoft Excel format, which was distributed via email when a respondent’s postal address was unavailable.

c. Physical Distribution (Face-to-face)

The physical distribution of the questionnaire was only being undertaken where a respondent preferred to meet with the researcher. This method was a contingency plan should the first two approaches yield minimal responses as it carried cost and time implications due to overseas travel being required.

4.3.3 Interview

The third stage of this research was conducted using an interview approach to explore further the notion of the VM workshop application for design development. The aim of this latter method was to investigate participant’s specific and individual experience in VM workshops and to validate findings from the survey analysis.

Allport as cited in Heidgerken (1953), states that *"if we want to know how people feel; what they experience and what they remember, what their emotions and motives are like, and the reasons for acting as they do - why not ask them?".*

This statement is consistent with researcher intention of conducting interviews designed to explore and understand people's experience, motives, and perceptions from their involvement in VM workshops.

The main objective being sought in using this method is to explore in much greater depth the experiences of VM participants in specifically handling the design development of a construction project. Design development involves the creative input from many stakeholders in order to enhance and add value to the original design in a single or continuous forum. Having many stakeholders in one workshop to provide complex inputs and outputs for the design development requires a proper workshop and process management framework or system. Measuring the existing system in place of VM workshop is conducted through the first and second stages of the research (document review and survey). However, measuring participant’s perceptions and experiences in VM workshop requires a different approach. Therefore, the interview method is adopted for the third stage of this research, as tapping the real value of participants' experiences requires extended exploration and deeper understanding. It is meant to literally attempt to shed new light on old problems in VM (Rubin & Rubin, 2005).

According to McNamara (1999), interviews are particularly useful for getting the story behind participant's experiences and as a supplement to questionnaire administration (Champion, 2006). The ability to perform in-depth investigation around the topic is possible through probing to obtain further clarification of responses. According to Rubin and Rubin (2005), the interviewing process is particularly effective for describing social processes. Respondents are able to give oral elaborations of answers that otherwise might have been determinable just by reading the questionnaire response. Through interviews, researchers can understand experiences and reconstruct events of the VM workshop (Rubin & Rubin, 2005). It is a valuable data gathering tool that can describe the social setting and people within such settings (Champion, 2006).

4.3.3.1 Selection of interview method

According to Rubin and Rubin (2005), there are a variety of qualitative interviewing approaches that may be used to suit particular research scenarios. Each interview approach differs in terms of the objectives of the study, and the focus and direction taken in solving research problems. Table 15 indicates the variety of qualitative interview types according to Rubin and Rubin (2005).

Table 15 Variety of qualitative interview types (Rubin and Rubin 2005)

	Narrowly Focused Scope	**In-Between**	**Broadly Focused Scope**
Focused Mainly on Meanings and Frameworks	Concept clarification	Theory elaboration	Ethnographic
In-Between	Exit interview	a. Oral histories b. Organizational Culture	Life history
Focused Mainly on Events and Processes	Investigate interviewing	Action research, Evaluation research	Elaborated case studies

In the case of this research, an evaluation approach is being used to collect data. The focus is mainly on the events and processes that take place within the VM workshop and during it's organisation. The evaluation of people, documentation and processes has placed this research within both narrow and broad scope. The overall scope of the documentation and processes attributes of this research was narrowed at the outset of the research where through reviewing the literature; a standard set of established practices of VM was identified.

According to Yin (2009), there are three types of interview methods - structured, unstructured and focused interviews. However, Merton, Fiske & Kendall (1956) assert that focused interviews actually form part of the structured interview method due to the nature and rigor of the conduct of the focused interview This is supported by Champion (2006) who claims that focused interviews rely on how much is known in advance about the target population, which in turn dictates the direction of the investigation. Structured interviews are more rigid in their composition and line of enquiry that follows specific predetermined fixed questions. The researcher has to adhere to the list of questions and asks the same questions to different respondents. It reflects a high degree of interview control and limits questions only to those factors relevant for the problem being investigated (Champion 2006). In contrast, unstructured interviews are less rigid in their line of enquiry and often are seen as having a similarity to natural conversation. The unstructured interview is characterised as having the direction and intensity determined by situational factors.

According to Champion (2006, p. 254), focused interviews are *"interviews with respondents who have shared some common experience that has, in turn, been carefully scrutinized by investigators to generate hypotheses about the effects of the experience as viewed by the participants".* They focus on the actual effects of the experience of the respondents towards particular subject of the study. In the context of this research where the VM workshop is the object of the study, the shared common experience of workshop participants is one of the major aspects that the researcher is trying to investigate. Apart from finding shared common experience, it is hoped also to identify any divergence in the experiences as to how VM in design development is being carried out and together these views will provide a sound basis to support new framework and theory building. Therefore, this research conducted focused interviews [semi-structured] with VM workshop participants who had undertaken the workshop processes of the selected cases.

4.3.3.2 Reasons for selecting Focused Interview [Semi-structured]

The experience of workshop participants offers a rich primary source of information for the researcher to seek further in depth clarification, understand and reconstruct the events (VM workshop) based on the respondents' experiences. It allows researcher to probe into specific processes of a VM workshop, such as, the discussion patterns, tools and techniques used, team dynamics, decision making and roadblocks throughout the workshop process. The people, documentation and process attributes examined in this research demand for the greatest flexibility of approach for comprehensive discovery of the 'unknowns' of VM workshop practices not likely to be reported elsewhere. Such flexibility would be diminished if only structured interview methods were used in this research, as conversation would then be limited to the content based on fixed sets of questions that offer little room for extended elaboration and clarification of certain issues. On the other hand, unstructured interview methods are fine for exploring a topic broadly and generally (Champion, 2006). Furthermore, unstructured interviews are only suitable when little or nothing is known about the research subjects providing information, but were not considered suitable for this research especially as the focus had been narrowed and much had already been discovered in the first two stages of this research.

4.3.3.3 Selecting Interview Respondents

Interview respondent are selected based on individuals involved in the selected case study of this research. The selection process is made through reviewing case study documentation to identify potential participants to be invited. Invitation letter are sent to potential respondents.

4.3.3.4 *Interview Approach*

The researcher, in order to increase response potential, introduced options for respondents to choose how they wished their interviews to be conducted and these were as follows:

a. *Face-to-face Interview*

   This approach is based on live physical interaction between interviewer and interviewee.

b. *Face-time Interview*

   This approach is based on interaction that uses laptop or an iPad as a medium to interview. This method is only use when live physical interview is not possible to arrange due to specific reason.

4.3.3.5 *Interview Plan*

In order to proceed with the interview process, an interview plan was designed to ensure all necessary arrangements for conducting interviews was well prepared. The plan is necessary in order to establish a consistent approach to conducting interviews across all cases and all participants in this research. Each stage of the plan includes a contingency plan as an alternative solution to complete the stage. The interview process begins after the completion of questionnaire survey by project participants of the selected case studies. Figure 6 indicates the interview plan designed for this research.

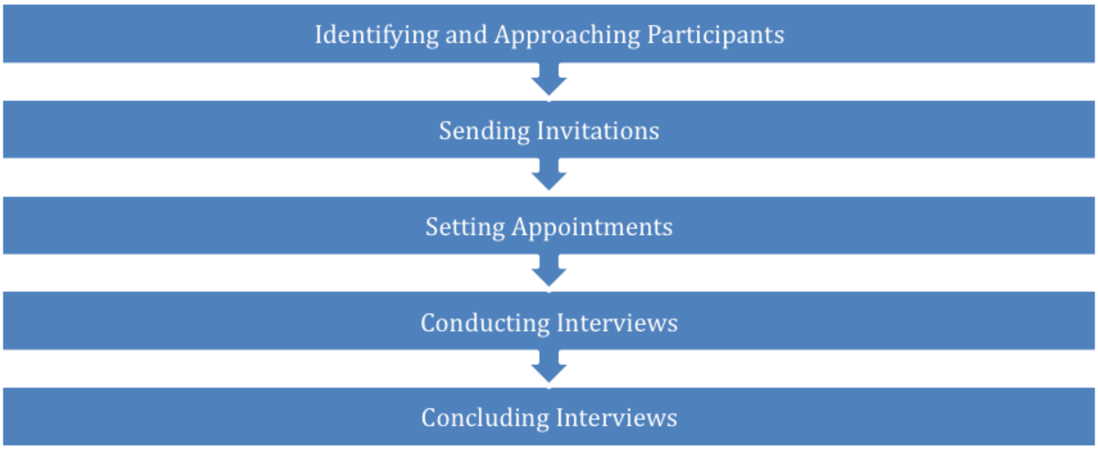

Figure 6 Interview Plan

Identifying and Approaching Participants

The process of identifying potential respondents for the interview was based on a three-stage approach. The first uses the “List of Participants” extracted from VM reports of all cases to identify potential respondents. The list contains each participant’s name, contact details and division of their representation in the construction project. The second approach required making reference to questionnaire respondents from the second stage of the research, who were identified through the same process of referring to the “List of Participants” from VM reports. In Section E of the questionnaire, respondents who were willing to participate in interviews were required to fill up their contact details for further arrangements for interview to be made. The process of getting consent to participate in interviews imposed some risk to the researcher in terms of the possibility of refusal to participate. Therefore, a third approach to overcome this risk and aimed at increasing the response to interviews was planned by requesting an MAHB representative to send bulk invitation emails to all VM participants of the case studies. However, this third approach is subject to case study organisation willingness to cooperate with researcher’s request.

Sending Invitation

Using the three approaches mentioned in the earlier section, a list of potential respondents was produced that consisted of all necessary information for invitations to be sent out. A formal invitation letter outlining research aims and **QUT Participant’s Consent** Form were included in the invitation sent to all participants. The content of the invitation letter to potential respondents by post or e-mail was as follows:

i. Invitation to Participate
ii. Research Topic
iii. Research Aims
iv. Reason for Inviting
v. Interview Topic

vi. Estimated Interview Duration
vii. QUT Participant's Information Consent

The invitations were sent out two weeks in advance to ensure respondents had time to understand the needs of the research and to allow for any necessary planning to be made. The researcher followed up on all invitations one week after the estimated receipt date of the invitation letter. The participant's reply through email to researcher was considered sufficient to proceed with setting up an appointment for interview.

Interview Session

As discussed in Section 4.3.3.3 of this Chapter, the conduct of interviews was done by one of two methods (i.e. face-to-face or Face-time™). The protocol for conducting interview was based on the particular method of interview.

a. Protocol for Face-to-face Interview

Face-to-face interview involves a two ways communication and interaction between the researcher and respondent. The protocol for face-to-face interview consisted of five (5) components, which as follow:

i. Starting An Interview

At the beginning of the interview, a short introduction about researcher's organization background and read through information regarding the objectives of the interview to the respondents is given. Information such as the research and interview topics, the structure of the interviews and expected duration will be informed in advance to ensure respondent is comfortable with the setting of the interview.

The research and interview topics introduced to the respondent have two significant differences, the research topic introduction aims to inform respondents on the general research areas that researcher is currently conducting, in this case *Value Management workshop in Design Planning Phase of a*

Construction Project. The interview topic is more focused toward issues of multi-disciplinary participant involvement in VM workshop while reviewing design. Establishing these differences at the beginning of the interview is expected to give respondents a clearer picture of the research.

The structure of the interview refers to how interviews will be conducted with the respondent. In this interview, **ten main questions** will be posed to respondents focusing on the VM workshop issues. Question formats are arranged from general to specific questions that correspond to the deepening focus of the interview. A conversational approach is adopted in this interview that allows two way discussions between the researcher and respondents. Probing questions are asked should further clarification be required to the responses. At the end of the interview, respondents were given an opportunity to summarise and provide their additional opinions (or any new views) on the interview topic.

The interview session was designed to last between 1.5 to 2 hours, thus allowing sufficient time to work through the set questions and to get further clarification on any issues that required additional information. Informing the duration of interview to respondents was crucial as it allowed them to gauge their commitment and estimate the depth of detail that the interviews were seeking. At the same time, the researcher was able to control the interview flow and move on from any ‘long-winded’ response that either went beyond the scope of the interview or was not adding further information to that already gleaned. The duration allocated for a typical interview was tested prior to the commencement of the actual interviews. The process of testing the interview questions and conduct of interviews will be discussed in Preliminary Study section of this chapter.

ii. Asking Interview Questions

In order to ensure the smooth running of each interview session, the protocol set for asking questions was to start by asking main questions (MQs) to the respondent and allow them to respond accordingly. The researcher s from making any comments on the response nor giving any view of the conversation. During the conversation, follow up questions (FQ) will be asked to allow deeper exploration of the meaning of the response in relation to the interview topic. According to Rubin and Rubin (2005), when a researcher detects an oversimplification, new ideas or relevant stories during the interview, a follow up question should be asked immediately. There is no strict rule controlling when to ask follow up questions in this research as the focus of the interviews is to explore and confirm the real experiences of respondents in VM workshop. On the same note, probing questions (PB) will be asked during the interview when any information or response given is too broad or too simple for the researcher to accept it as being a conclusive response by the respondents. The timing to ask FQs and PQs during the interview is subject to the flow of conversation between the researcher and respondent. In responsive interviewing, the researcher needs to figure out what people are saying, at the same time what they mean and working on what follow-up questions to ask (Rubin and Rubin 2005). Information that is vague and ambiguous will be subject to PQs being asked.

The researcher will take care to accommodate changing patterns of the conversation process. Familiarization on conversation topics and the direction that respondents are taking are important to this process to control the flow of the conversation.

iii. Controlling Interview Process

Controlling the flow of interview process will ensure all interview questions are covered and the objectives of interview are achieved. There are two conditions, which require measures to be taken in controlling the interview process, when the interview response by the respondent is too short or too long that could lead to it being out of context.

There are instances when the researcher will face the issue of short answers being given by the respondents, who may attempt to answer using either a “Yes” or “No” response that would provide minimal contribution to the interview process. Apart from having interview questions tested for clarity and wording prior to the interview, the researcher needs to understand how to control the conversation process and get as much response from the questions asked as possible as this is largely a ‘one shot’ process. These methods for controlling and managing short responses by the respondent are as suggested by Rubin and Rubin (2005). Both FQs and PQs are not designed at the outset of the interview; however, the researcher modifies the questioning approach progressively to match the knowledge and interests of the interviewees (Rubin and Rubin 2005). Using this form of approach it is expected that the interview process could be control and minimise the risk of short “Yes” or “No” answer.

iv. Dress Code

It is important to understand the context of the interview and potential respondent’s organization that researcher is dealing with. Making sure that a proper dress code is adhered to (in the case study settings it is usual to wear office/formal attire) ensured more effective interview and respect gain throughout the process.

v. Building Relation

According to Rubin and Rubin (2005), qualitative interviewing and ordinary conversations share some common similarity. Both evolve from discussing one single topic and expanding the conversation into a deeper exploration of the topic of interest. Achieving such a deep exploration of topics and establishing the meaning behind each conversation are not relatively easy to operate when the researcher is a stranger to the respondents. Therefore, using the conversation line to build up a relationship of respect and trust is important to try and achieve as it can increase the chance for the interview process to be more effective and informative. Rubin and Rubin (2005) remind the reader that some interviewees may become hostile, overly friendly, threatening or flirtatious during the interview process. Therefore, conversational and listening skills are important to the researcher in establishing a connection that allows for an openness of exchange.

4.3.3.6 Developing Interview Questions

Interview questions are constructed with the aim of exploring to a much deeper extent the application and organisation of VM practice. Development of interview questions is structured based on two main component outputs of this research - literature reviews on VM and results generated from the questionnaire analysis.

The first output (i.e. literature review) focuses on developing main interview questions that set a starting point of conversation. A collective review of literature on the VM tools and techniques, facilitation and job plan provided a guide for question development. The second output (questionnaire analysis) focuses on findings from survey conducted on VM workshop organisation. The results assist in forming background information on the actual issues faced in the current case study. Therefore a combination of both of these outputs helped to develop questions for the interviews.

Topics covered under the interview section of this research are as follows:

i. Value Management application in design review
ii. Value Management influence in improving construction process on-site
iii. Multi-disciplinary involvement in Value Management workshop
iv. Attributes of multi-disciplinary interaction in VM workshop
v. Facilitation, tools and techniques used in VM workshop

Kvale (1996) suggested nine (9) different kinds of question to be included when developing interview questions. They consist of introducing, follow-up, probing, specifying, direct, indirect, structuring, silence and interpreting questions (Kvale 1996). Bryman (2012) asserted that most interviews consist almost all kind of questions as mentioned by Kvale. Charmaz (2002) on the other hand simplified the types of questions into three categories that consist of a) initial open-ended questions, b) intermediate questions and c) ending questions. The design of interview questions adopted both approaches as suggested by Kvale (1996) and Charmaz (2002). The question structure was divided into three categories that consisted of a) Main questions, b) follow-up questions and c) probing questions. The types of questions as suggested by Kvale (1996) were infused within the three categories. The question types and methods used to apply them suggested by these authors were used in this research.

Vignette to interview questions

According to Bryman (2012), having general questions at the beginning of the interview to assist interviewees to understand the context of the enquiry is best to be avoided. He rather suggested (ibid 2012) the use of vignette questions as a small illustration of the case or issues to be covered in the interview. Barter and Renold (1999) as cited in Bryman (2012) suggested that the application of vignette questions could assist interviewees to view and account for behaviour in particular situations.

A vignette approach is introduced in this interview to provide an overview to interviewee about the topics of this research and aims to be achieved. The aim of the vignette is to contextualise the interview to be more focused and easy for interviewee to structure their responses to questions. A short introduction is read to interviewee to present a broad overview at the beginning of the interview before proceeding with the main questions. The following is the vignette statement used at the beginning of each interview conducted in this research:

> *"Value management application in construction project has proven to assist construction team in making structured approach to decision making in the design of a project. The involvement of multi-disciplinary team participant in VM workshop allows for comprehensive review of the design with aim to improve construction process on-site. However, their degrees of involvement in the workshop process are influenced by the level of skills, knowledge, experience and other related factors. The aim of this interview is to explore these issues and finding practical solution to improve current practice and hence construction process on-site."*

Developing main questions (MQs)

A vignette statement at the beginning of the interview assists in giving broad overview to interviewee about the aim and key result of the survey. The 10 MQs for the interview were open-ended designed to explore interviewee's views and perception about the topics (Refer Appendix E). The MQs were as follows:

MQ1 Please tell me about your role in VM workshop in this project.
MQ2 In reviewing the design for the current project, what is your perception on VM influence in improving construction process on-site?
MQ3 In your opinion, do you think that VM focussing on design will assist in improving construction process on-site?
MQ4 In what aspect does VM study can improve the design of the current project?
MQ5 How does multi-disciplinary involvement in this VM workshop influence design outcome of this project?
MQ6 Do you observe any limitation of multi-disciplinary participants in this workshop in term of their contribution?
MQ7 What are the main attributes of a workshop participant that make VM workshop effective in reviewing the design of this project?
MQ8 How do you view participant's level of knowledge/skills and experience in this workshop?
MQ9 What are your suggestions to improve these attributes among future participants?
MQ10 Considering maximising the outcome of the VM study for this project, what can be done in increasing contributions by participants looking into the design?

Developing follow up questions (FQs)

The FQs questions were aimed at getting the interviewees to elaborate on their answers on areas that needed further clarification. The design and structure for follow-up questions in this interview were designed to be flexible dependant on the kind of response given by the interviewee. Each MQ will have at least one FQ for further elaboration of the response.

The following are the generic FQs designed for this research. The questions were open ended at the point of design and the interviewer adjusted the questions to be more specific where appropriate during the course of the interview.

FQ for MQ2

1. Why do you think (interviewee perception) has an influence toward improving construction process on-site?

FQ for MQ3

1. In what area that VM could assist in improving construction process on-site?
2. How do you think this area could benefit from VM?

FQ for MQ4

1. What benefit do you observe on VM intervention for this project design?

FQ for MQ5

1. What is your observation on their participation during this workshop?
2. What is your observation on their contribution during this workshop?

FQ for MQ6

1. How do you view this limitation having an impact toward the design of this project?
2. What are the factors that lead to lack of contribution by the workshop participants?

FQ for MQ7

1. Is there any other that they could improve in increasing contribution toward workshop discussion?
2. Do you think that appropriate tools and techniques could assist with participant's contribution during the workshop?

FQ for MQ8

1. In what area that you think their knowledge/experience/skills can be further improved?

FQ for MQ9

1. Is there any area of VM administration of this workshop that requires further improvement?

The order of questions follows the flow of the main questions asked during the interview.

Developing probing questions (PQ)

Probing questions seek to follow up what has been said through direct questioning (Bryman 2012). The design of probing questions in this research focuses on obtaining interviewee's further explanation beyond their earlier response.

Language for interview questions

Although this research is conducted in English as the main language, the researcher devised a contingency plan by preparing a Bahasa Malaysia (BM) version of the interview questions (See Appendix F). This decision was based on the location of this study that took place in Malaysia where Bahasa Malaysia is the official language used in official matters. The BM version is used in situation when interviewee requested to answer in Bahasa Malaysia.

Testing of IQ for word, clarity and meaning

Completed interview questions were tested for context, clarity and meaning of the questions. For the English version, a mock-up interview was conducted among colleagues and academics within the area of Construction Management that had knowledge of VM. This ensured that the feedback on the questions was reasonable and suited the objectives of the interview. For Bahasa Malaysia version, a copy of the interview questions was sent to an academic within the VM area in Malaysia for validation. No mock-up was conducted, however written comments were received and used and revisions made to questions for further improvement.

4.3.3.7 Recording Interviews

There were two methods used for recording interviews in this research which were audio taping and note taking.

a. Audio Taping

In order to capture the entire conversation, this research used audio recording as the main technique to capture accurately all responses. This allowed the researcher to revisit the audio file for transcription and analysis purposes in the future. The recording was conducted using the Apple iPad™ device and the Audio Note™ application from Luminant Software Inc.

The software allows for recording to be made with unlimited time duration and included a note-taking function that could be used with the Apple iPad™.

b. Note Taking

Apart from recording audio, note taking was used by the researcher to record any thought capture during the interview or any visual/sketches that respondents may have used during the interview. According to Eliot (2010), note taking is essential in qualitative interviewing apart from audio recording as it helps the interviewer to be more alert to the conversation and nuances of answers being given (as well as to observe any relevant body language). The main reason for note taking in the interview process is to allow researcher to capture thoughts and new ideas that evolve, while at the same time getting interviewees to respond to such ideas. Note taking was conducted using two techniques, the first was using Audio Note™ Application mentioned earlier and the second consisted of manual handwriting in a notebook.

Safe keeping of Interview Audio Recordings

Each recorded interview was stored safely in a designated storage area accessible to both researcher and supervisory team. As this research is was conducted in Malaysia, the storage of all audios was in the researcher's external disk and in a dedicated QUT network drive through remote access. This approach allowed for retrievability and prevention for any loss of audio files.

Upon completion of each interview, audio files were assigned with a specific name unique for the case study. Assignment of specific name to each audio files is essential for future retrievability by the researcher and to identify case numbers of each interview that took place. An example of the audio file protocols is as follows:

Audio/Interview Number	:	1
Case study Number	:	CS1
Organisation	:	XXXX
Respondent	:	SS (Initials)
Example	:	XXXX_CS1_SS_1

4.3.3.8 Measures to eliminate bias during interview process

According to Rubin and Rubin (2005), researchers normally have a strong feeling about their topics and sometimes there can be a risk of them sharing their thoughts with interviewees. They (ibid 2005) further caution that researchers should refrain themselves from expressing their views during the interview although responses made by interviewee sometimes are in line with researcher's preconception of the topic. Having a preconception about the topics at the outset of the interview may indirectly affect the interview process should researcher having tendencies to share their views. Therefore, the researcher undertaking the interview needs to understand the potential and real biases that exist during the interview that may influence the direction of the conversation.

Acknowledging the existence of some preconceptions on VM issues based on previous experience, the researcher devised a strategy to eliminate bias during the interview process that consisted of two (2) techniques - Question Formulation and Interview Self-Revelation.

Question Formulation and Testing

According to Rubin and Rubin (2005), rather than pretending to have no bias during the interview, they suggested that is more sense to examine a researcher's preconceptions of the topics and work to formulate questions to offset existing biases. The formulation of interview questions in this research is discussed in Section 4.3.3.6 of this chapter. However, as a specific measure to eliminate bias in structuring the interview questions, each set of questions prepared was tested among peers and working colleagues from different backgrounds in construction industry (i.e. Architects, Engineers, Builders, Quantity Surveyors and Planners) to ensure questions are not biased towards a single (or any) profession. In other words, the researcher has attempted to establish a neutral set of fully unbiased questions.

Interviewer Self-Revelation

The conduct of interview and how conversation is being carried out during the session are subject to bias should the interviewer not take proper measures to control the conversation. According to Rubin and Rubin (2005) apart from the researched needing to have developed good conversational and listening skills, interviewing involves and create obligations. One major obligation is to ensure that interviewees feel protected and comfortable during and after the interview. Protection on behalf of the interviewee can be achieved in many ways dependant on the nature of the interview. In this research, protection to be provided to the interviewees is in the form of safeguarding their responses on their experiences in VM workshops.

In order to make sure this obligation is observed, the researcher has taken the measure of keeping the interview process and identity of interviewees recorded on audio anonymous. Upon completion of all interview process, recorded audios and field notes are compiled and prepared for the next phase of the research that is the Analysis Phase.

4.3.3.9 Preparation for Analysis

The next step prior to data analysis is to prepare all information collected from case study ready for analysis using one of three methods.

Method 1 : Documents Review

All information collected through document review method was recorded using two approaches - handwriting and type written formats. The handwritten approach is used for documents that haves restricted access not allowing the researcher to bring in any electronic recording devices where the documents were stored while the type written mode was used for recording in non-restricted document locations. A specific form (Refer **Appendix B**) was used to capture all information required and was necessary to support the research. The task of preparing data collected from document reviews involved revisiting all recorded information for sufficiency, completeness and clarity of information recorded.

The sufficiency and completeness of information recorded was determined by comparing information collected against the objectives of this research, literature review and scope of the study. For instance, in recording information from the VM report, the researcher recorded all information relevant to the study based on literature view made on published samples of VM reports. Such samples were used to determine the typical content of the reports in terms of information presented, drawings used and any supporting documentation. The format of VM reports varies across different organization, however, the main objectives of each report production remain the same and can therefore be used to guide the research at this stage.

The clarity of information was reviewed in terms of the written information collected from the document review. The process includes ensuring the wording and terms used to describe and record information from documents is consistent across all documents. This process is conducted with the aim of reducing any ambiguity that might occur when recording information.

Method 2: Questionnaire Survey

Questionnaire survey responses from various sources (i.e. postal, email and face-to-face) were collected and labelled for further analysis. The labelling of each responded survey helped to record the overall number of responses received and allocated the case number. Each responded survey was screened to ensure full response for each questions had been obtained. Surveys that had unresponded questions (i.e. missing data) were grouped together for ease of future reference during analysis. Upon completion of the screening process, the survey was analysed using SPSS Statistics for Windows, Version 19 (IBM 2012) software package.

Method 3: Interview

Each interview was recorded the Apple iPad™ device using the voice recorder application. The audio files were saved using MPEG-4 Audio file format so that Quick Time player could be used later to playback recordings. This format is considered a universal format to store information for use in later for the transcribing process and analysis using NVivo Version 9 (QSR International Pty Ltd., 2011) qualitative data analysis software.

The preparation prior to transcribing includes making sure all file formats are consistent, file naming is clear and permits re-identification (by the researcher only) of the respondent and that a master copy of audio files is saved in a separate back up folder. For the purpose of transcribing, only duplicated audio files will be used to ensure that any changes to the file (i.e. format or audio quality enhancement) will not override the original master copy.

4.3.3.9.3 Transcribing of Interview Audio

All interview audio files were transcribed into text format for the purpose of analysis and discussion of findings from the case studies. The process of transcribing audio files into text format involved several process and stages that will be described in the following section..

4.3.3.9.4 Transcription Methods

Factors for Selecting Independent Method of Transcribing

There are two approaches to transcribing audio files - it can be done either using external human resources (professional transcribers) to transcribe the audio or preparing transcriptions independently by the researcher. The researcher has selected to conduct transcribing of audio files independently without relying on external assistance. There were several factors that influenced the researcher's decision to conduct the process independently as follows:

a. Respondent's Accent Factor

The interview is conducted in English, however due to English being a second language in Malaysia, the accent factor may have a tendency to influence a transcribers' understanding of the spoken words.

b. English As A Second Language

Although interviews are conducted in English, the researcher was concerned that there was a possibility for respondents to use a mixture of English and Bahasa Malaysia language in their responses during the interviews. This factor contributed to the decision to transcribe independently.

c. Recollection of Thought During Interview

During the interview, the researcher sometimes took notes to highlight important information and record thoughts on the issues discussed. This information will form an additional supplement to information directly drawn from the interview process. The recollection process from 'mental notes' alone is not possible in the same way should the transcribing process be conducted externally as the transcriber relies on audio files alone. On the other hand, because the researcher has the first-hand experience of the conversation he can recall his own thoughts at that time and translate them into text. In addition, the body language of the respondents during the interview may indirectly give a certain impression of what they are feeling as they talk, that is not available to external transcribers.

d. Limited Funding

Transcription services for large amounts of recorded data are very expensive and the limited funding to pay for professional transcribers is one of the factors that the researcher has taken into consideration when selecting the best approach to transcribe the audio files.

All of above mentioned factors were considered at the outset of the interview session with aim to maximize transcribing accuracy, increase understanding of the spoken words, and reduce the risk of errors in transcribing by third party and increase control of the research process.

Software for transcribing

The researcher has selected to conduct transcribing process using the F4 application available free of charge at http://www.audiotranskription.de/english/f4.htm. The software contains features that allow transcribers to play audio, transcribe and adjust the playback speed at the same time. These features enable transcribers with minimum experience to adjust quickly to the transcription process and produce accurate transcripts more efficiently.

Transcribing Protocol

The researcher has set a protocol in transcribing the interview audios. The aim of this protocol is to ensure that all transcripts are re-identifiable (by the researcher) and segments of the interview transcript can be traced for further analysis. The protocol for transcribing the audio files consists of the following:

a. To name the researcher as “Interviewer” in transcribing all questions asked.
b. To name the interviewee as “Respondent” in transcribing all responses.
c. To include time stamp for every question and response given
d. To assign specific file names to completed transcriptions corresponding to respondent’s identity. For example, if the respondent is an Architect from Case study 1, the file name assign will be “INT_CS1_INV01”. The first segment shall be the mode of the data collection, the second segment is the case study number and the third segment corresponds to respondent’s identity.
e. Conduct verbatim transcription that includes word for word without any alteration to sentences structure.
f. To exclude any sign of gesture or non-verbal responses during the interview that does not address any specific questions.
g. Review the completed transcript by comparing with the audio files for consistency or any missing information.
h. Review the completed transcript for spelling errors.
i. Preparing transcripts for analysis using qualitative analysis software by formatting of completed transcript into standard heading, text font and sizes.

The completed transcripts from the transcribing process are compiled and transferred into NVivo Version 9 (QSR International Pty Ltd., 2011) software for further analysis. The analysis of these transcripts will be discussed in *Section 4.4 Method of Analysis* of this thesis.

4.4 METHOD OF ANALYSIS

The case study method used in this research consist a mixture of quantitative and qualitative data collection methods. The analysis for both methods will be discussed in two sections. The first Section 4.4.1 will discuss the quantitative method of analysis from questionnaire survey conducted using parametric tests while Section 4.4.2 will discuss the qualitative method from Content Analysis of the Document Review and Interview..

4.4.1 Quantitative Analysis

This section will describe the quantitative analysis process for data collected through survey. The aim of survey method used in this research is to obtain data frequencies and establish the nature of the relationship between variables related to the application of the VM workshop. The focus of the analysis is to produce descriptive results that consist of univariate and bivariate analyses.

The survey questions comprise three types of variables to be analysed. These variables consist of interval, nominal and ordinal data sets. Bryman (2012) asserted that each type of variables/data set requires specific type of analysis. The analysis of each variable is conducted according to the most appropriate analysis technique.

4.4.1.1 Univariate Analysis

Section A and portion of Section B of the survey questions consist of nominal type of data. Nominal variable data set in the survey are analysed using univariate analysis. This analysis comprises a frequency distribution and measures of central tendency and dispersion. The aim of using univariate analysis is to establish frequency background information on data focussing on respondent’s background (Refer Section A of the survey) and VM workshop organisation (Refer Section B of the survey).

4.4.1.2 Bivariate Analysis

Section B and C of the survey consist of interval and ordinal variables data set. Bivariate analysis is conducted for both sections to uncover relationships between two variables. The aim of analysing Section B and C of the survey is to obtain frequency and relationship of variables associated with VM workshop organisation.

The main method of analysis for comparing variables is conducted through cross-tabulation. However, certain data that requires further interpretation is considered using a different type of analysis. Table 16 indicates a summary of analyses used for the survey data set:

Table 16 Summary of Quantitative Analysis

			Variables		
Survey Section	**Test Type**	**Variables**	**Nominal**	**Ordinal**	**Interval**
Section A	Frequency	Nominal	Contingency table	Contingency table	Contingency table
Section B	Frequency/ Associations/Cross-tabs	Nominal	Contingency table	Chi-Square	
		Ordinal	Contingency table	Spearman Rho	Spearman Rho
		Interval	Contingency table	Spearman Rho	Pearson's r
Section C	Frequency/ Associations/Cross-tabs	Nominal	Contingency table	Chi-Square	
		Ordinal	Contingency table	Spearman Rho	Pearson's r
		Interval	Contingency table	Spearman Rho	Pearson's r

4.4.2 Qualitative Analysis

This section will discuss the qualitative analysis conducted for the document review and interviews of the case study. Content analysis was used to explore and investigate the practice of VM application in design development of selected case study. The document review analysis aimed at establishing the current setting of VM application and procedures of the selected case. The interview analysis on the other hand will validate the practice and exploring issues faced by VM participants in conducting VM in design.

4.4.2.1 Content Analysis

Content analysis refers to the process of identifying, coding and categorizing the primary pattern in the data (Patton 1990). The patterns and themes emerge from the analysis of raw data that has a separate identity from other themes. It allows the researcher to understand the context of the data collected. The aim of using this analysis is to explore the deeper meaning of the interview data collected and the context behind each conversation through themes generated.

This research has adopted an approach initiated by Glasser and Strauss (1965) termed the “constant comparative method”. This approach refers to the process of separating themes through reading of the raw data to produce themes in a few stages until the researcher develops more understanding about the phenomenon under investigation. Using this approach, each interview transcript (raw data) will be read a couple of times and each time new themes are generated, they will be compared for consistency. This approach is similar to the inductive approach in qualitative analysis where rich text is condensed into a brief/summary to establish clear links between research objectives and summary findings (Thomas, 2006b). The aim of taking this approach is to establish patterns and links between findings to research questions and to use this to answer the research problems.

The interview transcripts and documents reviewed during the case study stage of this research uses content analysis in exploring the information and arranging pattern of data. The interview transcripts were rich in data as result of the extensive conversations between the researcher and respondents. Therefore, an inductive approach is applied in both the interview analysis and document review in this research.

4.2.2.1.1 Interview Transcripts and Document Review Analysis

The analysis for interviews for this research has adopted Computer Assisted Qualitative Data Analysis Software (CAQDAS) to organize, manage and analyze data (Bryman, 2012). The application of software has assisted this research to categorically organize data in a more structured and systematic way. The following discussion will explain the application of CAQDAS and method of qualitative analysis used throughout this research.

Constant Comparative Analysis

The constant comparative analysis as introduced by Glaser and Strauss (1965) and improvised by Lincoln and Guba (1985) was used as an approach to analyse qualitative data. The analysis refers to the process of comparing single data with other pieces of data with a similar nature. The aim of this process is to identify any similarity or differences that exist between data throughout the comparison process. Information collected from interviews and document reviews was analysed and pieces of information were re-grouped into categories or themes that emerged from the analysis. The process itself is inductive in nature whereby the constant development of data categories assists the researcher in understanding data in a much greater context (Grove, 1988). The detailed reading process of raw data assists in producing concepts or themes through interpretation made from the raw data by the researcher (Thomas, 2006a).

The procedure in executing analysis for both interview and documents followed the process suggested by Lincoln and Guba (1985). It consists of four stages as follows:

Stage 1 Unitizing

Each data collected (i.e. interview transcripts, documents, field notes, diary etc) are compiled and arranged according to the specific case study number each data represents. The unitizing process involves assigning the case study number, project type, type of respondents, site where the data was collected, time and date of the data collected. This process minimises the possibility of mismatch between the data and case study.

Stage 2 Categorizing

Individual data are read through and assigned with codes to represent specific categories according to the researcher's intuition and knowledge of the subject matter. The process of assigning codes to each data depends on the researcher's interpretation of the data context. It is the reflective understanding of the data where intuition as part of the coding process offer ways to interpret using subtle means such sensitivity to the data context (Bernauer, Lichtman, Jacobs, & Robertson, 2013, p. 1). Each data set (i.e. interview transcripts, documents, field notes, diary, etc.) is read individually without making any connection between the data. Code categories that relate to specific themes associated with the current research were named including brief description of the context. The amount of codes developed throughout this process is enormous at the early stage but is incrementally refined once the data is read again. Codes that have similar characteristics and meaning are combined together while data that do not reflect any category related to the research are placed under ‘Miscellaneous” category. The process of reading the data and assigning codes is regurgitative as it aimed to ensure codes are appropriately assigned.

Stage 3 Filling Pattern

The development of codes and filling up with data collected increases the depth of information for each category. However, there are tendencies for a lack of information for certain categories due to no connection being made in between the data (i.e. interview transcripts, documents, field notes, diary etc). Therefore, Lincoln and Guba (1985) suggested “bridging” the data and categories by linking all sources of data. This process allow for researcher to understand the relationship that exists between cateogries and allows for creating new possible categories.

Stage 4 Member Checking

In stage 2, the researcher develops codes for categories based on intuition and knowledge of the subject matter. This process however is subjective depending on the person who conducts such a coding process. In ensuring consistency of codes developed by the research, a member checking procedures as suggested by Lincoln and Guba (1985) are employed. This procedure requires an assistant or another individual to perform coding and re-checking for the codes. Feedback from the process is discussed and revision is made where necessary. The procedure is taken to ensure consistency of interpretation and understanding of the data collected.

The process of executing all four stages as described above uses computer assisted software to manage all coding processes. The application of software speeds up the coding process and increases visual understanding and management of data collected.

Analysis using NVIVO

NVivo Version 9 (QSR International Pty Ltd., 2011) was used as CAQDAS software for this research specifically for document and interview analysis. The aim of using this software is to assist researcher to organize and categorized all data collected from interviews and document reviews for easy retrieval and interpretation through coding. It allows the researcher to manage a diversity of data, to record decisions and create new records (Richard 1999 as cited in Cavana et al. 2001). However, Sprokkereef et al. (1995) cautioned that the application of a CAQDAS couldn't assist with decisions about the coding of textual materials nor interpretation of findings. Therefore, taking from this finding, the research has adopted CAQDAS as a tool to manage qualitative data for easy interpretation while theory development was reserved until a later stage of the research.

Coding

According to Bryman (2012), coding entails reviewing transcripts and /or field notes and giving labels to component parts that seem to be of potential theoretical significance. The process involves transferring interview transcripts and document texts into themes or groups generated through the literature review and researchers' interpretation of the data. "Theme coding system" is used in this research to re-organise data according to the conceptual theme based on the researcher's initial setup (Minichiello et al. 1990, p.293). The following sub-sections will discuss in details on methods of coding, protocols and validation of the processes.

Methods of Coding

Strauss and Corbin (1990) as cited by Bryman (2012) have distinguished three types of coding method that are open coding, axial coding and selective coding. This research uses open and selective approach as coding method for interview transcripts. The selections of these approaches are made based on steps suggested by Charmaz (2006). He suggests using general coding at the beginning of the process and moving toward much more specific coding as the process progresses - he defines these as initial and selective coding.

An open coding approach is used at the beginning of this research as this allows the researcher to explore with an open-mind the interview transcripts to determine any potential concepts that are specifically related to further exploring the VM workshop organisation. The coding process is conducted by comprehensively and carefully reviewing the transcription and assigning codes based on the researchers' understanding of the data.

Selective coding is then conducted upon completion of open coding where core categories identified as being the central focus of this research are used to assist with further breakdown of coding. This process is conducted by assigning codes to selected texts from the transcriptions that relate specifically to core categories. In some instances, codes from the open coding process that are similar in nature are combined into one code to make up a single core category. Although the process seems to be regurgitative, it assists greatly in making sure that the contexts of the data are not left out from the process.

Coding Validation

Coding validation is conducted to ensure the coding of texts is conducted in a structured and consistent manner. The process involved previously coded texts being distributed to a second coder with knowledge in VM to re-code the transcription copy. A copy of the transcription is provided to the second coder along with form for their feedback. The coder is required to re-code the texts using NVivo Version 9 (QSR International Pty Ltd., 2011) software application and using open coding approach. This process allows for the researcher to compare and contrast between the original codes and those of the second coder and identify and ratify any contradicting codes.

Coding Revision

This re-coding process by the second coder when completed offers a second opportunity to refine and improve the coding process for this research. Coding that is similar with the original codes is maintained while contradicting codes are discussed with the second coder and finalized after further clarification. Decisions and revisions are made on acceptable codes that appear to be consistent between both coders. This is important to avoid double-barrelled meanings being allocated to the texts that may lead to wrong interpretation.

Cessation of data processing activity

Lincoln and Guba (1985) have set criteria for use in deciding when to cease data processing activity. There are four criteria used for this decision:

a. Themes emerging from data are exhausted
b. Codes become saturated
c. Regularities emerges
d. Over-extension of codes occur

These criteria have been used to assist the researcher in deciding the limit of data processing for qualitative analysis. However, the decision is not entirely influenced by the criteria suggested by Lincoln and Guba (1985). An additional measure has been taken in deciding when to stop data processing. It is observed that although the emergence of codes becomes saturated after repeated reading of data, there are instances where some codes do not relate to each other and therefore become isolated. Such codes do not belong to the 'miscellaneous' code category nor are they related to VM. Therefore, establishing the link for these isolated codes with other codes is crucial before data processing can finally be stopped.

Assessment of trustworthiness with coding

The member checking approach as suggested by Lincoln and Guba (1985) is one of measures applied to ensure transparency and accuracy of the overall coding process. Although the process involves an external coder with sufficient level of knowledge in VM, there is still a risk that both coders (i.e. researcher and external coder) can miss the subtle meaning of some of the data. According to Hammersley (1981), the systematic and repeated approach in analysing data influences the quality of data output. Nolan and Behi (1995) suggested that findings should be presented to participants and their views should be explored in maintaining the quality of findings. This process also allows for researchers to obtain the greater trust of the research participants on interpretations of their responses.

This process involves the researcher in discussing with selected research participants on the outcomes from the coding process and obtaining their view. However, Silverman (1993) cautioned that this procedure does not fully validate the findings. It is but a part of making sure the interpretation given is acceptable to respondents.

Cross Case Analysis and Pattern Matching

Upon completion of the data processing process (i.e. coding and assessment of acceptability to participants), the next stage of the data examination is to perform a cross case analysis between the coded data and data obtained from selected case studies of this research. The aim of conducting cross case analysis is to identify pattern matching of variables between cases. The multiple case studies in this research allow for examination of large amounts of data in order to understand the similarities and differences between the cases.

An approach suggested by Eisenhardt (1989) is used in the analysis in this research. The identification of dimensions and constructs from literature are used as a guide to look for patterns within groups that exhibit both similarities and inter-group differences. Dimensions based on the themes/codes generated from the coding process and those obtained from literature provide a framework for the researcher to examine across cases. The analyses are conducted using, matrices of categories, tabulation frequency of events, arrangement of information in chronological order and creation of a data display. The pattern-matching logic is applied throughout the process by comparing an empirical based pattern against the forecast one (Trochim, 1989).

The use of NVivo Version 9 (QSR International Pty Ltd., 2011) in this research assists in managing codes and displaying a relationship between themes using a developed concept model that forms a basis to construct a preliminary framework as an output from this research. The framework and other significant findings are then compiled to be included in a survey form for subsequent validation process.

4.5 DATA VALIDATION

Results obtained from both quantitative and qualitative analyses require to be validated. The validations of both results are validated in two stages. The first stage is the triangulation of data from analysis result. It refers to a process of using more than single source of data as part of validation purposes (Hussein, 2009). Triangulation for this section consists of data collected from all three sources (i.e. interview, survey and document analysis). The second phase is validation through expert panel based on results obtained from triangulation process.

Triangulation process is conducted through analysing results obtained for all three sources (i.e. survey, documents review and interview) through cross verification. A methodological triangulation is used in this research where the focus on results obtained from different types of methods used. This allow for increase in credibility and validity of the results. According to Thurmond (2001, p.254), the application of triangulation enable researcher to reveal unique findings, integrating theories and provide clearer understanding of the problem.

On the second phase, an expert panels are invited to provide their feedback and comments on findings made from the triangulation results. The panels consist of VM practitioners (i.e. Architect, Quantity Surveyor, Value Engineers) and academician in VM field and The experts are required to provide their views and comments on the results. The aim of using the panel of experts to validate the results is to test the significance of the findings of this research in terms of construct validity, external validity and reliability of the chosen case studies.

4.6 PILOT STUDY

Prior to conducting a full-scale study for this research, pilot studies were conducted. There were two phases of pilot study conducted in this research with two separate aims. The first phase of pilot study was conducted prior to the Confirmation of Candidature process of the researcher to test on the overall viability of the research project. The second phase of the project was conducted prior to the actual main study of this research therefore acting as ‘a mini case study’.

4.6.1 Phase One Pilot Study: The Exploration

The main focus of this pilot is to obtain feedback and comments functions of VM in the design process. Pilot study data collection was undertaken using unstructured interviews. The intention of using this method was to explore the possibility of conducting VM research in Malaysia from a VM practitioners' point of view. Issues such as VM application during the construction process, decision-making in VM, workshop processes and multi-disciplinary involvement were explored.

4.6.1.1 Unstructured Interviews

According to Streubert and Carpenter (1999) as cited in Moyle (2002), unstructured interviews evolved as open ended question conversations between the interviewer and pilot study respondents. A topic for discussion is briefly introduced and respondents are free to provide their views on the topic (Fellows & Liu, 2008) while the interviewer records the details. The specific aim of the pilot study interview in this research was to **identify functions and constraints of VM in the design process** as practiced in the Malaysian construction industry. Three respondents were selected for the interview, all of whom possess vast experience in both the practice of, and research into, VM. Interview topics were prepared in advance based upon the literature review. There were altogether four main areas on which the interview sought to obtain views from the respondents. A summary of the structure and topic of the interviews is discussed here:

a. Application of Value Management

All respondents to this topic are in the agreement that the demand for Value Management application has increased since the launch of the VM Circular 3/2009 by the Economic Planning Unit (Office of the Deputy Assistant Secretary of Defense for Systems Engineering) Malaysia. The circular made it compulsory for all public construction projects and programmes, estimated more than RM 50 Million (AUD 16.40 Million), to conduct VM studies. One of the respondents observed that prior to the circular launching; the uptake of VM in construction projects was minimal and mostly only initiated sporadically in the private sector.

The application of VM in construction projects has increased steadily due to various marketing strategies taken by the Government and Institute of Value Management Malaysia (IVMM) in educating construction practitioners of the benefits of VM. Malaysia Airport Holding Berhad (MAHB) for instance, a company that is responsible to oversee airport construction projects in Malaysia has its own VM Department and has made it mandatory for all projects to conduct a VM study as an initiative to increase value for money and optimise construction costs.

In terms of research in VM in Malaysia, there are several researchers actively promoting the use of VM tools for more effective management of construction costs. Most of their research focuses on the contribution of VM in projects (Jaapar & Torrence, 2006), sustainability in VM (Zainul Abidin & Pasquire, 2007), implementing VM in projects and case studies (Che'Mat, 2006b), and application of VM (Ghani, 2004). Based on the respondent's observations, research into VM has matured overtime in many respects, however, some fine tuning of the research is required to more aptly suit the Malaysian construction industry practices and culture. This observation confirms findings made by Jaapar *et al.* (2009) that a knowledge gap on VM application exists among practitioners in Malaysia.

b. Success Factor of VM Studies

Respondents are in consensus that the client's support and active participation are among the most critical success factors in VM studies. Getting these key stakeholders involved in the workshop provides an opportunity to further understand their needs, especially as clients are so directly involved in the decision making process. This finding confirms the results of a study by Shen and Liu (2003) which concluded that client support is the most critical success factor in VM.

Shen and Liu (2003) also found that the multidisciplinary composition of VM teams is critical to a VM study. One of the respondents highlighted that having the right mix of multidisciplinary team members possessing a combined appropriate interdisciplinary skills base is important to ensure that the VM study fully achieves its objectives. Each profession involved in the VM study has its own level of knowledge and experience, which can significantly contribute to the success of the study. There are instances where the VM studies fail due to either participants having an insufficient level of experience, and/or the right person for the study is not invited, for example, a VM study conducted to find an alternative solution for light-weight roof structure construction for an airport project may not achieve the desired result if contractors or consultants with experience in roof construction are not involved in developing and evaluating value adding solutions.

c. Constraints in VM Studies

As suggested by of one of the respondents, there is a stigma among some workshop participants due to VM only being seen by many as a “cost-cutting tool” and this is considered as a threat in getting say the designers of projects involved in the research. This may stem from VM being often associated as part of the natural progression in the Quantity Surveying profession (Ellis, et al., 2005) and their ability to often focus on cutting costs, which presents a negative image (Brandon, 1990 as cited in Green and Liu, (2007). VM is therefore perceived as limiting the creativity of designers in the design stage of a project and all respondent still believe that this misconception of VM still exists among practitioners in Malaysia where there is a need to perceive VM as being a real management tool which works based on structured problem-solving and multidisciplinary contribution rather than being purely a cost saving measure.

4.6.2 Phase Two Pilot Study : The Test Case

The second phase of the pilot study focused on testing the particular research setting, methods and approach before the actual main-study. According to Frankland and Bloor (1999) as cited in Teijlingen (2002), piloting provides the researcher with a ‘clear definition of the focus of the study’ by portraying possible topics and directions to be explored. The method used in the second study is similar with that of the main study setting, which involves survey and interviews. However, the document review method is excluded from the pilot.

The pilot study is conducted using mini cases obtained from the actual case study project as described in Chapter 5 of this thesis. The cases used in this study are meant to explore the issues under study, test the research design and planned methodology and identify potential practical problems that may occur when conducting the main study (Teijlingen & Hudley, 2002).

4.6.2.1 Exclusion of pilot study data

All data collected from the pilot studies was meant to provide information to the researcher on the feasibility of conducting the main study. The information gathered and respondents used in the pilot study are not included in the data analysed under the main study. This measure was taken in line with the findings of Teijlingen and Hudley (2002) who cautioned on the possibility of data contamination should the pilot study result be included in the main study.

4.7 RESEARCH ETHICS CONSIDERATION

This research has been approved by the QUT Research Ethics Committee (UHREC) and is considered as a low-risk research project. The ethics approval number for this research is **1100001014** with validation until February 2016.

4.7.1 Risks

The initial proposed duration of data collection for this study was always considered as a potential risk for this project, this was due to the criticality of collecting all data within a prescribed time period to suit the formally approved programme of the research. Initial correspondence with the potential case study organisation informed the researcher that all consultants for the case study project were working on a busy schedule aimed at achieving the official construction project completion date that was scheduled for July 2013. The move for completion of the project was critically affected by the upcoming Malaysian General Election in March 2013 and the case study organisation was as a result required to speed up progress of all projects. It was seen that this would eventually affect the time available for participants to be involved with this research project. During this period, most offices increased their working hours, making it difficult to secure any appointment for data collection. Secondly, during the course of this research, there is one case study that need to be terminated half way through this research by the case provider. This is was due to confidentiality issue that the case provider faced as it is an on-going project. This eventually prolonged the study and affected the researchers' progress. In terms of risk to the participants, this research has no risk imposed on them in participating with the research. All information collected from the participants was agreed to be treated as confidential and aligned with the UHREC's requirements.

4.7.2 Risk Management

This research is design for a multiple case study that is selected from a single organization that has experience of a large amount of previous VM studies. Therefore, an early approach from the researcher to inform and obtain permission from the case study organisation to participate in the study assisted the organisation in planning appropriate time slots. The researcher made early contact with potential organisations expressing interest in conducting case study and positive replies were received.

4.7.3 Communication on Study Result

It was agreed that as a gesture for participation, the overall outcome of the study would be provided to the participants' organisations. No individual report was to be made to participants. The case study organisation selected has its own Research and Development Unit who agreed to cooperate fully with the researcher in return for being able to use some of the outcomes of the research to contribute to their organisation's future development of use of VM. The report will include an executive summary and findings from the study including some supporting information (i.e. statistics) and also a copy of the framework developed.

Chapter 5: Case Study Design

One of the aims of this research is to obtain the perspectives and views of construction professionals on the effectiveness of multi-disciplinary involvement with VM workshops. The focus is to understand how multi-disciplinary teams interacts during workshop processes specifically when examining issues relating to design development and how does such interaction influence the VM outcomes that may subsequently facilitate better and improved construction processes on-site. Therefore, a case study approach was used in this research to investigate the process of design development throughout the VM workshop.

According to Robson (2002 p.178), a case study is 'a strategy for doing research that involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence'. The setting of this research project offering multiple case sources of evident points anticipated to benefit and assist in achieving the research aims and objectives as stated previously. The in-depth investigation as suggested by Hamel et al (2003) as cited by Jones and Lyons (2004) advocated on the use of a variety of methods to investigate the phenomena in question.

Table 17 Relevant situations for different research methods (Yin 2009)

Method	**Form Research Question**	**Requires control of behavioural events?**	**Focuses on contemporary events?**
Experiment	How/why?	Yes	Yes
Survey	Who/what/where/how many/how much?	No	Yes
Archival Analysis	Who/what/where/how many/how much?	No	Yes/no
History	How/why?	No	No
Case study	How/why?	No	yes

Table 18 refers to the variety of methods used in this research to achieve a solution to specific research questions, the forms of questions and the degree of control required by the researcher. Each of these methods has its own strength and focus in answering particular research questions. A case study approach is appropriate to be used when the research deals with contemporary events in which the behaviour of the people or systems at the centre of the research problem cannot be manipulated (Yin, 1993). However, Yin (2009) states that there are three conditions to be fulfilled before deciding to choose a case study approach for a research. The three conditions are as follows:

i. The type of research question

In the case for this research; the "how" and "why" questions are the main forms of questions that drive the selection for a case study approach. Based on this research; the research questions are as follows:

1. *How the design planning process of a construction project is conducted through Value Management workshop?*
2. *What are the factors that influence human interaction and decision-making process of VM workshop participants?*
3. *How does multi-disciplinary participant involvement in a VM workshop affect the outcomes of the planning and design of a project?*
4. *What are the impact of these interactions and decision process through VM has on the subsequent construction phase of a project?*

This decision is also supported by a need for the study to deal with operational links and traces over time rather than just mere frequencies of incidences suggested by Yin (2009), The use of VM as a practice as specifically experienced by MAHB is the focus of this research.

ii. The extent of control an investigator has over actual behavioural events

The researcher has minimal control over actual behavioural events of the selected case studies. However, the KLIA2 project packages offered a variety of VM cases that are crucial in answering the research questions. All cases are currently on-going projects that are expected to complete by April 2014. Therefore, some level of risk is expected in term of respondent's willingness to cooperate, access to documents and time constraints for interviews and survey, which are dependent on time being able to be allocated away from crucial project related activities..

iii. The degree of focus on contemporary, as opposed to historical events

The KLIA2 project is an on-going series of construction projects with expected completions by mid-2014. The initiation of the projects commenced as early as 2008 with numerous recorded VM studies having been able to provide part of the primary documents for the study. The consultants involved with the project are still serving the project development, which offer access continuous direct input on the contemporary issues of VM to assist and validate the study. All of these reasons add to the justification in selecting the case study as an approach for the research as contemporary and historical events are all made available. Furthermore, the exploration of dynamic processes and changes in an organisation are among characteristics that can be explored in this project through use of the case study (Croswaithe et al. 1997).

5.1 MULTIPLE CASE STUDIES

The investigation of a case study is a strategy used to research an experimental theory or topic using set procedures, comprising several different combinations of data collection such as interviews, surveys and documentary evidence, where the emphasis is towards investigating a phenomenon within a context (Fellows and Liu (2003) cited in (Knight and Ruddock, 2008). An exploratory case study is proposed for this research in order to investigate a contemporary phenomenon in depth and within its real life context (Yin, 2009).

The aim of using the case study methodology for this stage of the research is to expand the propositions of VM as a structured approach to decision-making and multidisciplinary team effort as being highly beneficial in construction projects. The exploratory study intends to investigate the presumed causal links in real-life interventions that are too complex for the survey or experimental strategies (Yin, 2009). In this study, the multi-disciplinary involvement/participation in VM workshop forms the ***unit of analysis***.

In selecting the number of cases for the study, Herriott and Firestone (1983) in Yin (2009) assert that multiple case studies are more compelling and the overall study of several cases is regarded as being more robust as compared to a single case study. However, Yin (2009) cautioned that in order for a study to be regarded as robust, the design of a multiple case should allow for “replication” of the same design in which every case selected will adhere to same protocol and procedures. In the context of this research, the ‘unit of analysis’ that refers to the multi-disciplinary participant involvement is not unusual (Che'Mat, 2010), neither is it a rare case, which requires just a single case study to be executed. The VM study in general terms, is an effort taken to enhance project value and function (Kelly et al., 2002) in which documented evidence of past VM case studies reported can be obtained through the review of extant and current literatures.

5.2 CASE SELECTION CRITERIA

This research has selected the national construction sector of Malaysia as the case study area for examining VM. Despite VM only being introduced into Malaysia in 1986 (Che'Mat, 1999), it has not to date become widely practiced in the country (Jaapar and Torrence, 2005; Jaapar and Torrence, 2006). The term "widely practiced" refers to the limited reported study of VM conducted in the Malaysian construction sector on either private or public funded projects. In December 2009, the “Value Management Guideline Circular 3/2009” authored by Economic Planning Unit (Office of the Deputy Assistant Secretary of Defense for Systems Engineering) was made mandatory for use on public construction projects valued more than RM 50 million (AUD 17 million) to undertake VM studies. This indicates a potential increase of projects using VM and as such, one criterion for project selection is for it’s use as a suitable case study to suit the research objectives.

Case selection criteria

Yin (2009) has suggested that a defined set of operational criteria is required to select a case. This is to avoid cases being selected that in the future turn out to be non-viable. Based on the research questions, objectives, propositions and literature reviewed, the following criteria have been selected for the case study selection.

1. Completed projects with VM studies

In every VM study, the outcome of each study will be documented and produce as report submitted (Kelly et al., 2004) to the project sponsor. This document consists of information such as project details, drawings, project issues which prompted the study, decisions made, report of every phase of the Job Plan and cost estimates based on decisions made.

2. Building or Civil Engineering Works Project

A VM study can be apply to any construction project (Kelly et al., 2004), programmes, manufacturing design (Dell'Isola, 1982), alternative dispute resolution (Tanenbaum, 2004) and many more. However, this research sets building and/or civil engineering works projects as the selection criteria.

3. VM study initiated with design as a main factor of investigation

The study of VM can be initiated on any grounds, depending upon the need of the clients. A client may want to see whether their project proposal is worth investing in, VM is conducted to study the viability of the proposal. Or a project having serious cost overrun may initiate VM to seek a solution as a cost saving measure. Despite their potentially being many reasons to undertake VM, a study that is initiated due to a focus on design issues will be shortlisted. The consideration of design can range from initial design development, detail design, design changes to suit budget up to complicated design. All of these factors can be covered under the definition of design as a suitable topic for a VM study.

4. Multidisciplinary team composition including stakeholders

The requirement for an effective VM study is to have a multi-disciplinary representation in the workshop. This allows for contribution of ideas from different perspectives and enhances the quality of problem solving and decision-making. There are three major groups that this research attempts to identify in a multi-disciplinary composition. The first is the client group, consultants and finally stakeholders. These three groups represent a generic composition of participants in a typical design improvement oriented VM workshop.

5. Organizations that has establishes procedure to conduct VM study

This criteria is required to ensure that information collected from cases are based on conduct of VM workshop which are in accordance to specific guidelines/procedures. This criterion is place as measure to increase the quality outcome of this research and maintaining the consistency of VM application across all selected cases.

VM studies that have met all of these criteria are selected for further investigation.

5.3 TIME FRAME

There are two aspects to the issue of the research time frame that will be discussed in this sub-section. The first aspect covers the time dimension of when this research will take place and second aspect is on the project phase of the selected case study.

This research is designed to be conducted based on a cross-sectional study approach in terms of time. It refers to an investigation being conducted at one particular period of time. Projects are selected and data collection is conducted within stipulated time frame with constant on-going monitoring of the project progress. The cross-sectional approach is taken due to the nature of this study that focuses on capturing respondents' experience of the organisation of previous VM workshops without having to monitor the effect of the entire VM process.

This research has allocated three months for data collection purposes and obtaining necessary approval from relevant authorities is required. However, the actual time spent in collecting data and obtaining gatekeeper's approval took more than seven months. The delay of the additional four (4) months from the original time frame was partly influenced by the process of obtaining further approvals from case study organisation to provide access to all chosen cases. The details of the process will be discussed in the following section of this Chapter.

The second aspect of time frame of this research touches on phase of construction project that this research is focused on. This research focuses on VM workshop application that has been conducted during the pre-construction phase of a construction project. The definition or boundary of pre-construction phase covers the stage from project initiation phase until prior to Contractor's commencement of work on-site. This is due to the objectives of this research seeking to understand the multi-disciplinary involvement of stakeholders at the project design planning stage of a project, using VM applications. In addition, majority of literature (Kelly and Male, 2004; Dell'Isola 1997; Che'Mat 2010) asserts that the influence of VM in construction projects is highly effective during the earliest possible stages of the project. Therefore, projects that have conducted VM during pre-construction phase that falls under the definition set in this research are shortlisted as potential case studies.

5.4 CASE STUDY BACKGROUND

The Malaysian construction sector has been selected as the research location in terms of researcher's knowledge of the sector, geographical factor and it's status of being a developing country where the construction sector has contributed significantly to the economy. The construction sector has contributed an average of 3.3% to the Malaysian GDP from 2009 to 2011 (Construction Industry Development Board (CIDB) Malaysia, 2013). The construction sector based on CIBD is divided into four (4) categories - infrastructure, non-residential, residential and commercial. The infrastructure category contributed 68% of the total value of work carried out in 2011 that is the biggest among all categories (Construction Industry Development Board (CIDB) Malaysia, 2013). Both the private and public sector contributed significantly to the economics where majority of Foreign Direct Investment (FDI) and Domestic Direct Investment (DDI) projects focuses on the 68% contribution of the Construction industry to national GDP.

Because of Malaysia’s developing country status, the application of VM has not yet reached its maturity as compared to other countries that have established VM such as Hong Kong, Australia, United States and Japan. However, the awareness and increasing demand for its application has been reported in several publications (Jaapar, 2006, 2008; Jaapar, et al., 2009). Therefore, the Malaysian construction sector with increasing application of VM is selected as a suitable case study area for this research.

The search for projects that have already adopted the VM application is conducted throughout the early stage of this research. Both private and public sector organisations have been approached and reviewed to seek further information about their of VM application. From the preliminary search and screening made, there were several organisations from both sectors that expressed interest in allowing research to be conducted. However, due to the criteria set in advance for this research, where only organisations with procedures and policies in place confirming their use of VM will be used as a potential case study. Due to this criterion, only the public sector organisations were left as options with which to proceed.

There are two public organisations that have been conducting VM in most of their projects with an established sets of procedures, policies and guidelines on its implementation. The organisations were the Public Works Department (PWD) and the Malaysia Airports Holdings Berhad (MAHB). The PWD is a department under the Ministry of Works Malaysia with responsibility to oversee all public funded construction projects in Malaysia. The MAHB on the other hand, is a public listed company under the Ministry of Transport Malaysia with a function of sole airport operator in Malaysia.

Expression of interest and proposal was sent to both organisations expressing researcher’s interest to conduct study on VM implementation. However, only MAHB has replied to the research team with their intention for further collaboration in this research. Access has been granted for six (6) case studies of project packages under the current on-going airport project in Sepang, Malaysia.

The following sub-section will be discussing how the case study was obtained for this research and the processes taken to secure access to all cases.

5.5 THE PROJECT

Approval and access was granted on the current on-going airport construction project in Sepang, Malaysia. The project under study is the **Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor, Malaysia.** Hence the project is called **'KLIA2'** and the planning phase for this project is under the supervision of Planning and Development Department (P&D) of MAHB.

Figure 7 KLIA2 Site Location in Sepang, Malaysia (Source:www.klia2.info)

The project is located within the province of Sepang in the state of Selangor Darul Ehsan (Refer Figures 7 and 8). The new site for KLIA2 is on the opposite of the existing KLIA airport and adjacent to the Low Cost Carrier Terminal (LCCT) which currently accommodating Air Asia as major airline operator in the airport.

Figure 8 KLIA2 Aerial Site Overview (Source:www.klia2.info)

The project is a Government funded project aimed at building a new low cost carrier terminal airport that could accommodate 45 mppa (Million Passengers Per Annum) and operation of low-budget airline companies upon completion. The **Malaysia Airport Holdings Berhad (MAHB)** has been entrusted to oversee the entire process of planning, design, construction and operation of the airport. MAHB is a public listed company and licensed under Malaysia's Ministry of Transport to carry out its function as airport operator in Malaysia (Malaysia Airports Holdings Berhad, 2013).

The KLIA2 project is publically funded and financed through the Ministry of Finance (MOF) Malaysia with aims to cater for increasing numbers of passengers using the current Low Cost Carriage Terminal (LCCT) which was expected to reach its maximum capacity by 2020. The current LCCT based on projection made in KLIA Master Plan 1982 is designed to accommodate 15 MPPA (*million passengers per annum)* while the National Airport Master Plan 2008 (NAMP) has projected increasing growth due to ongoing expansion in aviation industry.

A comprehensive study made through the NAMP 2008 committee involving stakeholders comprises of MAHB, Ministry of Transport, Ministry of Finance, Department of Civil Aviation, Ministry of Home Affairs and all airlines has concluded with a recommendation for a new airport to be built. Moreover, based on review on the original KLIA Master Plan 1982, the growth of the aviation industry, rationalisation of routes, liberalisation of air service agreements and aviation security requirement has significantly influenced the need for a new airport (Malaysia Airport Holdings Berhad, 2011).

Air Asia Sdn Bhd is currently a major occupier of the airport serving both domestic and international flights. Due to their business expansion via Air Asia X, the company has projected growth and increased numbers of passengers using their aircraft for travelling, coupled with the introduction of new routes to India, China, Europe and Australia. Furthermore; Air Asia has been reported to be forging a deal with Airbus for the purchase of 200 (A320 neo) aircraft that are expected to arrive by 2015. This has prompted the need for a bigger and more sophisticated airport to cater both for the increasing passengers and more numerous and complex flights demands.

Therefore, under the KLIA Master Plan 1982, the NAMP 2008 and the drive from the major clients has created KLIA2 as the next public funded mega project which is expected to be completed by 28 April 2014 (The News Straits Times, 2013).

This research is initiated with the aim to obtain the comprehensive and detailed perspectives and views of construction professionals on multi-disciplinary involvement with VM workshops on the KLIA2 project. The MAHB is the sole Government Linked Company (GLC) that has established its own policies that mandate the use of VM in all tendering exercises.

The mandatory policy as set by MAHB for the entire project tendered, has opened up significant renewed interest in, and need for an enhanced pool of resources to service, the use of VM in construction projects. The KLIA2 project alone is tendered in packages to allow for more competitive bids and to fast track procurement delivery of the project. There are altogether 40 packages tendered under KLIA2 project all of which have been required to go through the VM study process.

The decision to use the case study as an approach for this research is influenced by the nature of KLIA2 projects that comprises of various stakeholders, policies, on-going construction project, inter-department involvement with VM and recorded VM resources.

5.5.1 Malaysia Airport Holdings Berhad (MAHB)

Malaysia Airports is the operator and manager of Malaysia's 39 airports that comprise international, domestic and Short Take-Off and Landing (STOL) ports. The main airport is the KL International Airport (KLIA).

The KLIA2 project is currently under construction and is expected to be complete by April 2014. Under MAHB’s Procurement Activities, System & Procedure (PASP) policy, all tender packages must go through VM study prior to calling of tenders. Subsequently, Value Engineering (VE) studies are also required to be conducted during the construction process as means of offering continuous improvement to the construction process. This policy mandated a compulsory VM study to be conducted to maximise the value to the project and ensure maximum benefits without large implementation cost and schedule.

Based on undisclosed record by MAHB, KLIA2 has conducted a large amount of VM studies for all tender packages with the potential for more VM studies to come. Additionally, as for other airport projects, more than 100 VM studies by MAHB had been conducted.

MAHB through **Procurement Activities, System & Procedure** (PASP) policy is a pioneer GLC to implement VM as a mandatory exercise apart from the public sector. Being the pioneer organisation to use VM, a lot of work has been put in strengthening their practices and position as a benchmark in the industry. The mandatory policy coupled with extensive track record in conducting VM also forms a solid case for the researcher to select MAHB as the organisation providing the best examples of VM of study interest.

5.5.2 KLIA 2 Project Technical Information

The KLIA2 project is procured through Design and Construct (D&C) procurement system. It comprises of 40 main project packages with each packages conducted their own VM study overseas by the Planning and Development Department of MAHB.

Figure 9 Artist impression of KLIA2 Project (Source:www.klia2.info)

The following Table 18 indicates the technical information and features on KLIA 2 infrastructure project:

Table 18 KLIA2 Project Technical Information and Features

FEATURES AND TECHNICAL INFORMATION	
Earthworks Area : 11.19m^2	
Aircraft Stand Area : 803, 709 m^2	
Terminal Building (Main Terminal and Satelite Terminal)	
Floor Areas	250,000m^2 with 32,000m^2 allocated for retail space
Handling Capacity	45 million passengers
Parking Bays	68 Gates and 8 remote stand
	8 Aerobridges
Baggage Handling	Fully Automated Baggage Handling System (BHS)
Car park	6,000 unit Multi-level car park
Passenger Comfort	124pax/sqm (capacity/floor space)
Aircraft Parking Apron	104 Aircraft stand including remote stands
Air Traffic Control Tower (ATC) [93.00 m height] complete with guardhouse, car parks and access road.	

Airport Fire and Rescue Station near Runaway	
Runaway, Taxiway, Pavement and Air Ground Lighting (AGL)	
Runway Integration	Integrate with existing KLIA runway (Runway 1 and 2) with 1 new additional runway 3 construction
Runaway 3 Length	4.00KM (Dual Parallel Taxiway)
Runway 3 Width	60m (Code E)
Runway 3 Connection with Runaway 1 & 2	Lateral 2.2KM taxiway
AGL	New AGL Building with ICAO CAT I System Recommendations
Airside Roads	Apron Service Road, Main Service Road, Perimeter Road, Maintenance and Security Road and Crash Roads
Public Infrastructure Works (Roads)	
Total Length	15KM
Elevated Length	5.4KM
Privatized Facilities	Air Transit Hotel
Special Features	300m Sky Bridge connecting Main Terminal and Satellite Building with 60m of walkalators.

Figure 10 indicates the KLIA 2 terminal building plan that includes a Sky Bridge in Sector 4. The provision for an Integrated Hub that will house a multi-level car park is shown in Figure 10.

KLIA2 has two passenger terminals; the main terminal building will operate as central passenger terminal that house a provision of retail outlets, check-in facilities, immigration, ticketing counters and other airport operation facilities. The satellite terminal will accommodate passengers for International flight boarding and transit movements from Sectors 5 and 7. Both terminals are connected through a 300m long metal Sky Bridge that provides passengers/users to oversee airport operations and transfer between all relevant sectors. The commercial and retail space of 32,000m^2 is located in the main terminal building connecting between Sector 1 (Domestic) and Sector 3(Domestic/International).

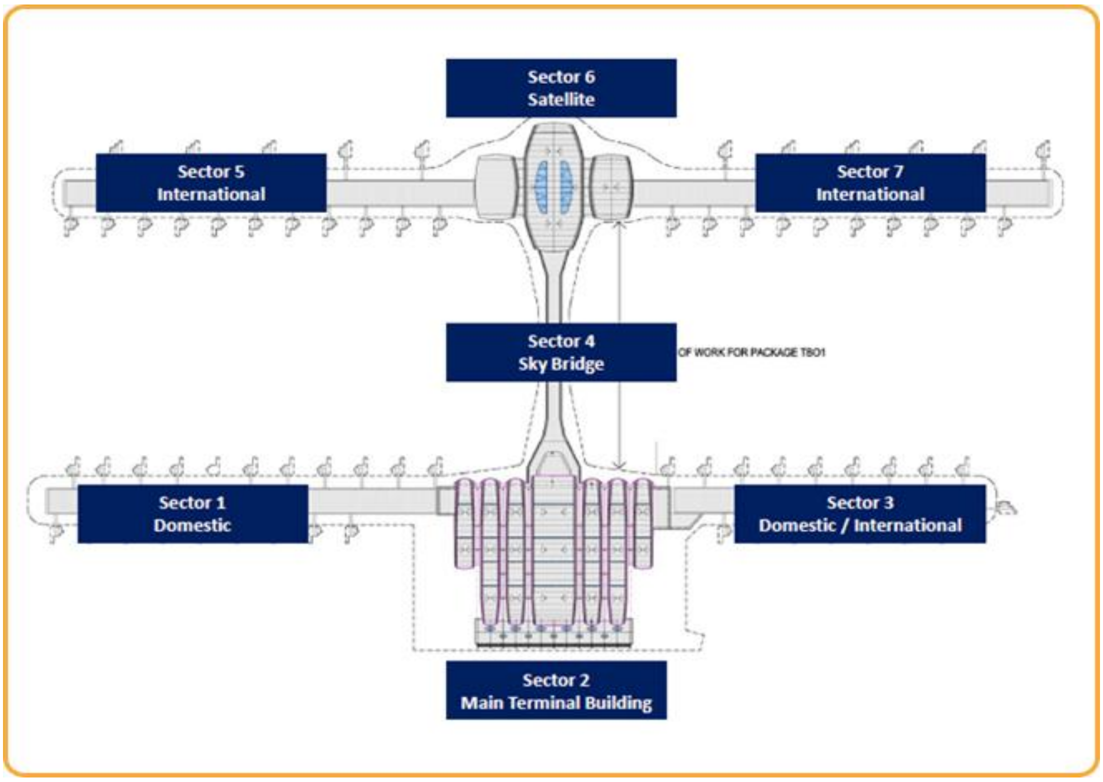

Figure 10 KLIA2 Terminal Building Plan

Figure 11 KLIA2 External View

5.5.3 KLIA 2 Project Packages

Due to the nature and complexity of the airport project with various stakeholders and special interest groups, the project is divided into 40 contract packages. These contract packages include provision for physical construction works as well as professional consultants and specialist appointments. This approach allows MAHB to better manage all packages and oversee the procurement process of the airport project. Table 19 below indicates physical contract packages tendered under KLIA2 project. The packages are grouped into specific category for streamlining the procurement process.

Table 19 KLIA2 Contract Packages

Package Categories	Contract ID	Total Contract Packages
Earthworks	EW01, EW01A and EN01	3
Runaway/Taxiway and Airside Facilities	AF01, AF02, EW02, AF04, AF04A, AF08, FV01	7
Terminal and Aircraft Stand	TB01, TB01B, TB02A, TB02B, TB03	5
Baggage Handling System	BHS	1
Landside	AF06, AECOM 07, AECOM AF05, LF05A & 05B, LF06 and LANDSCAPE	6
Utilities and Infrastructure	UT01, UT02, UT03, UT03A and UT04,UT05, UT06, UT07, UT08	9
ICT Packages	ICT01, ICT02, ICT03 and ICT04	4
Privatised Facilities	Zone C, D, AAB, 4 (Hotels) and ERL	5

Contract packages as listed in Table 19 were tendered in stages to suit the construction phase planning of KLIA2. During the course of this research, the majority of contract packages had already been awarded with most contracts approaching completion stage. Considering the progress status of these contract packages, the opportunity to conduct studies on VM application in KLIA2 project was seen as being highly feasible. The following sub section will discuss the processes and protocols involved in getting access to cases for this research.

5.6 CASE STUDY PROTOCOL: OBTAINING MAHB ACCESS AND APPROVAL

In order to ensure the case study for this research is conducted using a transparent and systematic approach, a case study protocol was designed for data collection purposes. According to Yin (2009), a case protocol is required to ensure a structured data collection process is observed and allows for consistent procedures in capturing data for further analysis.

5.6.1 Expression of Interest

Obtaining access to MAHB from allowing them to provide cases for this research was not a straightforward task. The practice of VM is still in a fairly early stage of development even though its introduction has been made in 1980's. Therefore, in obtaining information regarding the practice of VM in Malaysia, the researcher has registered as a member with the Institute of Value Management Malaysia (IVMM) to gain better access to the VM circle of influence. The researcher attended the AGM held in February 2011 in order to be introduced to key personnel in VM in Malaysia. A short presentation about researcher's project and interests was presented to all members during the AGM in order to attract interest and market the research project. The presentation has led to the introduction to a high ranking MAHB official authority who was also an IVMM committee member.

MAHB as reported during the meeting is the pioneer GLC that has conducted VM study for all procurement tenders.

As a result of attending the AGM, an email was sent to MAHB General Manager (Planning & Development Department) in June 2011 stating researcher's interest to conduct case study with MAHB. An initial approval was given via email also directing the researcher to make further contact with the VM Unit Manager of MAHB. A copy of the initial approval email was sent to the VM Unit Manager.

A comprehensive proposal was prepared and submitted formally to VM Unit Manager to help in obtaining approval to conduct a comprehensive research case study in MAHB. The proposal covered the aims of the projects, methodology, data collection techniques, ethics and protection of confidential information for MAHB. The Manager acknowledged the receipt of the proposal and expression of interest; however, this is the first time MAHB has experienced a request from a research student to conduct research within MAHB. This has lead to delay on part of MAHB in giving full approval for the project. The delay was due to numerous corresponding emails about the research project, the ethical aspects, protection of confidential information, the details required for the project and access to personnel. The proposal submitted has covered all such information required, however, the MAHB authority was still reluctant to give full approval for the conducting of the case study.

The researcher was advised to re-submit a formal proposal and expression of interest to the Human Resources Manager (Learning Unit). Numerous follow ups and emails on the project justification were sent, as a result an official approval email was given to the researcher three weeks after the proposal re-submission.

5.6.2 Meeting with MAHB Representative

The official approval email was copied to the VM Unit Manager and further arrangement for a research kick-off meeting was then made. The meeting was held at MAHB head quarters in Sepang between the researcher, VM Unit Manager and VM Executive from MAHB in May 2012.

Presentations on the research project were made during the meeting thus giving comprehensive information on the scope and direction of the study. Information contained in the presentation was as follows:

a. Background of the research
b. Aim and objectives
c. Benefit of the research
d. Case study protocol
e. Project duration
f. Project case selection criteria
g. Access of cases, documentation and personnel

h. Protection of confidential information on part of MAHB

In return, the MAHB VM Unit gave a reciprocal presentation to the researcher on MAHB practice and policies in using VM for all project tenders. The presentation included past project review of VM practice, the requirements for VM, as well procedures and issues arising from previous and current VM practice.

5.6.3 Approved Project Packages

The researcher was given access to 10 project packages, including to all documentation and project personnel. All of these packages are sub-packages from the on-going KLIA2 project.

All 10 project packages given were based on the availability of documentation and project personnel ready to accommodate research interest. However, case filtration is still required in order to ascertain the right cases to suit the research aims and objectives.

5.6.4 Filtering Cases

The research project has set in advance four main criteria for the case study selection. All four criteria have been discussed in *Section 5.2 - Case Selection Criteria of this Chapter*.

The approved 10 project packages were subjected to filtering process in order to select the most suitable cases that suit the research aims. Out of ten (10) cases given, six (6) cases were shortlisted to proceed with the case study. Details of all six cases are derived from the *Value Management Report* produced by the VM consultants appointed by MAHB.

A summary of the shortlisted cases is presented in Table 20 and details of each case are presented in Appendix G.

Table 20 Summary of shortlisted cases

Package Categories	Contract ID	Workshop Orbjectives	Case ID
Runaway/Taxiway and Airside Facilities	AF08	Cost optimization & Procurement Strategy	CS2
Terminal and Aircraft Stand	TB01	Cost optimization & Design Efficiency	CS5
Landside	AF06,	Cost optimization & Design Efficiency	CS1
	LF05& 06	Cost optimization & Procurement Strategy	CS3
	LF05A, 05B & 06	Cost optimization & Procurement Strategy	CS4
Utilities and Infrastructure	UT03	Cost optimization & Design Efficiency	CS6

5.6.5 Excluded Cases

Not all ten cases given by the MAHB met the research case selection criteria. This section highlights remaining cases that were unsuitable for this research. There are altogether 4 cases that were excluded from this research.

5.6.5.1 Case study 7(CS 7)

Table 21 Excluded Case - AF04A

Project Title	Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor Malaysia
Project Package	AF 04A
VM Subject	Relocation of AGL Sub-Station D and Associated works
Client	Malaysia Airports Holdings Berhad (MAHB)
VM Consultant	MCM Value Sdn Bhd
Reason to Exclude	The study focus on the relocation process of the sub-station and specific preference on design are not reported in the VM report.

5.6.5.2 Case study 8 (CS 8)

Table 22 Excluded Case – BHS

Project Title	Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor Malaysia
Project Package	BHS
VM Subject	Baggage Handling System
Client	Malaysia Airports Holdings Berhad (MAHB)
VM Consultant	MCM Value Sdn Bhd
Reason to Exclude	The study focus on the decision to select the best type of BGS for the project combined with user requirements and future expansion. No specific reference that made on the design apart from the running system itself.

5.6.5.3 Case study 9 (CS 9)

Table 23 Excluded Case - ICT 01B

Project Title	Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor Malaysia
Project Package	ICT 01B
VM Subject	Supply, deliver, install, configure, testing and commissioning of ISP infrastructure & active equipment
Client	Malaysia Airports Holdings Berhad (MAHB)
VM Consultant	MCM Value Sdn Bhd
Reason to Exclude	The study focuses on the IT installation system that is not part of the research interest.

5.6.5.4 Case study10 (CS10)

Table 24 Excluded Case - UT03A

Project Title	Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor Malaysia
Project Package	UT 03A
VM Subject	Relocation of Utilities
Client	Malaysia Airports Holdings Berhad (MAHB)
VM Consultant	MCM Value Sdn Bhd
Reason to Exclude	The study focus on the relocation process of all utilities and specific preference on design are not reported in the VM report.

5.6.6 Establishment of a Reporting System

In an effort to protect the confidentiality of all information, MAHB has requested a formal communication procedure to be adhered to by the researcher. The researcher has been assigned to work with a VM Executive Officer from the VM Unit in assisting with any information pertaining to the project.

The researcher was required to report regularly to the assigned VM Executive Officer on the progress of the research. No written report was required, however emails were required to be sent weekly and copied to the VM Manager. Apart from monitoring by the VM Executive Officer, MAHB involvement in this project is essential in influencing potential respondents to be involved with the study.

5.6.7 Access to Documentation and Personnel

MAHB has its own policy and procedure in disclosing any information for public access. For this study, the researcher is required to conduct all document review exercises in the MAHB Headquarters Office (Planning and Development Department).

The researcher was assigned a workstation complete with Internet access within the VM Unit.

Documents such as reports, policies and project files were not allowed to be photocopied or scanned. Therefore, the researcher needs to attend to document review exercises on a daily basis to properly capture all information provided.

The researcher has designed a specific form that summarises all information required for the study in order to capture entirely all relevant information about the projects. A sample of this form is attached in **Appendix B**.

In accessing information on VM participants for all project packages, the researcher worked closely with VM Executive Officer in obtaining all contact details and gaining subsequent access to them, especially when VM reports did not include any details on contact information.

Although previous participants' involvement has been recorded, the researcher observed that complete databases of all contact information were not established. This lead to some respondents' contact information needing to be retrieved through Google search and the personal contact records of the VM Executive Officer in MAHB. The expected risk of an **incomplete database** could lead to the outdated contact information being provided which in turn may not allow the potential respondents to be contacted.

Apart from incomplete contact database, the **contractual validity** of all consultants did play an important role in gaining access to potential respondents. As recorded from the document review, majority of all VM studies were conducted between end 2009 and mid 2010. The appointment of all consultants should follow the contract duration in providing their consultancy services. However, in the case of KLIA2 project, the appointment of Project Management Consultants (PMC) has been terminated prior to the construction project completion. The reason for their termination has not been disclosed to researcher due to confidentiality concerns.

The researcher had foreseen this termination as a potential 'excuse' by the potential respondents to be excluded from the study, citing their non-involvement with the project development.

Notwithstanding instances of an incomplete database and contractual validity of consultants, the researcher managed to obtain a complete set of all contact information and details to assist in reaching the respondents. The establishment of a healthy working relationship with the VM Unit staff has helped the researcher to obtain much of the incomplete database.

5.6.8 Review of Questionnaire and Interview Documentation

Although this research was required to obtain Human Ethics Approval from QUT that involved a review on all processes and documentation used for collecting data, the researcher was also required to adhere to MAHB authority policy with regards to the conduct of the research.

The VM Unit requested the researcher to submit the survey questionnaire and interview questions to be review by the unit. The objectives of this review was to ensure that any questions deemed too sensitive on the part of MAHB or having any potential risk to MAHB or the participants, or which might affect MAHB's image would be eliminated.

The researcher submitted all the documents required for MAHB scrutiny and no further amendment was required from the documents. No questions were omitted from the survey questionnaire and interview questions. The researcher then proceeded with the data collection process.

5.6.9 Agreeing a timetable

Since the project was an on-going and had construction activities with a tight deadline to be met, the researcher agreed with the MAHB to abide by all conditions related to timetabling in accessing construction sites and personnel for interview and data collection. All documentation access for the project can only be accessed during office hours of MAHB head-quarters with restrictions on making copies to any documents. In term of accessing interviewees on-site, the researcher was required to report to the Superintending Officer (S.O.) on site prior to gaining access to conduct interviews. Work, Health and Safety induction was required to be completed prior to being given a green card granting site accessibility.

5.6.10 Protecting MAHB Interests

The KLIA2 project is a public funded project by the Ministry of Finance Malaysia. Therefore, the performance and progress of this project is always subject to media and public attention. Issues such as selection of site, development cost, delay and specific user requirements tend often to become the unwanted centre of negative media attention rather than the media concentrating on the benefits this project will provide to the aviation and tourism industries of Malaysia.

In protecting the interests of MAHB, this research is not allowed to make public any sensitive information about the project especially on the development costs and changes to scope of the project. Both issues are considered as easy targets for critics of the organisation and would seriously affect the image of the project and MAHB as the owner.

No written non-disclosure agreement has been signed between the researcher and MAHB. MAHB has entrusted the researcher in conducting this research with certain limits impose.

The information pertaining to development cost of this project in report is meant for internal academic exercise and not to be publicly circulated.

5.6.11 Publication Permission

As a goodwill gesture in return for MAHB’s generosity in providing access to KLIA2 project packages, the researcher has offered a joint authorship opportunity with the MAHB VM Unit to report on findings made from this research in subsequent conference or journal papers.

This offer is also considered part of the researcher’s effort in making this research more transparent. All data collected is accessible by MAHB and they will undertake to filter out any sensitive information emanating from the data collection process prior to anything being published.

5.7 CASE STUDY KICK-OFF

In gaining access to project personnel (potential respondents), the researcher needs to adhere to another procedure set by MAHB.

There are two sets of letters that need to be sent to the KLIA2 project Superintending Officer (SO). The first letter refers to the application to gain access to the project site office where all consultants are based and some documentation is kept. The location of project site offices is remote from the MAHB head quarters therefore gaining access to the office requires a different set of permissions to be obtained. The second letter refers to the application to obtain approval to interview project consultants. A potential respondent list is required to be attached in obtaining approval. A copy of the letter is required to be sent to the General Manager for KLIA2 project and

General Manager of Planning and Development Department of MAHB. This exercise is required when the researcher approaches potential respondents and requires to gain access to project site offices. The document review technique adopted for this research did not require such a permission letter as the official approval by MAHB authority was sufficient to gain access.

Both letters sent to the SO are meant to obtain approval and form part of the effort by MAHB to monitor the flow of the case study information and data. On the researcher's part, this exercise helps to increase the transparency and accountability of the research. Once approval from the SO was obtained, the researcher proceeded with distribution of survey questionnaire and interview.

5.8 PILOT CASE STUDY SUMMARY

Upon obtaining approval from MAHB to proceed with the study, a briefing was given at their office to explain the content and purpose of the research and discuss access to case studies. Two project packages were given access under the KLIA2 project for pilot study purposes. The packages were as follows:

a. Package TB02A : Aircraft Parking Apron

b. LCCT Packages Cost Review 1 -4

However, due to the limitation of time allocated for the entire data collection process, only package TB02A was selected for the pilot study. Both data collection methods (i.e. survey and interview) were conducted on the pilot project.

The Survey

In order to avoid contamination of data with the main study, only 1 representative from each discipline of a VM workshop participants was invited for the survey and interview. The list for which the selection was made was obtained from the VM report published for TB02A project packages that contained the name, company and contact details of the respondent. An invitation was sent to each of them to participate with the pilot. The survey was circulated and the table below shows the responses from professionals:

Table 25 Pilot Study Respondents

Ref	Respondents	Survey	Interview	Qty
1	Client	-	*Yes*	1
2	Quantity Surveyor	*Yes*	*Yes*	3
3	Architect	*Yes*	-	1
4	Engineer	*Yes*	-	1

Respondents gave their consent to participate in both data collection exercises as indicated in Table 25. The comments addressed in the pilot survey were generally focussed on wording of the questions, general terms used in construction and proposals for questions that were not relevant to the study. The timing to complete the survey and flow of questions received positive feedback without requiring any further changes. All comments were taken into account when revising and developing an improved version of the questionnaire.

Only two interviews were conducted as pilot study. The remaining potential respondents (i.e. Architect and Engineer) requested to be excluded from the pilot study citing their interest was in the full scale study where their views can be fully taken on board and used in the findings. Therefore, the Quantity Surveyor and the client for this project contributed their time and feedback on the interview process. The result obtained from the process was positive, as both interviewees were able to respond to every question. However, minor changes were made on the arrangement of questions and re-phrasing of one question to suit the MAHB environment. The time taken to conduct each interview was considered reasonable to the respondents considering their involvement was being made at a crucial time of the KLIA2 project completion.

In summary, it is concluded that both methods (i.e. survey and interview) designed for the case study are observed to be practically suitable to be conducted on a full-scale study in MAHB. These observations were made based on feedback and comments made by respondents on the pilot study. However, comments on the practicality of conducting document analysis were reserved at this stage as no particular pilot test was conducted for this method.

5.9 DATA COLLECTION PROCESS

This sub-section will discuss the data collection process for the cases.

5.9.1 Document review

The document review process starts with the designing of a specific form, which is meant to collect and simplify the information obtained from the review. The sample of the form is attached in **Appendix B**. For the purpose of this research, there are four major documents reviewed to support the study objectives:

MAHB Value Management Manual

The VM manual set as a manual for MAHB staff to undertake VM study for all project packages to be tendered. The manual covers methodology, tools and techniques, forms and processes involved in a VM study. The document provides an overall view on how VM is being undertaken within MAHB organisation. Information on the flow of the VM job plan and techniques used is being retrieved so as to support the report on processes of VM in order for these to be compared with existing practices and literature. In addition, the VM Job plan information is being used as basis to support interview question development.

Financial Limit of Authority (FLOA) Guidelines

This document is mentioned in the VM Manual, which forms part of the documents required to conduct a VM study. The document outlines procedures and processes involved in obtaining approval to finance the proposed projects. Its sets the financial limits of any proposed project against the need and policies of MAHB and the level of approving authority. The financial limit as stated in this document is accompanied with procedures on conducting VM studies as part of the measures taken to meet the financial limit requirements. Based on the document, the requirement to conduct VM studies does not apply to all proposed project packages. However, the need for VM is subjected to certain estimated development costs, which are in excess of RM 300,000.00 (AUD 100,000.00). The document was reviewed in getting the procedural information on the requirements to conduct VM studies.

Procurement, Policies, Procedures and Guidelines (3Ps)

This document is mentioned in the VM Manual and form parts of documents required to conduct a VM study. The document details the procurement procedures, processes and the requirements for a project to be tendered. It includes the level of approving authority required against certain limits of financial requirement of the projects. It also includes procedures in appointing external consultants with specific reference to a VM facilitator.

Value Management Reports

The VM reports are comprehensive documents that describe the entire VM study processes, procedures and techniques used to achieve specific objectives of the study. The report is prepared upon completion of a VM study by the VM facilitation team. The objective of the report is to record decisions made during the VM study with supporting facts regarding facilitating further management of the construction process. In addition, as a practice of MAHB, the VM report is used in reporting to the Board of Directors on any cost and time implications of the proposed project. The information contained in this report is as follows:

- Project details
- Time, date and location of VM study
- Value Management methodology
- Function Analysis
- Consultants presentation slide of project issues
- List of generated recommendations
- List of shortlisted recommendations
- List of participants
- Analysis of shortlisted recommendation

The researcher was given full access to the VM report for all six cases (CS1-CS6) where each case has its own series of reports. All information from this report is extracted and transferred into a “Document Review Form”. The researcher as much as possible has attempted to capture all information from the reports by note-taking and transcription as photocopying was not allowed.

Drawings

For the purpose of this study, drawings are used as supporting documents to identify the locations, the scope of the study and recommendations made during VM study. Only drawings associated with the VM study and the master layout plan were given permission by the MAHB authority to be used for the purpose of this research.

5.9.1.2 Information Collected

The analysis of documents for this research has generated key information, which forms a basis to structure subsequent interview questions and guide the case study process. The following are attributes derived from the documents analysis:

- Project details information
- Visual documents used for the study (i.e. drawings, PowerPoint presentation, sketches etc)
- The objectives of the workshop
- Workshop agenda
- Workshop participants list and details
- The boundary set for the study
- Cost plan
- Function analysis process
- List of generated ideas
- VM recommendation
- Action plan
- Approving authority for all recommendation
- Procurement system and procedures

Attributes listed above are used to provide insight and create a foundation to understand the whole scenario of VM as practiced by Organisation A. It is observed that the methodology applied and approach taken in the VM process are similar to existing literature relating to what is practiced in typical VM workshops. The management during pre and post workshop phase, the Job Plan, tools and techniques as well as facilitation style are reflective of what has been practiced outside of the case study organisation. The flow of each of the five phases of the Job Plan are clearly reported with key findings at the end of each phase. 'Brainstorming' technique has been used as a main driver to stimulate creativity among participants while Function Analysis is use to investigate core issues in the design of the project.

5.9.2 Survey

The second stage of this research is the distribution of a questionnaire survey. This research relies on a non-probability sampling technique in distributing the questionnaire. The population of this study refers to the participants of VM study conducted by MAHB. Based on MAHB records, there are more than 100 VM studies previously conducted by MAHB that cover various types of projects, programmes, systems, procurement methodologies and procedures. Purposive sampling is used to derive a relevant sample of the population of interest. A predefined group constituting a sample is determined in advance during the selection of case study. The narrowing of the sample for this research is restricted to *VM participants for construction project packages under MAHB*. Although there are many VM workshops conducted under construction packages, only samples from approved project packages were used for this research.

5.9.2.1 Sampling Frame & Size

The distributions of questionnaire are based on sampling taken from a list of VM study participants. Based on VM reports, the distribution of samples per VM study is as follows:

Table 26 Distribution of samples

Project Packages	AF06	AF08	LF05 & LF06	LF05A, LF05B & LF06	TB01	UT03	
Case ID	CS1	CS2	CS3	CS4	CS5	CS6	**Total**
Samples	34	28	23	29	47	12	173

5.9.2.2 Sampling Duplication

Although initial sampling procedure calculated a requirement for 173 samples, the researcher found that not all samples were valid to be used. This is due to duplication of samples identified from the list of VM participants found in different reports. There are instances where one participant has attended more than two VM studies and it would be ineffective for them to answer more than 1 questionnaire focussing on the same issues. Therefore, only 1 set of questionnaires was sent to each respondent. In deciding to select samples of respondents which has participated in more than 1 VM study, the research employed a simple random sampling approach for each duplicate sample. For example, if Respondent 1 (R1) has participated in 3 VM study (i.e. AF06, AF08 & TB01) each packages will be assigned with numbers (i.e.1, 2 &3). Using a service from true random number generator (Haahr, 2011), a random number is generated and used to select the project package which will be used as reference for R1 sample. Based on the simple random sampling technique in eliminating duplication of samples, a revised distribution of samples table is derived.

Table 27 Revised distribution of samples

Project Packages	AF06	AF08	LF05 & LF06	LF05A, LF05B & LF06	TB01	UT03	
Case ID	CS1	CS2	CS3	CS4	CS5	CS6	**Total**
Samples	24	21	10	16	47	8	126
%	19.04	16.67	7.94	12.70	37.30	6.35	100%

Therefore, finally a total of 126 respondents was used for this research

5.9.2.3 Survey Distribution

Based on meeting with VM Unit held to obtain contacts details of potential respondent, the researcher decided to employ three (3) methods of questionnaire distribution. This was due to some incomplete details of contact information obtained. An initial request was made to include name, office address, contact numbers and email address as information to assist with the distribution. However, incomplete details were received which resulted in the need for multiple distribution methods used. Three distribution methods used for this research were as follows:

a. Postal Distribution

This method was conducted by posting questionnaire to registered address. The content of the envelope sent consist of:

- i. Invitation Letter
- ii. Questionnaire
- iii. Researcher's self-addressed envelope with stamps

b. Email Distribution

A soft copy format of the questionnaire is converted into Microsoft Excel format. This format is distributed to respondent where only their email address is available as point of contact.

c. Physical Distribution (Face-to-face)

The physical distributions of questionnaire are only being carried out within the MAHB headquarters office. The distribution is based on staff identified in the VM participant list.

The distribution of questionnaires using all three methods mentioned above is summarised as follows:

Table 28 Survey distribution methods

Project Packages	AF06	AF08	LF05 & LF06	LF05A, LF05B & LF06	TB01	UT03	
Case ID	CS1	CS2	CS3	CS4	CS5	CS6	**Total**
Total Samples	24	21	10	16	47	8	126
Postal	13	10	5	5	11	5	49
Emails	5	3	3	8	23	1	43
Face-to-face	6	8	2	3	13	2	34

5.9.2.4 Survey Time Frame

Each respondent was given 3 weeks to complete the questionnaire and return back to the researcher.

5.9.2.5 Follow Up

The researcher set up a procedure in following up with all respondents. Two follow up were sent out, the first was 2 weeks after distribution while the final call was sent out after the completion of the allocated 3 weeks period. Emails and phone calls were used to follow up with all respondents. As for the face-to-face distribution methods, phone calls and emails are only made on the first call, and the final calls are made through arrangement between researcher and respondent for collection.

5.9. 3 Interview

The sample from VM reports are categorized into 6 sub-groups to enable the researcher to identify a distribution of samples according to the different professional backgrounds of respondents and to facilitate ease of follow up on responses.

Table 29 Workshop participant distribution

VM Workshop Participant

Project Packages	**AF06**	**AF08**	**LF05 & LF06**	**LF05A, LF05B & LF06**	**TB01**	**UT03**	
Case ID	CS1	CS2	CS3	CS4	CS5	CS6	**Total**
Client	4	-	1	2	6	1	14
PMCs	1	-	3	2	4	3	13
VM Facilitator	1	-	1	1	6	1	10
Airport Management Team	5	-	1	-	5	-	11
Engineers	8	-	1	6	6	2	23
Architect	1	-	-	-	7	-	8
Quantity Surveyor	1	-	-	-	7	1	9
Interior Designer	-	-	-	-	3	-	3
Specialist	4	-	1	2	1	-	8
Total							99

5.9.3.1 Interview Invitation

Table 30 Invitations to Participate

Interview Invitation Sent

Project Packages	**AF06**	**AF08**	**LF05 & LF06**	**LF05A, LF05B & LF06**	**TB01**	**UT03**	
Case ID	CS1	CS2	CS3	CS4	CS5	CS6	**Total**
Total Samples	25	-	10	16	40	8	99
Invitation Emails	25	-	5	16	40	8	99
Response	2	-	2	2	10	1	17
Face-to-face	1	-	2	1	13	2	19

5.9.3.2 Interview Response Rate

Table 31 Interview Response Rate

Project Packages	AF06	LF05 & LF06	LF05A, LF05B & LF06	TB01	UT03		
Case ID	CS1	CS3	CS4	CS5	CS6	**Total**	**Response (%)**
Invitation	**25**	**5**	**16**	**40**	**8**	**99**	**100**
Face Time	1	1	-	2	-	3	3.0
Face-to-face	4	4	2	9	4	22	22.2
Total Response	**5**	**3**	**2**	**11**	**4**	**25**	**25.0**

5.9.4 Refusal to participate

Throughout the study period, there were some potential respondents who refused to participate with this research citing several reasons to MAHB that were not disclosed to the researcher. Such refusal has only indirectly affected the target design of this case study aimed at obtaining multiple views of all VM workshop applications selected in the original sampling schema.

5.9.5 Exclusion of case study 2 (CS2)

During the course of data collection, all case studies went well except for CS2 that refers to project package AF08. This case had to be terminated from the research half way through due to a direct instruction from the MAHB authority.

Table 32 Cases Exclusion

Project Packages	**AF06**	**AF08**	**LF05 & LF06**	**LF05A, LF05B & LF06**	**TB01**	**UT03**	
Case ID	CS1	CS2	CS3	CS4	CS5	CS6	**Total**
Samples	24	X	10	16	47	8	126
%	19.04	X	7.94	12.70	37.30	6.35	83.33%

5.10 SUMMARY

In summary, the process of obtaining access to MAHB cases on VM studies conducted and participants views on the same has been conducted in a structured manner designed at maintaining the level of involvement and interest of MAHB whilst at the same time maximising the data to be collected. The multiple case studies designed in this research are aimed at garnering as much information as possible regarding the involvement of MAHB's VM workshop participants. Through the multiple case studies that are represented by each project package under KLIA2, the potential of exploring the practices, experience and issues in VM application in design process have been highly positive. The multiple cases used a cross case basis as the method of analysis allows for results obtained from the process to be more in-depth while increasing the chances of construct validity, reliability and external validity.

Chapter 6: Analysis

This chapter describes analyses of data collected from the survey, interviews and document review conducted on six case studies from the Malaysian Airports Holdings Berhad (MAHB) airport projects. This chapter is divided into three main sections. The first section is the survey analysis, followed by the interview analysis and finally the document review. The survey analysis is structured according to the typical VM workshop phases to be consistent with the literature review structure and to accommodate the discussion section of this thesis. The interview and document review analyses provide further in-depth investigation to support and validate the findings from the survey.

There are two approaches used for the analyses undertaken for this research, Quantitative analysis is conducted on the survey questionnaire with the aim of achieving a general overview on the organisation of the VM workshops of the selected case studies. The objective of this analysis is to establish an overview of VM workshops conducted by MAHB, obtain an understanding of the activities conducted during each phase of the VM job plan, study the techniques and tools applied, and establish respondents' experiences as participants in the workshops. Descriptive analyses utilizing Univariate and Bivariate methods are applied to understand the relationship between the variables of interest in the research.

Qualitative analysis is conducted on the interview transcripts and documents reviewed and is aimed at establishing an in-depth understanding of VM workshop organisation within the MAHB. Coding, Pattern Matching (Yin, 2009) and Content Analysis (Bryman, 2012) are used to analyse data from both sources. Results from all three sources of data are triangulated through cross verification across findings made from all sources.

6.1 RESPONDENT'S PROFILE

This section presents the results obtained from the survey questionnaire distributed to all six case studies within MAHB. The results show each respondent's profile comprising professional working background, experience and qualifications. The analyses conducted are descriptive and provide an overview of the demographic distribution of respondents.

6.1.1 Response Rate

Table 33 indicates the planned distribution and response rate of samples across all six cases. A total of 126 numbers of survey questionnaire were distributed among value management workshop participant using three approaches (i.e. postal, emails and face-to-face) to increase the response rate as described earlier in chapter 4.

Out of the 126 sent out, 52 questionnaires were returned. This result represents 41.27% response rate of the total samples distributed. However, during the course of this research, Case CS2 was terminated by MAHB due to undisclosed reasons. Therefore, the response rate for the survey is revised to exclude Case CS2 as indicated in Table 46. Total samples were reduced to 99 and returned questionnaire were 44 with revised response rate of 44.44%. Case CS5 accounts for the largest response rate followed by CS4, while CS6 is the least among all cases.

Table 33 Initial distributed samples and response rate

Case ID	CS1	CS2	CS3	CS4	CS5	CS6	**Total**
Postal	13	10	5	5	11	5	49
Emails	5	3	3	8	23	1	43
Face-to-face	6	8	2	3	13	2	34
Total Samples Distributed	**24**	**27**	**10**	**13**	**43**	**8**	**126**
Sample Received	**6**	**8**	**6**	**9**	**18**	**5**	**52**
Response Rate							**41.27%**

Table 34 Revised Response Rate

Case ID	CS1	CS2	CS3	CS4	CS5	CS6	Total
Total Samples Distributed	24	-	10	13	43	8	99
Sample Received	**6**	**-**	**6**	**9**	**18**	**5**	**44**
Response Rate							**44.44%**

6.1.2 Professional Background

The largest response rate under this category comes from the Quantity Surveying discipline that represents 20.50% of the total respondents as indicated in Table 35. This is followed by Project Managers (13.60%) while Building Services Engineers and Civil Engineers each share the same rate of 11.40%. Mechanical and Electrical Engineers form the lowest respondent group with only 4.5% responses from each category. There are four (4) respondents with a Value Engineering (VE) background that account for 9.10% of responses. Whilst the latter indicates that apparently only a small portion of respondents have a direct VE background, this percentage is not an absolute indication that the remaining respondents (90.90%) do not possess any qualification or experience in VE. The 'professional backgrounds' of respondents indicated in this survey are meant to identify each respondent's area of specialisation in a VM workshop. This result is not necessarily representative of their membership role in a VM workshop. Such information is discussed in the sub-section of this chapter dealing with the qualitative analysis.

Table 35 Respondent's professional background

	Frequency	Percent	Valid Percent	Cumulative Percent
Quantity Surveyor	9	20.5	20.5	70.5
Project Manager	6	13.6	13.6	84.1
Building Service Engineer	5	11.4	11.4	18.2
Civil Engineer	5	11.4	11.4	36.4
Value Engineer	4	9.1	9.1	93.2
Architect	3	6.8	6.8	6.8
System Engineer	3	6.8	6.8	25.0
Structural Engineer	2	4.5	4.5	40.9
Electrical Engineer	2	4.5	4.5	45.5
Mechanical Engineer	2	4.5	4.5	50.0
Others	3	6.8	6.8	100.0
Total	**44**	**100.0**	**100.0**	

6.1.3 Academic Qualification

The majority of respondents are in possession of a Bachelor Degree, some 79.5% of the total respondents. Only 20.5% have a Master Degree qualification as indicated in Table 36. A cross tabulation analysis is conducted between the professional background variables and academic qualifications to understand the demographics of the qualification. Table 37 indicates the result of the cross tabulation where 20.5% with Master Degree qualification come from the Architecture, Civil, Quantity Surveying and Value Engineering backgrounds.

Table 36 Respondent's academic qualification

Academic Qualification

	Frequency	Percent	Valid Percent	Cumulative Percent
Bachelor	35	79.5	79.5	79.5
Master	9	20.5	20.5	100.0
Total	**44**	**100.0**	**100.0**	

Table 37 Cross tabulation: Professional background and academic qualification

		Academic Qualification		
		Bachelor	Master	Total
Professional background	Architect	1	2	3
	Building Service Engineer	5	0	5
	System Engineer	3	0	3
	Civil Engineer	4	1	5
	Structural Engineer	2	0	2
	Electrical Engineer	2	0	2
	Mechanical Engineer	2	0	2
	Quantity Surveyor	5	4	9
	Project Manager	6	0	6
	Value Engineer	2	2	4
	Others	3	0	3
	Total	**35**	**9**	**44**

6.1.4 Working Experience in Construction Industry

Majority of respondents have worked in the construction industry between 6 to 15 years as indicated in Table 38. This group represents 86.4% of the total respondents. Only three (6.8%) respondents have more than 20 years of experience working in the construction industry. While the junior level staff (with less than 5 years working experience) are represented by only 3 respondents.

The Project Managers and Value Engineers have representation in the most experienced group (with more than 20 years' experience). This provides an indication that these respondents hold a significant position in their current construction projects as well as working experience. These results also show that the majority of respondents have sufficient working experience in the construction industry to give valid responses.

Table 38 Respondent's Working Experience

		Years working in construction industry				
		Less than 5 years	**6 to 10 years**	**11 to 15 years**	**More than 20 years**	**Total**
Professional background	Architect	-	2	1	-	3
	Building Service Engineer	-	5	-	-	5
	System Engineer	-	-	3	-	3
	Civil Engineer	-	1	4	-	5
	Structural Engineer	-	-	2	-	2
	Electrical Engineer	1	-	1	-	2
	Mechanical Engineer	-	-	2	-	2
	Quantity Surveyor	1	6	2	-	9
	Project Manager	-	1	3	2	6
	Value Engineer	1	1	1	1	4
	Others	-	3	-	-	3
	Total	**3**	**19**	**19**	**3**	**44**
	Percent	**6.8%**	**43.2%**	**43.2%**	**6.8%**	

6.1.5 Working Organisation

The respondents in this research represent three major organisations; general consultancy, project management consultants and Government Linked Company (GLCs). The consultant group is the largest respondent group with 56.8%, followed by the GLCs with 34.1% and finally project management consultants (PMC) with 9.1%.

This indicates an almost balanced distribution between the consultants and the Client's side of the respondents. The Client's side comprises of 43.2% (GLCs 34.1%

+ PMC 9.1%) of total respondents meaning that the responses for this survey will reflect a balance view between the workshop authority (i.e. Client) and consultants.

Table 39 Respondent's Organisation Background

		Type of organisation currently serving			
		Consultancy	Project Management	Government Linked Company	Total
Professional background	Quantity Surveyor	4	0	5	9
	Project Manager	0	4	2	6
	Building Service Engineer	5	0	0	5
	Civil Engineer	3	0	2	5
	Value Engineer	4	0	0	4
	Architect	3	0	0	3
	System Engineer	0	0	3	3
	Structural Engineer	2	0	0	2
	Electrical Engineer	1	0	1	2
	Mechanical Engineer	1	0	1	2
	Others	2	0	1	3
	Total	**25**	**4**	**15**	**44**
	Percent	**56.8%**	**9.1%**	**34.1%**	

6.1.6 Current Position and Years of Service

Table 40 indicates respondent's current position in their organisations and number of years they have served. Based on the table, the Senior Executives and Managers represent the largest groups with 36.4% and 34.1% respectively. This is followed by Executive level (13.6%), Director (11.4%) and Senior Manager (4.5%).

Table 40 Respondent's Year of Service in Current Position

			Years serve in current position				
		%	Less than 5 years	6 to 10 years	11 to 19 years	More than 20 years	Total
Current position	Senior Executive	**36.4**	1	4	11	0	16
	Manager	**34.1**	0	6	9	0	15
	Executive	**13.6**	5	1	0	0	6
	Director	**11.4**	0	1	2	2	5
	Senior Manager	**4.5**	0	1	1	0	2
	Total	**100.0**	**6**	**13**	**23**	**2**	**44**

6.1.7 Professional Certification

The vast majority of respondents (81.8%) possess no professional certification. The remaining 18.2% respondents possess some professional certification with Value Engineers forming the majority group of 6.8% while only one respondent possessed a Project Management Professional (PMP) certification. Engineers and Quantity Surveyors share equal distribution with 4.5%.

Table 41 Respondent's Professional Certification

		Possess professional certification		
		Yes	%	Total
Professional certification	No certification	36	**81.8**	36
	Certified Value Engineer	3	**6.8**	3
	Registered Engineer	2	**4.5**	2
	Registered Quantity Surveyor	2	**4.5**	2
	Project Management Professional	1	**2.3**	1
	Total	**44**	**100**	**44**

6.2 PRE-WORKSHOP PHASE ANALYSIS

This section analyses respondents' experience as workshop participants during the Pre-Workshop Phase. The aim of this section of the survey is to establish a background understanding on the organisation of VM workshops in MAHB. Information generated will allow for comparison, further exploration and validation by the subsequent interview process. Univariate and Bivariate analyses are used to generate findings in this section.

6.2.1 Past Experience in Value Management Workshops

84.1% of respondents had experience as participants in a VM workshops/studies in their previous projects and had been exposed to the VM processes and procedures.

Only 15.9% respondents indicated that they were first time VM workshop participants.

Table 42 Respondents' Past VM Workshop Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	37	84.1	**84.1**	84.1
	No	7	15.9	**15.9**	100.0
	Total	**44**	**100.0**	**100.0**	

84.1% of respondents also selected the types of projects that they have been involved in for previous VM studies as indicated in Table 42. The majority of respondents are involved with civil engineering projects (25%), followed by 22.7% on building and 20.5% on mechanical projects. Only one respondent has different experience for the listed type projects where he had previously been involved in oil and gas projects.

Table 43 Respondent's Previous Project Experience with VM

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Civil Engineering	11	25.0	**25.0**	47.7
	Building [Residential and Commercial]	10	22.7	**22.7**	22.7
	Mechanical	9	20.5	**20.5**	90.9
	Aviation	8	18.2	**18.2**	70.5
	Electrical	3	6.8	**6.8**	97.7
	Transportation	2	4.5	**4.5**	52.3
	Others	1	2.3	**2.3**	100.0
	Total	**44**	**100.0**	**100.0**	

The result shows that the majority of respondents had experience of participating in VM workshops having similar characteristics with the current case study (i.e. the KLIA2 project). This is indicative of the fact that respondents already have some basic understanding of the processes involved in VM studies.

6.2.2 Understanding of Value Management

Respondents were further questioned on their understanding of how VM could assist with their current projects. Likert-scale based questions were used to assess the responses. As a result, the range of the standard deviation of results for each variable is small in comparison with the mean, as indicated in Table 44. This result shows that the majority of respondents were in the agreement with statements V1, V2, V3, V7, V8 and V10. Their views were focussed towards using VM as a means to evaluate project objectives, constraints, client’s focus, prioritise project needs and promote innovation in design.

A large percentage of neutral responses were received on statements V4, V5, V6 and V9. This indicates that many respondents appeared to feel that evaluating project needs, improving the project brief, developing shared understanding among stakeholders and structuring frameworks to accommodate future design changes were not significant to the current case study project. This shows that large percentage of respondents view VM as a strategic approach in planning for the project. Although neutral result indicate almost similar percentage, the focus on strategic point of VM application is observed to be closely related

Despite giving some general indication on the level of agreement/disagreement among respondents, the percentages of the results are not strong enough to reject outright any statements from the survey. However, variable V5 came close to being rejected by the respondents with a slight difference of 4.6% having a more neutral response and a mean of 2.50.

Based on this result, it can be summarised that respondents view the current VM study as an attempt to address a strategic project delivery approach through understanding project needs, objectives and focusing on design innovation.

Table 44 Understanding of the need for VM implementation

		M	SD	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
V1	Identifying and evaluating the need for construction works	3.64	.892	13.60%	50.00%	22.70%	13.60%	-
V2	Identifying and prioritising the key objectives construction projects	3.61	.868	11.40%	52.30%	22.70%	13.60%	-
V3	Identifying and evaluating the major constraints and risks	3.61	.868	11.40%	52.30%	22.70%	13.60%	-
V4	Identifying and evaluating the means of meeting needs and objectives of construction projects	3.07	.998	6.80%	25.00%	43.20%	18.20%	6.80%
V5	Improving the quality definition of a project brief	2.50	.629x	-	2.30%	50.00%	43.20%	4.50%
V6	Developing a shared understanding of projects goals among key participants	3.07	.998	6.80%	25.00%	43.20%	18.20%	6.80%
V7	Ensuring that all aspects of the design are the most effective for their purpose	4.30	.765	45.50%	40.90%	11.40%	2.30%	-
V8	Maintaining a strategic focus on the client's needs during design and construction	3.64	.892	13.60%	50.00%	22.70%	13.60%	-
V9	Providing a priority framework against which future potential design changes can be evaluated	3.05	.987	6.80%	22.70%	45.50%	18.20%	6.80%
V10	Promoting design innovation	3.59	.871	11.40%	50.00%	25.00%	13.60%	-

Note: Degree of agreement 5 =Strongly Agree, 4=Agree, 3= Neutral, 2=Disagree, 1= Strongly Disagree

6.2.3 Reason for Workshop Initiation

Full consensus (100%, M=5.00, SD=. 000) was obtained from respondents who felt that a Standard Operating Procedures (SOP) is one of the main reasons for VM studies to be conducted for their projects. A high percentage was also recorded for statement V3 (77.2%) where the workshop initiation is seen as a value adding initiative by MAHB. This is followed by statement V2 with 42.2% who think it is part of the overall development process to conduct such workshops. However, this result needs to be balanced against the 27.3% neutral responses and 29.5% who reject such a reason for initiating a workshop.

Statements V4, V5 and V6 were rejected by respondents with recorded levels of 47.7%, 45.4% and 47.7% respectively. The issues of over budget and behind schedule were not seen as the driving factors for VM workshops to be conducted on the case study project. Despite rejections of statements V4, V5 and V6, a close value of neutral responses was identified in V4 (29.5%), V5 (29.5%) and V6 (31.8%). This close margin raises a concern on the clarity of respondents' understanding of the main reason for VM workshop initiation on the case study project.

Table 45 Reason for VM workshop initiation

		M	SD	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
V1	Standard operating procedures (SOP) by MAHB	5.00	.000	100%	-	-	-	-
V2	Part of project development process	3.34	1.293	27.30%	15.90%	27.30%	22.70%	6.80%
V3	MAHB's initiative to add value to projects	3.86	.702	13.60%	63.60%	18.20%	4.50%	-
V4	Project over-budget	2.77	1.008	6.80%	15.90%	29.50%	43.20%	4.50%
V5	Project over-design	2.80	1.047	6.80%	18.20%	29.50%	38.60%	6.80%
V6	Project behind schedule	2.73	.949	4.50%	15.90%	31.80%	43.20%	4.50%

Note: Degree of agreement 5 =Strongly Agree, 4=Agree, 3= Neutral, 2=Disagree, 1= Strongly Disagree

6.2.4 Workshop Objectives

In relation to understanding the main reasons for VM workshop initiation, the respondents were asked what workshop objectives did they perceive were sought at the beginning of the study. Respondents were in agreement with statements V2, V3, V4, V5, V7 and V8 with high percentage recorded in Table 46. Statements V2 and V3 achieved the highest preference with Means of 3.89 and a standard deviation of .722. Respondents believed that the workshop objectives were to enhance project function (V2) and to study the viability of the proposed project (V3). High disagreement was observed on statements V9 and V10 with recorded percentages of 47.7% each and standard deviations of 2.68. The objectives to complete the design and improve communication were not perceived as relevant to the current workshop understudy. Statements V1 and V6 received neutral responses with percentages of 43.2% for each statement. Neutral responses were also given on the need to clarify client’s project objectives and for seeking alternative solutions to construction methods.

Table 46 VM workshop objectives

		Mean	SD	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
V1	To clarify client’s project objectives	3.07	.998	6.80%	25.00%	43.20%	18.20%	6.80%
V2	To enhance project function	3.89	.722	15.90%	61.40%	18.20%	4.50%	-
V3	To study the viability of the proposed project	3.89	.722	15.90%	61.40%	18.20%	4.50%	-
V4	To find alternative solution for the proposed development scheme	3.34	1.293	27.30%	15.90%	27.30%	22.70%	6.80%
V5	To find alternative solution for design	3.34	1.293	27.30%	15.90%	27.30%	22.70%	6.80%
V6	To find alternative solution for construction methods	3.07	.998	6.80%	25.00%	43.20%	18.20%	6.80%
V7	To find alternative solution to save cost	3.36	1.313	29.50%	13.60%	27.30%	22.70%	6.80%
V8	To find alternative solution to save time	3.32	1.290	27.30%	13.60%	29.50%	22.70%	6.80%
V9	To complete the design	2.68	.883	2.30%	15.90%	34.10%	43.20%	4.50%
V10	To improve communication	2.68	.883	2.30%	15.90%	34.10%	43.20%	4.50%

Note: Degree of agreement 5 =Strongly Agree, 4=Agree, 3= Neutral, 2=Disagree, 1= Strongly Disagree

6.2.5 Pre-Qualification Exercise

The majority of respondents were not involved in any pre-qualification exercise to be selected as participants into the VM workshop. This is shown in Table 47 where 68.2% (30) were not part of such an exercise. Only 31.8% of 14 respondents indicated that they had been involved in a pre-qualification.

Table 47 VM workshop pre-qualification exercise

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	14	**31.8**	31.8	31.8
	No	30	**68.2**	68.2	100.0
	Total	**44**	**100.0**	**100.0**	

A cross tabulation analysis was conducted between the responses related to involvement in a pre-qualification exercise and respondent's professional background to further understand the nature of these responses. The results tabulated in Table 48 indicate that respondents with a professional background of Value Engineer, Project Manager, Quantity Surveyor, Civil and Electrical Engineer were involved in a pre-qualification exercise.

Table 48 Crosstabs: Professional Background and Pre-Qualification Exercise

Professional background * Prequalification involvement Cross tabulation

		Prequalification involvement		
		Yes	No	Total
Professional background	Quantity Surveyor	5	4	9
	Value Engineer	3	1	4
	Project Manager	2	4	6
	Civil Engineer	2	3	5
	Electrical Engineer	1	1	2
	Others	1	2	3
	Mechanical Engineer	-	2	2
	Structural Engineer	-	2	2
	System Engineer	-	3	3
	Building Service Engineer	-	5	5
	Architect	-	3	3
	Total	**14**	**30**	**44**

Further cross tabulation analysis was conducted to identify respondent's working organisations and any relationship with a pre-qualification exercise. Table 49, shows that the majority of those involved in a pre-qualification exercise are working with a Government Linked Company. In this case, the GLC in the current case study is the MAHB organisation. Therefore, the majority of respondents involved in pre-qualification exercise are actually internal to the client's organisation. The remaining 3 respondents were external to MAHB that comes from consultant organisations.

Despite the involvement of Project Managers to oversee this project, they were not involved in any pre-qualification exercise used to select participants for the VM study in this project.

Table 49 Crosstabs: Respondent's Working Organisation and Pre-Qualification Exercise

Type of organisation currently serving * Prequalification involvement Cross tabulation

		Prequalification involvement		
		Yes	No	Total
Organisation	Government Linked Company	11	4	15
	Project Management	0	4	4
	Consultancy	3	22	25
	Total	**14**	**30**	**44**

6.2.6 Selection Factor for Participants

The team composition for the workshop was assessed through the results of the survey and also based on the list of participants in the VM report. Respondents were asked what factors did they perceived were used for their selection as participants in the VM study.

Table 50 indicate the descriptive breakdown on the perceived factors for selection. Majority of respondents (56.8%) felt that their role as consultant to the project was the main factor for including them in the workshop team. This can be taken as an automatic selection to the workshop as they are employed as consultants to the project. The factors of being a client's representative accounted for only 29.5% (n=13) of total respondents. Only 13.6% of respondents believe that their involvement in the VM workshop was due to their professional expertise. This indicates that participants to the workshop were internal to the construction project where their participation was due to their existing role in the project.

Table 50 Factors of selection as workshop participants

	Frequency	Percent	Valid Percent	Cumulative Percent
Consultants to the project	25	**56.8**	56.8	100.0
Client's representative	7	**15.9**	15.9	29.5
Professional expertise	6	**13.6**	13.6	13.6
Decision making authority	6	**13.6**	13.6	43.2
Total	**44**	**100.0**	**100.0**	

Cross tabulation analysis was conducted to compare the relationship between respondents profiles in terms of their working organisations and factors for selection as participants. The results in Table 51 indicate that 56.82% of respondents are attached with the consultant's organization, 34.09% (n=15) respondents are currently working with the GLCs while 9.09% (n=4) as Project Management consultants to the project. Respondent's from GLC represents staff that are working with MAHB which account for only 34.09%, while the remaining majority of the workshop participants comes from consultant's group that represent more than 50% of the total participants.

Table 51 Crosstabs: Factors of Selection as Participant and Working Organisation

	Factors of selection as participant					
	Professional expertise	*Client's representative*	*Decision making authority*	*Consultants to the project*	Total	%
Government Linked Company	1	5	5	4	15	34.09
Project Management (PMC)	1	2	1	-	4	9.09
Consultancy	4	-	-	21	25	56.82
Total	**6**	**7**	**6**	**25**	**44**	**100**

6.2.7 Membership Role in Workshop

In relation to determining respondents' understanding of workshop participation selection factors, there were also asked about their main membership role in the workshop. Results in Table 52 indicate a breakdown of respondent's role in the VM study. The largest majority viewed themselves as being a participant in the consultant role (56.8%) followed by those seeing themselves in client's representative role (34.09% including the PMC with 9.1%). The decision making authority role in the workshop was represented with only 2 respondents (4.5%) while there are four (4) facilitators in this VM study.

Table 52 Membership role in Workshop

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Consultants to the project	29	65.9	**65.9**	100.0
	Client's representative	9	20.5	**20.5**	25.0
	Facilitator	4	9.1	**9.1**	34.1
	Decision making authority	2	4.5	**4.5**	4.5
	Total	**44**	**100.0**	**100.0**	

6.2.8 Information Distribution

The adequacy and timely distribution of workshop information as a reference for participants and facilitators to support a VM workshop is one of key factors for an effective VM process. Tables 53 – 55 indicate the responses to questions regarding the distribution of information prior the VM workshop phase.

The result shows that 65.9% of workshop supporting information was distributed during the workshop phase of the VM study. Only 34.1% of respondents had experienced information being distributed prior to the workshop phase. This records the fact that a high percentage of information distribution occurred at a point after the workshop has already started that may cause issues due to participants feeling they required more time to fully understand and study the distributed information.

Table 53 Timing of workshop information distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Before workshop	15	34.1	**34.1**	34.1
	During workshop	29	65.9	**65.9**	100.0
	Total	**44**	**100.0**	**100.0**	

The possibility of respondents feeling that they require sufficient (or more) time to familiarise with the information pre-workshop phase was further tested. Although 65.9% of workshop information was distributed during the workshop phase, the respondent's felt nevertheless that the time given for study and familiarization was sufficient. This is was based on a 70.5% response agreeing that sufficient time was given to them while only 29.5% think they didn't have enough time.

Table 54 Time sufficiency to understand workshop information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	31	70.5	70.5	70.5
	No	13	29.5	29.5	100.0
	Total	**44**	**100.0**	**100.0**	

In terms of adequacy of information distributed to support the VM study, all respondents agreed with the level of adequacy. A full 100% response was received that indicates the effectiveness of the distribution of information by MAHB.

Table 55 Adequacy of distributed workshop information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	44	100.0	100.0	100.0

6.2.9 Workshop Briefing

Table 56 indicates the result on responses as to whether a VM briefing was conducted prior to workshop phase. Based on the result, only 34.1% of respondents experienced a briefing being conducted prior to workshop. The majority of 65.9% showed that no pre-workshop briefing was held in their experience to inform participants on the objectives of the workshop.

Table 56 Pre-workshop briefing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	15	34.1	**34.1**	34.1
	No	29	65.9	**65.9**	100.0
	Total	**44**	**100.0**	**100.0**	

6.2.10 Summary

Section 6.2 summarises the results of the pre-workshop phase exercise in VM studies conducted on the MAHB case study project. The results indicate a positive effort taken by workshop organisers to ensure that sufficient measures were taken to provide an effective starting point for each VM study. The majority of workshop participants in this study were from the client's organisation followed by consultants working either in-house or external to the client's organisation. Most of them have been involved in VM study prior to their current project. This provides some benefit to this research in terms of the expected level of quality in responses being good based on the previous experience of respondents. Pre-qualification is not normally practiced outside MAHB where only internal staff (31.8%) are subject to this exercise. Despite the workshop information only being distributed during, rather than prior to, the workshop phase, the respondents felt that the information was adequate to support the subsequent VM study.

The following sub-section will focus on analyses obtained from consideration of the Workshop Phase of the VM study.

6.3 WORKSHOP PHASE ANALYSIS

The analysis of the Workshop Phase of the VM study is divided into sub-phases corresponding to the VM Job Plan. Descriptive and non-parametric analyses are used to analyse data in this sub-section.

6.3.1 Information Phase

This section of the survey was designed to collect data on the activities and issues faced during the Information Phase of the VM study.

6.3.1.1 Workshop Main Issues

Architectural issues were perceived by respondents to be the main areas of study in the VM workshop conducted in this case (Table 57). Although this was the top issue category at 27%, the remaining issues were also regarded as quite important. Structural engineering at 19.8% is the second highest rated issue followed by Statutory Approval at 18%. Out of all the issues, Contract was the least focussed on issue in the workshop at only 1% (n=1).

Table 57 Value study issues

		Responses		
		N	Percent	Percent of Cases
Issues	Architectural	30	27.0%	71.4%
	Structural	22	19.8%	52.4%
	Statutory Approval	20	18.0%	47.6%
	Mechanical and Electrical	14	12.6%	33.3%
	Land Issue	13	11.7%	31.0%
	Project Management	3	2.7%	7.1%
	Contract	1	.9%	2.4%
	Others	8	7.2%	19.0%
	Total	**111**	**100.0%**	**264.3%**

7.2% of respondents attributed other issues as being focussed on during the workshop. Such issues provided by respondents are as follows:

- Information Technology
- Geotechnical Issue
- Airport System Integration
- Design review
- Cost Planning

6.3.1.2 Workshop Reference Documents

Section 6.2.8 analysed the timing and adequacy of information distributed to workshop participants during the Pre-workshop Phase. Results indicated that the majority of information/reference documents were distributed during the Workshop Phase instead of during the Pre-workshop Phase. A multiple-response question was given to respondents to gather data on the kind of reference documents that were issued and used during the Workshop Phase of the study.

Table 58 indicates frequencies of use of reference documents during the VM workshop. Drawings are the most frequently used reference document in this workshop with 47.1%. This was followed by Life-Cycle Costing at 18.4% and Construction Programme with 11.5%. Feasibility Study Reports were the least used reference documents with only 2.3% response.

Table 58 VM Workshop reference documents

		Responses		
		N	Percent	Percent of Cases
Resources used in VM workshop	Drawings	41	**47.1%**	93.2%
	Life Cycle Costing	16	**18.4%**	36.4%
	Construction Programme	10	**11.5%**	22.7%
	Specifications	6	**6.9%**	13.6%
	Statutes and By-Laws	5	**5.7%**	11.4%
	Cost Benefit Analysis	4	**4.6%**	9.1%
	Preliminary estimate	3	**3.4%**	6.8%
	Feasibility study report	2	**2.3%**	4.5%
	Total	**87**	**100.0%**	**197.7%**

Apart from these results above, a number of respondents proposed other types of reference information that should be incorporated during the workshop, to assist the study. Building Information Modelling (BIM) was suggested to be used and incorporated during the workshop. Although BIM is not considered as documentation but more as a tool, this suggestion provides an indication of the level of significance given to consideration of this tool for use during the workshop process.

A Pearson correlation analysis was conducted to assist in understanding the relationship between the main workshop issues and the types of documents issued and the results were as indicated in Table 59.

Table 59 Pearson Correlations: VM Reference Documents - Value Study Issue

		Architectural	Mechanical and Electrical	Statutory Approval	Land Issue	Structural	Contractual	Project Management	Others
V1	Feasibility study report	.149	-.149	.239	.337	-.218	-.033	-.059	.180
V2	Preliminary estimate	.185	-.185	.115	.022*	.090	-.041	-.073	-.128
V3	Drawings	.009*	-.009	-.115	-.220	.090	.041*	.073	.128
V4	Specifications	.129	.013*	.036*	.033*	.000*	-.061	-.107	.156
V5	Construction Programme	.021*	-.021	.267	.362	.108	-.083	.068	-.256
V6	Life Cycle Costing	-.092	-.111	.164	.235	-.189	.202	-.017	-.111
V7	Statutes and By-Laws	-.063	-.091	-.183	-.075	.358	-.055	.471	-.169
V8	Cost Benefit Analysis	.046*	.123	.188	-.205	.316	.482	.228	-.149

V9	Site Instruction	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]
V10	Bills of Quantities	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]
V11	Method Statements	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]
V12	Preliminary Detail Abstract	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]	.[a]

**Correlation is significant at the level 0.05 (2-tailed)*
a. Cannot be computed because at least one variable is constant

Table 59 indicates that generally rather weak relationships exist between the variables and in some cases negative correlations were seen. On average, all variables scored close to 0 and the highest correlation was .267 for Construction Programme (V7) that correlates with statutory approval issue of the project. However, there are five documents that do appear to have a significant correlation relationship with other variables (V2, V3, V4, V5 and V8). The five significant correlation variables were Preliminary Estimate, Drawings, Specification, Construction Programme and Cost Benefit Analysis. These variables correlate with Architectural, Mechanical and Electrical, Statutory Approval and Land Issues. These are the four main issues that perceived by respondent as highly associated with the project documentations. Despite these significant correlations, there are four variables that could not be computed (V9, V10, V11 and V12). These variables are Bills of Quantities, Method Statement, Site Instruction and Preliminary Detail Abstract.

6.3.1.3 Personal Function in Workshop

Table 72 indicates a breakdown of the personal functions of workshop participants in the VM study. Respondents were asked to indicate their own functions in the workshop they attended. Results in Table 60 indicates that 29.5% of respondents believed their participation in the workshop was to 'initiate new ideas'. This response is the largest response among all functions listed in the question. This was followed by 'coordinating information' (22.7%) and 'supplying information' (20.5%) while 'information seeking' and 'evaluating information' are the least with 13.6% each. The result from this analysis indicates a higher percentage of respondents felt themselves engaged to contribute ideas during the workshop study. However, this result could not be taken to collectively represent the total view of all respondents as there were respondents who declared that they attended the workshop for the sake of 'seeking' (13.6%) and 'supplying information' to the workshop (20.5%).

Table 60 Personal function during VM workshop

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Initiating new ideas	13	29.5	**29.5**	29.5
	Coordinating information	10	22.7	**22.7**	86.4
	Giving information	9	20.5	**20.5**	63.6
	Seeking information	6	13.6	**13.6**	43.2
	Evaluating information	6	13.6	**13.6**	100.0
	Total	**44**	**100.0**	**100.0**	

A cross tabulation between personal functions in the workshop and membership role was conducted to further understand the relationship of the respondents within the workshop. Based on the result of this, a higher percentage of respondents who felt they initiated ideas were from the consultants' category as indicated in Table 61. The consultants also make up most of the declared function of coordinating, as well as seeking and giving information during the workshop. The involvement of decision-making authorities in this workshop is consistent with the VM needs where involvement of authorities personnel increase workshop engagement. Their representations in this workshop are merely to assist in evaluating information generated throughout the workshop process. Client's representatives in this workshop were seen as being actively involved in the workshop process through fair distribution of functions across the workshop except for initiating ideas and information seeking.

Table 61 Cross tabulation: Personal function and Membership role in VM

Personal function in this workshop * Membership role Cross tabulation

		Membership role				
		Decision making authority	Client's representative	Facilitator	Consultants to the project	Total
Personal function in this workshop	Initiating new ideas	0	0	2	11	13
	Seeking information	0	0	0	6	6
	Giving information	0	1	0	8	9
	Coordinating information	0	4	2	4	10
	Evaluating information	2	4	0	0	6
	Total	**2**	**9**	**4**	**29**	**44**

6.3.1.4 Team Composition

93.2% or respondents believed that the current team composition in their workshop was sufficient as indicated in Table 62. Only 6.8% of them thought that it was insufficient.

Table 62 Team Composition sufficiency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	41	93.2	93.2	93.2
	No	3	6.8	6.8	100.0
	Total	**44**	**100.0**	**100.0**	

A similar result was achieved when they were asked whether any further participants are required to be included in the workshop. Based on the results shown in Table 63, three respondents gave similar suggestions on possible extra participants that should be on the list. They suggested a person that would potentially be involved in the physical construction of the design should to be part of the team. They reasoned that such a person could monitor and be involved in the decision making relating to the designed facilities. Only one respondent made specific reference to a contractor as being the most suitable person while the remaining two provided more general suggestions.

Table 63 Requirement for additional participant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	3	6.8	6.8	6.8
	No	41	93.2	93.2	100.0
	Total	**44**	**100.0**	**100.0**	

The analysis of the results in this sub-section only indicates the respondents' views on the sufficiency of team composition. The actual team composition, including the respondents' position in the project, is analysed in the qualitative analysis section where the full participant list used was obtained from the Document Review process.

6.3.2 Functional Analysis Phase

This sub-section analyses data on activities and issues faced during the Functional Analysis Phase of the VM workshop.

6.3.2.1 Techniques to analyze value study

Frequencies evaluation and cross tabulations analyses were used to analyse the frequency of techniques used to assess value study problems during the workshop. Respondents were given an opportunity to select multiple options in this question. Results presented in Table 64 indicate the actual responded preference and eliminate nil responses. Based on these results,, presentation and brainstorming are the most frequently used techniques with equal percentages of 29.8%. The FAST diagram is second on the list with 25.3% while Spatial Adjacency Analysis is the least used technique with only 3.5% response rate. Out of 8 listed in the survey, only 5 techniques were used in the case study workshop. The 3 remaining techniques that includes the SMART technique did not receive any response. This result shows that presentation and brainstorming are techniques that have been used in workshop more frequently than the Functional Analysis techniques.

Table 64 Cross tabulation: Function analysis technique and value study issues

Function Analysis Phase Techniques		Architectural	Mechanical and Electrical	Statutory Approval	Land Issue	Structural	Contract	Project Management	Others	
Presentation	n	30	14	20	13	22	1	3	8	111
	%	8.1%	3.8%	5.4%	3.5%	5.9%	0.3%	0.8%	2.2%	29.8%
Brainstorming	n	30	14	20	13	22	1	3	8	111
	%	8.1%	3.8%	5.4%	3.5%	5.9%	0.3%	0.8%	2.2%	29.8%
FAST diagram	n	23	13	20	13	17	1	1	6	94
	%	6.2%	3.5%	5.4%	3.5%	4.6%	0.3%	0.3%	1.6%	25.3%
Spatial Adjacency Analysis	n	3	1	3	3	2	0	0	1	13
	%	0.8%	0.3%	0.8%	0.8%	0.5%	0.0%	0.0%	0.3%	3.5%
Functional Space Analysis	n	10	6	9	9	6	0	0	3	43
	%	2.7%	1.6%	2.4%	2.4%	1.6%	0.0%	0.0%	0.8%	11.6%
Total	n	**96**	**48**	**72**	**51**	**69**	**3**	**7**	**26**	**372**
	%	**25.8%**	**12.9%**	**19.4%**	**13.7%**	**18.5%**	**0.8%**	**1.9%**	**7.0%**	**100.0%**

A cross tabulation analysis between the use of functional analysis techniques and value study problems indicates more clearly the areas where most techniques are being applied. The presentation and brainstorming techniques are used frequently when the VM study focuses on Architectural aspects with a 25.8% contribution. This is followed by a focus on Statutory Approvals issues with 19.4% and Structural issues at 18.5%. Function Analysis technique is most frequently used in the VM study with the highest focus on the Architectural issues and followed by Statutory Approvals and Structural. It can be summarised from this analysis that the presentation and brainstorming techniques were among frequently used technique during this phase and mostly focus on the Architectural aspects of the study.

Despite a variety of tools and techniques having been used in the workshop, only 75% of respondents felt that the techniques used were sufficient as indicated in Table 65. The remaining 25% think that the techniques used were insufficient.

Table 65 Sufficiency of techniques used during function analysis phase

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	33	75.0	75.0	75.0
	No	11	25.0	25.0	100.0
	Total	**44**	**100.0**	**100.0**	

The 25% respondents that thought tools and techniques used were insufficient were given a chance to indicate their suggestions on other relevant techniques that they felt should be used during Functional Analysis phase. The following are their suggestions:

a. Fishbone diagram – application of problem identification and causes of specific event through mapping
b. Mind-mapping – visual outline of information and problems of the project
c. ReDress technique

6.3.3 Creativity Phase

This sub-section analysed data on activities and issues faced during the Creativity Phase of the VM study.

6.3.3.1 Creativity Techniques

As shown in Table 66, brainstorming is the most frequently used technique during the Creativity Phase with a 36.6% response. The use of this technique continues over from the Functional Analysis phase where it achieved similar high response from the respondents. Evaluation Comparison techniques come second with a 29.8% response rate followed by 'idea hitchhiking' (i.e where participants start with one idea and gradually expand by others) with a 17% response. Out of 6 techniques as listed in the survey, only 4 were used during the Creativity Phase of the workshop based on respondents' experience.

Table 66 Cross tabulation: Creativity techniques and value study issues

		VM Main Issues								
		Architectural	Mechanical and Electrical	Statutory Approval	Land Issue	Structural	Contract	Project Management	Others	Total
Brainstorming	%	10.2%	4.5%	6.0%	4.5%	7.2%	0.0%	1.1%	3.0%	**36.6%**
Evaluation Comparison	%	7.5%	4.2%	4.9%	3.0%	6.0%	0.4%	1.1%	2.6%	**29.8%**
Idea Hitchiking	%	5.7%	1.5%	2.6%	2.3%	4.5%	0.0%	0.4%	0.0%	**17.0%**
Gordon Technique	%	4.2%	2.6%	1.9%	1.5%	3.0%	0.0%	0.8%	2.6%	**16.6%**
Total	%	**27.5%**	**12.8%**	**15.5%**	**11.3%**	**20.8%**	**0.4%**	**3.4%**	**8.3%**	**100.0%**

A cross tabulation between creativity techniques and value study issues indicated almost a similar result as seen with a similar cross tabulation undertaken in the earlier sub-section during the Functional Analysis phase. Brainstorming technique were frequently used for both Architectural and Structural issues of the study with 10.2% and 7.2% respectively. Both issues also benefitted from the use of the Evaluation Comparison technique. Architectural issues used creativity techniques the most with 27.5% and Structural with 20.8%. The remaining issues usage was less than 20% with Contractual issues being the least with 0.4%.

Further cross tabulation was conducted between creative techniques and reference documents used during the workshop with the aim of investigating consistency with the other techniques applied during the workshop. Results in Table 67 indicate that Brainstorming techniques are mostly applied when drawings are used as the reference documents to the workshop with a 17.5% response rate. The same applies to the use of the Evaluation Comparison technique with a 13.7% response. It can be summarised that the use of drawings as reference documents contribute significantly to the Creativity process of the workshop with an indicated 48.8% usage. This is the highest among other reference documents with the second highest beings Life Cycle Costing at 18.5%, the remaining documents accounted for less than 10% of application.

Table 67 Cross tabulation: Creativity technique and VM reference documents

		VM Reference Documents								
		Feasibility study report	Preliminary estimate	Drawings	Specifications	Construction Programme	Life Cycle Costing	Statutes and By-Laws	Cost Benefit Analysis	Total
Evaluation Comparison	%	0.5%	0.9%	13.7%	2.4%	1.9%	5.7%	1.9%	1.9%	28.9%
Brainstorming	%	0.9%	1.4%	17.5%	2.8%	4.3%	6.2%	2.4%	0.9%	36.5%
Gordon Technique	%	0.5%	0.5%	9.0%	1.4%	0.9%	3.3%	1.4%	0.0%	17.1%
Idea Hitchiking	%	0.0%	0.9%	8.5%	0.9%	2.4%	3.3%	0.9%	0.5%	17.5%
Total	**%**	**1.9%**	**3.8%**	**48.8%**	**7.6%**	**9.5%**	**18.5%**	**6.6%**	**3.3%**	**100.0%**

77.3% of respondents were satisfied with the techniques used during the workshop to generate solutions for the value study as indicated in Table 68. Only 22.7% thought that the techniques used were insufficient and these respondents provided their suggestions for possible additions to the existing techniques as follows:

a. Interactive Value Management System (IVMS) – an approach where workshop is being conducted through assisted computer software in recording participant’s ideas and proposal.
b. Mind-mapping - visual outline of information and problems of the project
c. Building Information Modelling (BIM) – computer visualisation software where design can be visualise in multiple dimension and allow for real-time changes be made.

Table 68 Sufficiency of Creativity techniques

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	34	77.3	77.3	77.3
	No	10	22.7	22.7	100.0
	Total	44	100.0	100.0	

6.3.4 Evaluation Phase

This sub-section analysed data on the use of evaluation techniques to inform proposed solutions drawn from the Creativity Phase and together with issues faced during the Evaluation Phase of the VM workshop. The section is arranged to reflect the flow starting from obtaining the ‘pool of solutions’ from the Creativity Phase right up to selection of a preferred solution for further development. Frequency Analysis is used in this section to obtain general background of the processes and issues faced during this workshop phase.

6.3.4.1 Evaluation of Proposed Solutions

The Evaluation Phase is where proposed solutions from the Creativity Phase are evaluated and solutions and options proposed for further action or decisions by the client. During the Creativity Phase, solutions generated are listed without any judgment being made so as to create as many discussable ideas as possible. Therefore, the Evaluation Phase is where discussion among participants takes place and short listing and decisions on suitable solutions for further development are undertaken.

Full agreement was received from respondents who think that they were given adequate opportunity to provide suggestions and input during the Evaluation Phase of the workshop. This result is reflected in Table 69 that indicates 100% agreement on full opportunity being given.

Table 69 Opportunity to suggest during Evaluation Phase

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	44	100.0	100.0	100.0

However, in terms of being able to assess their own proposed solutions, 34.1% of respondents felt that they were not given enough opportunity for this exercise, whereas 65.9% of respondents believed that they were given a full chance to assess their solutions during this workshop phase.

Table 70 Opportunity to assess suggestion during Evaluation Phase

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	29	65.9	65.9	65.9
	No	15	34.1	34.1	100.0
	Total	44	100.0	100.0	

A Spearman's Rank Order correlation was run to determine the relationship between respondents' working experience and their ability to enhance the quality of proposed suggestions. There was a moderate, negative correlation between working experience and their ability to enhance suggestions, which was statistically significant (r_s = -.430, p = .004) as indicated in Table 71.

Table 71 Spearman Rho: Working Experience and ability to enhance suggestion

			Years working in construction industry	Ability to enhance quality of suggestion
Spearman's rho	Years working in construction industry	Correlation Coefficient	1.000	-.430**
		Sig. (2-tailed)	.	.004
		N	44	44
	Ability to enhance quality of suggestion	Correlation Coefficient	-.430**	1.000
		Sig. (2-tailed)	.004	.
		N	44	44

**. Correlation is significant at the 0.01 level (2-tailed).

Despite a statistically significant association between the two variables, 15.9% of respondents felt that they had only limited ability to enhance solutions proposed by others as indicated in Table 72.

Table 72 Ability to improve others proposed solutions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	37	84.1	84.1	84.1
	No	7	15.9	15.9	100.0
	Total	**44**	**100.0**	**100.0**	

6.3.4.2 Factors Limiting Suggestion Opportunity

A Frequency Analysis was run to understand factors that limit respondent's ability to provide suggestions during the Evaluation Phase. Based on the results shown in Table 73, only 38.6% of respondents felt any limitation on providing suggestions during this phase of the workshop, while the remaining 61.4% didn't think they had any issues.

Table 73 Agreement on factors limiting suggestion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	17	38.6	38.6	38.6
	No	27	61.4	61.4	100.0
	Total	**44**	**100.0**	**100.0**	

The reason for their indicated limitation was further explored. Results in Table 74 indicate the list of factors that were perceived to limit respondents' ability to contribute during the Evaluation Phase of the workshop. Insufficient time is ranked as the highest factor with a 21.8% rating among respondents and this was followed by a perception that other participants (19.4%) were dominant in the workshop.

Table 74 Factors limiting suggestion during evaluation phase

		Responses		
		N	Percent	Percent of Cases
Limitation to Contribute	Insufficient time to suggest	27	21.8%	61.4%
	Dominant by others	24	19.4%	54.5%
	Others	23	18.5%	52.3%
	Limited experience	17	13.7%	38.6%
	Confidence Level of acceptance	14	11.3%	31.8%
	Insufficient information	10	8.1%	22.7%
	Limited speaking opportunity	9	7.3%	20.5%
	Total	**124**	**100.0%**	**281.8%**

There were also other factors that were not listed in the survey responses but received response frequencies of 18.5%. This is the third highest response after time and dominant participants. Descriptions of these other factors were obtained directly from respondents, which were as follows:

a. *I could not visualise from the drawings how to solve the issue*
b. *The drawings use as reference is insufficient and rather confusing*
c. *How can I contribute when the only drawings issued during the workshop are from PowerPoint with limited visibility on the details*
d. *Parallel session of this workshop make me difficult to comprehend my suggestion with other associated issues as discussed by other groups*
e. *Coming from non-construction based professional, it take some time to understand and visualise the drawings*

f. *It's difficult to contribute when there are separate discussion groups looking at different issue and decision made might be overlapped.*
g. *Involvement as only representative to workshop*
h. *Involvement as decision making authority*
i. *Potential conflict of interest as I am part of the facilitation team but with other workshop under same project packages*

Cross tabulation analysis was conducted between limitation factors (left hand column) and value study issues (vertical axis). The aim of this was to determine the extent of influence that the value study issues had on respondents' ability to contribute during this workshop phase. Result in Table 75 show that 'time' and 'domination by other participants' were highly concentrated towards Architectural (28.7%) issues in the VM workshop. 'Insufficient Time' was observed to be the highest among all value study issues with 7.1% for Architectural VM Main Issue while others were rated with less than 5%. Individual breakdown for Architectural VM Main Issue is also attributed by other factors such as 'dominant by others' (6.7%), 'other factors' (6.4%), 'limited experience' and 'confidence level of acceptance' (3.55) and 'limited speaking turn' (1.4%).

Table 75 Cross tabulation: Limitation factors to contribute and value study issue

		VM Main Issues								
		Architectural	Mechanical and Electrical	Statutory Approval	Land Issue	Structural	Contract	Project Management	Others	Total
Insufficient time	%	7.1%	3.2%	5.3%	2.8%	5.0%	0.4%	0.7%	1.1%	25.5%
Limited Experience	%	3.5%	1.8%	3.9%	1.4%	3.5%	0.4%	0.0%	1.1%	15.6%
Limited speaking turn	%	1.4%	1.8%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	4.3%
Confidence level of acceptance	%	3.5%	1.4%	1.4%	1.4%	2.5%	0.0%	0.4%	0.7%	11.3%
Dominant by others	%	6.7%	2.5%	3.9%	3.2%	3.9%	0.0%	0.0%	2.1%	22.3%
Other factors	%	6.4%	1.4%	4.6%	4.3%	2.8%	0.0%	0.4%	1.1%	20.9%
Total	%	**28.7%**	**12.1%**	**19.1%**	**13.1%**	**18.8%**	**0.7%**	**1.4%**	**6.0%**	**100.0%**

In summary, ‘time insufficiency’ is observed to be the most critical factor that influences workshop participants’ ability to contribute (i.e. provide, enhance and assess) towards workshop discussion during the Evaluation Phase. Other factors medium ranked factors gave an indication that there are additional issues at work in VM workshops that need particular attention. These factors are carried forward for further exploration through interview and qualitative analysis.

Architectural VM Main Issue remains the focal point of influence as a result of cross tabulation. Most of the limitation factors are highly concentrated towards this issue that indicates that the Architectural aspect of a VM study requires additional attention.

6.3.4.3 Motivation Factors

Frequency Analysis was used to assess the respondents’ preference on factors that motivate them to contribute towards discussion during this phase of workshop. Based on the results shown in Table 76, the ‘leadership of the facilitator’ (17%) plays an important role according to respondents. This is followed by ‘opportunity to speak’ (16.1%), ‘sufficiency of information’ (14.3%), ‘experience’ and ‘knowledge of the issue’ (14.3%) and ‘sufficiency of time’ (11.2%).

Table 76 Participants' motivation factor to contribute

		Responses		
		N	Percent	Percent of Cases
Motivation factors to contribute	Leadership of the facilitator	38	17.0%	86.4%
	Opportunity to speak	36	16.1%	81.8%
	Others	34	15.2%	77.3%
	Sufficiency of information	32	14.3%	72.7%
	Experience of the issue	32	14.3%	72.7%
	Knowledge of the issue	27	12.1%	61.4%
	Sufficiency of time	25	11.2%	56.8%
	Total	**224**	**100.0%**	**509.1%**

It is observed that ‘other factors’ were rated as the third largest motivation factor with a 15.2% response and responses including suggestions that related to these factors. The following is a summary of suggested motivation factors obtained from respondents:

a. *Clarity of information presented during presentation phase*
b. *Clarity of information distributed to participants*
c. *Inclusion of subject matter expert or stakeholders to the issue being discussed*
d. *Minimise pre-judgment of ideas by others*
e. *Refrain from ideas criticism*
f. *Control mechanism among participant during discussion as some participants clearly dominate the session*
g. *Facilitator should not press participants too much to revise the design*
h. *Refrain for solely putting cost saving as direction of discussion*

These factors were used as a basis for further analysis together with data obtained during interviews that will be discussed in the Qualitative Analysis section.

6.3.4.4 Personal Traits in Problem Solving

Frequency Analysis was used to assess respondent's preference on personal traits that will assist them to contribute towards discussion during this phase of workshop. Based on the results shown in Table 77, 'tacit knowledge' is the highest rated trait amongst respondents (21.4%), followed by 'cooperative' (17.5%), 'explicit knowledge' (17.5%) and 'strategic thinking' (10.7%). The remaining traits were distributed below 10% with 'being decisive' is the lowest with 1.5%.

Table 77 Personal traits to problem solving

		Responses		
		N	Percent	Percent of Cases
Personal Traits	Tacit knowledge	44	21.4%	100.0%
	Cooperative	36	17.5%	81.8%
	Explicit knowledge	36	17.5%	81.8%
	Strategic thinking	22	10.7%	50.0%
	Ability to challenge ideas	15	7.3%	34.1%
	Communicative	14	6.8%	31.8%
	Meticulous	14	6.8%	31.8%
	Creative	12	5.8%	27.3%
	Ability to change ideas into action	10	4.9%	22.7%
	Decisive	3	1.5%	6.8%
	Total	**206**	**100.0%**	**468.2%**

Further cross tabulation analysis was conducted between personal traits and membership role of respondents in the workshop. The aim of this was to identify the level of involvement of each participant role and the related traits associated with that role. Table 78indicates the results of the cross tabulation. Based on the results in Table 78, 'consultants to the project' are highly related to the top three traits observed. 'Tacit knowledge' (65.9%), 'cooperative' (47.7%) and 'explicit knowledge' (47.7%) are all useful traits that influence problem solving by the consultants. Similar trends are observed for respondents who are in the role of the client's representative to the workshop with equal distribution of 20.5% across all top three traits. Low percentage was observed on the decision-making authority group with an average of below 5% on all traits. The 'meticulous', 'creative' and 'decisive' traits did not receive any responses from this group, although their roles in the workshop are significant.

Table 78 Cross tabulation: Personal traits and membership role

		Membership role				
		Decision making authority	Client's representative	Facilitator	Consultants to the project	Total
Tacit knowledge	%	4.5%	20.5%	9.1%	65.9%	100 %
Cooperative	%	4.5%	20.5%	9.1%	47.7%	81.8%
Explicit knowledge	%	4.5%	20.5%	9.1%	47.7%	81.8%
Strategic	%	4.5%	6.8%	0.0%	38.6%	50.0%
Ability to challenge ideas	%	2.3%	11.4%	4.5%	15.9%	34.1%
Meticulous	%	0.0%	2.3%	2.3%	27.3%	31.8%
Communicative	%	2.3%	6.8%	2.3%	20.5%	31.8%
Creative	%	0.0%	2.3%	0.0%	25.0%	27.3%
Ability to change ideas into action	%	2.3%	6.8%	9.1%	4.5%	22.7%
Decisive	%	0.0%	0.0%	0.0%	6.8%	6.8%
Total	**%**	**4.5%**	**20.5%**	**9.1%**	**65.9%**	**100 %**

In summary, 'tacit knowledge', 'being cooperative', 'explicit knowledge' and 'strategic thinking' are observed to be the key personal traits that respondents think could assist them with problem solving during this stage of the workshop. Other traits are observed to have lower preference with less than 10%. The consultant group of respondents is identified as having the top four traits as mentioned based on the cross tabulation analysis conducted. This result indicates that the high level of their contributions as workshop participants is consistent with their high level role as consultants to the project.

6.3.5 Implementation Phase

The Implementation Phase is where shortlisted solutions from Evaluation Phase are further developed or potential action to be taken. This section will analyse the key outcome areas of the solutions generated from the previous workshop stage.

6.3.5.1 Workshop Key Area Outcome

Results in Table 79 show a summary of analysis using frequencies on key outcome areas for the workshop. Based on the result, out of 13 variables, all variables were accepted by respondents as key outcome areas for the workshop, with an average mean of 3.82. Variable V13 ‘Recommendation with improved specification requirements’ is the lowest with an average mean of 2.82.

There are four variables (V1, V2, V3 and V4) that achieved the highest response agreement from respondents with 77.20% (Mean = 3.86). Those variables are concentrated toward key outcomes that focus on ‘Recommendation provide alternative solution for the proposed development scheme’ [V1], ‘Recommendation provide alternative solution for design’ [V2], ‘Recommendation provide alternative solution for construction methods’ [V3] and ‘Recommendation provide alternative solution to save cost’ [V4]. This findings are consistent with finding made by Fong et al. (2001) where VM recommendations made during post-workshop phase allows the Management team to structure for resources in accomodating potential changes, refinement for further improvement (Ellis et al. 2005) as well as ensuring it can be implemented (Dell’Isola, 1982; SAVE International, 2007). The remaining variables (V5 – V12) achieved a positive level of agreement but with less than 50% acceptance level.

It is observed that variables V5 – V12 with less than 50% acceptance level are closely parallel with neutral and disagreement responses. Variable V5 – V12 received a consistent neutral response (27.3%) while disagreement responses range from 29.5% to 31.8%. Despite the high level of disagreement and neutral response received from respondents, the percentage of the result does not appear strong enough to reject the variables V5 – V12.

Based on this result, it can be summarised that respondent's views on the current case study VM outcome areas attempt to address a solution towards improving the project scheme through better design, construction methodologies and application of cost saving measures.

Table 79 Workshop key outcome area

		Mean	SD	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Recommendation provide alternative solution for the proposed development scheme	3.86	.702	13.60%	63.60%	18.20%	4.50%	-
2	Recommendation provide alternative solution for design	3.86	.702	13.60%	63.60%	18.20%	4.50%	-
3	Recommendation provide alternative solution for construction methods	3.86	.702	13.60%	63.60%	18.20%	4.50%	-
4	Recommendation provide alternative solution to save cost	3.86	1.313	29.50%	13.60%	27.30%	22.70%	6.80%
5	Recommendation enhance project function	3.36	1.313	29.50%	13.60%	27.30%	22.70%	6.80%
6	Recommendation improve value to the project	3.36	1.313	29.50%	13.60%	27.30%	22.70%	6.80%
7	Recommendation increase the viability of the project	3.36	1.313	29.50%	13.60%	27.30%	22.70%	6.80%
8	Recommendation improve understanding of the project objectives	3.34	1.293	27.30%	15.90%	27.30%	22.70%	6.80%
9	Recommendation with improved constructability of the design	3.34	1.293	27.30%	15.90%	27.30%	22.70%	6.80%
10	Recommendation with improved life cycle costing	3.30	1.304	27.30%	13.60%	27.30%	25.00%	6.80%
11	Recommendation improved time performance of the	3.30	1.304	27.30%	13.60%	27.30%	25.00%	6.80%

	project							
12	Recommendation minimise risk for the project	3.27	1.336	27.30%	13.60%	27.30%	22.70%	9.10%
13	Recommendation with improved specification requirements	2.82	1.063	6.80%	20.50%	27.30%	38.60%	6.80%

6.4 SUMMARY OF SURVEY ANALYSIS

Analysis conducted from Section 6.1 to 6. 3 of this chapter have identified the background constituents of VM workshop organisation as practiced by MAHB on all five case studies. A 44% response rate was achieved out of 99 useable distributed surveys among workshop participants involved in VM workshops undertaken by MAHB. Responses from only five case studies were analysed after case study No. 2 (CS2) was terminated by MAHB during the course of data collection due to undisclosed reasons.

The Quantity Surveyors, Project Managers, Building Services Engineers and Civil Engineers are the largest groups of respondents to this survey. The majority of them have worked in the construction industry between 6 – 15 years. Respondents' working organisations are almost equally divided between the Consultants and Client organisations. Many of them have had experience as participants in VM workshops in their previous projects and this credential adds value to the quality and accuracy of responses given in this survey.

Results in the Pre-Workshop Phase of the VM workshop indicate respondents' views on the organisation of preparatory work prior to the workshop phase and the reasons for workshop being conducted. Majority of respondents were of the opinion that the reason for the workshop to be conducted in their projects was due to Standard Operating Procedures (SOP) and value-adding initiative sought by the MAHB. These results appear to be due to the fact that the objectives of the workshop are perceived to be able to enhance functionality and viability of the proposed project. Pre-qualification exercises to select workshop participants were conducted but were limited to internal staff within client's organisation (i.e. MAHB). The remaining external parties to the client's organisation believed their selection for the VM workshop was due to their current appointment as consultants to the on-going project. The consultants account for more than half (65%) of the total team composition. This includes consultants who are in-house to the MAHB. The remaining respondents acted in the capacity of facilitators, client's representative and decision-making authorities. It is observed that only 34.1% (n=2) of total case study projects conducted a briefing and distributed information related to the workshop during the pre-workshop phase while the remaining briefing and information distribution were conducted during the workshop.

Result in the Workshop Phase indicate the respondents' views on the Job Plan sequence of activities of the workshop, including the use of techniques and documentation to assist with problem solving. Drawings are the most frequently used reference documents across all cases followed by Life-Cycle Costing and Construction Programme. Building Information Modelling is suggested to be part of system to be used during the early workshop phase in future to assist with problem identification and solution finding. Presentation and brainstorming techniques are observed as the most frequently applied techniques during the Functional Analysis and Creativity Phases of the workshop. 22.7% of respondents think that the techniques used currently are insufficient and have suggested several other techniques. The techniques include Interactive Value Management System (IVMS), Fishbone Diagrams, and Mind Mapping techniques to assist with the workshop process.

In terms of workshop participant interactions, all respondents agreed that they were given an opportunity to present their ideas during the workshop, however 34.1% felt some limitation to be given the chance to further assess their own improvement suggestions. Architectural issues were seen as the main focus of the workshop where this problem often arises. It is observed that this scenario happens apparently due to insufficient time being allocated for workshop participants to contribute their ideas during the actual VM workshop. In addition, domination by other participants contributes significantly to aggravating this limitation. On the other hand leadership by the Facilitator and a greater opportunity to speak are observed as being amongst the main factors that could motivate workshop participants to more easily contribute. Other factors were the inclusion of a control mechanism among participants during workshop discussion, better clarity of information and references, reduction of domination of certain participants and inclusion of construction-based subject matter experts. Tacit knowledge by workshop participants is perceived as the key personal trait that contributes greatly in problem solving during workshop phase of the study. The inclusion of this knowledge is observed to receive higher preference as compared to explicit knowledge and other traits listed in the survey.

The respondents accepted the majority of the proposed key outcome areas from VM workshops for all cases. However, there were four key outcomes that were distinct among all 13 outcomes. The respondents were of the opinion that in all cases, the outcomes of the workshop are focussed towards improving the development scheme, finding alternative design solutions, including construction methodologies and instigating cost saving measures for the project.

In summary, results obtained through descriptive analysis for the survey provide background information on the organisation and issues faced within VM workshops in all case studies. Information in terms of frequencies and relationships between variables are further explored and analysed in the later sections of this chapter using the results of interviews conducted among workshop participants. The following section will be discussing the analysis obtained from the document review process.

6.5 DOCUMENTS ANALYSIS

This section will analyse data collected from the document review process conducted across all cases of this research (CS1, CS3, CS4, CS5 and CS6). The aim of the document review is to understand the procedures and processes involved in organising VM workshops. This includes decision-making procedures, workshop processes and how each document influences the outcomes of the VM workshop.

Documents analysed for this phase of this research consist of (including identifier codes):

a. Value Management Reports (for case CS1, CS3, CS4, CS5 and CS6) [Code: **VMR**]

b. MAHB Value Management Manual (Che'Mat & Malaysia Airports Holdings Berhad, 2008) [Code: **VMM**]

c. MAHB Procurement Policies, Procedures and Guidelines (3rd Edition) [Code: **3PG**]

d. MAHB Quality Manual [Code: **QM**]

e. MAHB Financial Limit of Authority (FLOA) [Code: **FLOA**]

f. Drawings and sketches [Code: **DWS**]

The analysis was conducted on all documents and across all cases of this research. Each individual document was read and reviewed separately to extract information relevant to the study. A Microsoft Excel spread sheet was used to capture and recorded data from the document review process against all cases. However, the presentation of data and findings in this section is arranged to follow the stages of the VM workshop - Pre-Workshop, Workshop and Post-Workshop sub-sections. This arrangement will assist in making easier comparisons between surveys, interviews and the literature review.

6.5.1 Necessity to conduct Value Management Workshop

The 3PG, QM and FLOA documents confirmed the requirement to conduct VM studies on projects initiated by MAHB. The 3PG and FLOA specifies MAHB procurement processes and states that it is mandatory to perform VM studies on projects/programme with a cost estimated to exceed RM 300,000.00 (AUD 100, 000.00). The requirement for conducting VM studies in MAHB is normal procedure in every project due to the relatively low threshold value of most projects.

The documents specify the Planning and Development (P&D) as the responsible department assigned to organise and manage all VM studies under MAHB. There is a special Value Management Unit (VMU) that focuses specifically on organizing VM studies.

6.5.2 Requirements for VM study

The 3PG, QM and FLOA documents did not specify any specific requirements related to organizing the VM studies in MAHB. These documents were limited only to specifying the rules that mandated the need for VM studies to be performed but made no reference on how they should be performed. The processes of conducting VM are specified in a VMM produced by the VMU of MAHB and an external consultant (Che'Mat & Malaysia Airports Holdings Berhad, 2008). Together these documents work as a guideline for the conduct of VM within MAHB. It contains several major topics that include:

i. VM Performance Measure
ii. Job Plan methodology
iii. VM framework that operate entire VM practices across MAHB
iv. Organisational structure of VM implementation (i.e. approving authority and line of command
v. Tools and Techniques

VM Performance Measure

This section examined the contribution of the VM to assist the project to meet or improve either cost or performance expectations/outcomes. There are eight key areas of performance specified to be measured under this document that could benefit from VM implementation as indicated in Table 80 below.

Table 80 VM Outcome Performance Measures

Monetary	Quality
Constructability	Time
Design Efficiency	Energy
Environmental Impact	Durability

Although the 3GP and FLOA documents specify a threshold value for the implementation of VM, the processes and phases where VM are most desirable/applicable are not clearly stated. However, the VMM has outlined some conditions where the application of VM should take place during the course of the project. Based on VMM, there are two stages where VM is required to be performed:

a. Strategic and Initiation Stages of a Project

   This refers to the early VM intervention to a project where financial commitment towards the budget is relatively low and has the flexibility to be changed.

b. Prior to a Budget Challenge Exercise

   Under the FLOA and 3GP, there is a condition stated whereby any project/programme initiated is required to perform a budget challenge exercise. This 'exercise aims to obtain senior officials' approval and funding for the project'. The department initiating such projects is required to present and convince the board of senior officials in MAHB on the financial commitment needed for, and cash flow to be applied to the project. Therefore, the requirement for VM to be performed prior to such a budget challenge exercise indicates a pro-active approach by MAHB to increase the value of the proposed project.

It is observed that the requirement for VM intervention in MAHB projects focuses on the early intervention point. However, no specific information was found in all documents reviewed regarding any requirement to conduct VM studies during the later stages of a project.

Job Plan Methodology

The Job Plan described an outlines of three major stages of VM termed as Pre – Study, Value Study and Post Study. The Pre-study stage outlines necessary preparatory works that need to be completed prior to the full Value Study implementation. The pre-study outlines the requirements for preparing the following documents/information :

- Project brief
- Specification and drawings
- Bills of Quantities
- Cost estimates
- Projected revenue or other form of savings
- Relevant documents related to expenses
- Assumptions used for technical/commercial parameters
- Relevant documentation to support life cycle costing
- Cost Model and Space Function Model

The Value Study underlines the processes involved in the actual workshop element of VM in MAHB. There are five (5) phases of Job Plan that were practiced in MAHB VM application. The phases consist of:

1. Information Phase
2. Speculation Phase
3. Judgement Phase
4. Development Phase
5. Recommendation & Action Plan Phase

Each phase has a description of activities and expected s at the end of each phase. It is observed that all activities and outcome of all phases are consistent with typical VM methodology as practiced and suggested worldwide (Kelly, et al., 2004; Kirk, et al., 2002; Male, et al., 1998; Norton & McElligott, 1995; SAVE International, 1998, 2001, 2007).

Framework of VM Operation

The following Figure 12 indicates the framework that governs the operation of VM within the MAHB organisation.

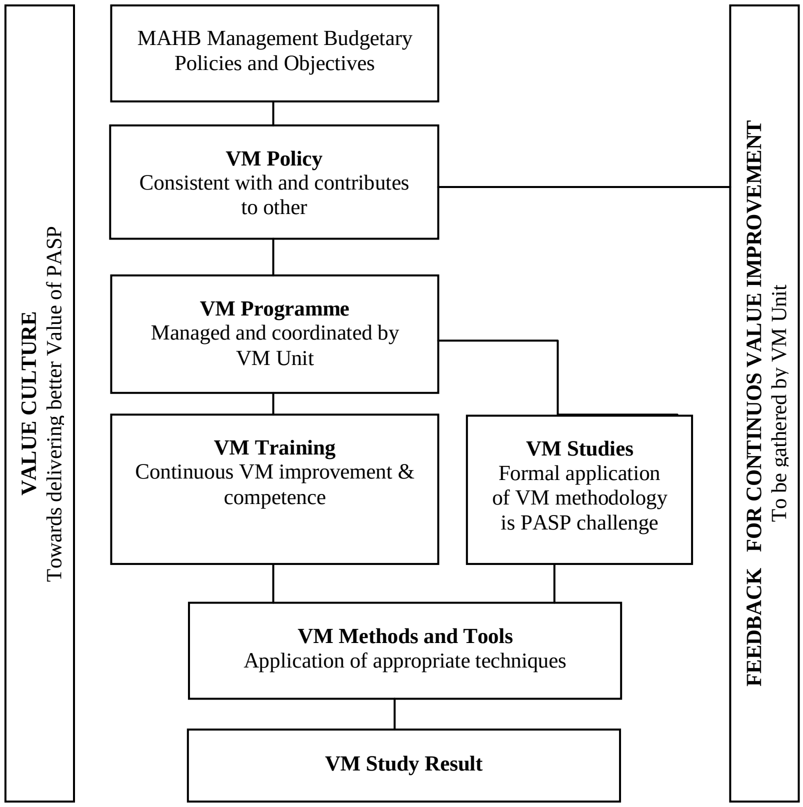

Figure 12 VM framework within MAHB

The framework indicates five major components that make up the system. VM policy is the overriding component that guides the entire process. The policy consists of documents reviewed in this research (i.e. 3GP, FLOA, QM and VMM). MAHB's VM Unit manages all VM programmes.. There are two main activities that are run by the VM unit; the training and VM studies. The VM study is the normal VM application on projects as required under the 3GP and FLOA documentation. However, there is a requirement for VM training to be provided for MAHB staff. The training and VM programme are not exclusively for MAHB staff only; the opportunity is extended toward their SME's staff. This shows that the MAHB has taken appropriate measures to instil awareness and knowledge about VM to their overall staff.

Organisational structure of VM implementation

This section in the document specifies the implementation procedures of VM and the relevant approving authority for all recommendations made during this study. This section is included for information and context only as it is outside the scope of this research.

VM Tools and Techniques

The document specifies tools and techniques that to be used when conducting VM studies. These are covered by collections of Standard Forms included but there are no specific instructions or guidelines on how to apply and use those forms. The set of forms consist of:

- Form 1: Cost Model Form
- Form 2: Space Function Analysis Form
- Form 3 : Question Prompt Form
- Form 4a and b : Evaluation Matrix Forms
- Form 5: VM Recommendation Form
- Form 6: Summary of VM Recommendation Form

These forms provide a standard toolset to be used throughout the VM study. It is also observed that in this document, there is no mention of specific decision-making or creative techniques to be used. Some references on specific techniques problem and decision making process are briefly described in the Job Plan sub-section of the VMM document. Based on the analysis, the following are the tools and techniques suggested to be used under the documents (VMM) mapped out against MAHB's Job Plan.

Table 81 MAHB VM tools and techniques

Job Plan Phases	Tools	Techniques
Information Phase	Cost Model (Form 1) / Life-Cycle Costing (LCC) Model/ Space Function Model (Form 2) / FAST Diagram / PERT	Function Analysis
Speculation Phase	*nil*	Brainstorming
Judgement Phase	Form 3/4a and 4b	Question Prompt (Form 3)
Development Phase	*nil*	*nil*
Recommendation & Action Plan Phase	Form 5 and 6	Oral Presentation/Written Report

This table indicates that MAHB applies a basic approach to VM studies. It also observed that there is no specific information on tools and techniques for Speculations Phase (tools) and Development Phase (both) described in the VMM document.

All three documents reviewed (3GP, VMM, QM and FLOA) provide basic information and procedures on conducting VM studies for projects. Based on the analysis across all these four documents, there are still some areas of information that were not covered. There is no specific mentions of the following areas:

- Facilitator
- VM Workshop participants (internal or external to MAHB)
- Study duration/location
- Alternative tools and techniques for Speculation and Judgement Phases.

The lack of these elements is considered a crucial omission in the documents as if included, they would provide greater guidance on the appropriate full application of VM in terms of human resources and logistics components. Key components of timing of the study, job plan, and tools are clearly stated in these documents.

However, the four areas identified to be missing from the documents were noted to be among the key success factors in any VM study/workshop by Shen and Liu (2003). Findings made from the review by these authors (ibid 2003) leads to several questions that require further clarification on the conduct of VM within MAHB such as:

Facilitator

- *What are the processes involved in appointment facilitator?*
- *What are the criteria for a person to be appointed as Facilitator?*
- *Does the appointment of facilitator is made among internal staff or external to MAHB?*

Workshop Participants

- *Who are the participants to VM workshop?*
- *What are the criteria to be selected as participant to VM workshop?*
- *What are the limits on number of workshop participants for each VM study?*

Study Location/duration

- *What is the duration for each VM study?*
- *How long each phases of Job Plan will last?*
- *Where is the location of VM study?*

Alternative tools and techniques

- *What are the alternative tools and techniques for Speculation Phase?*
- *What are the alternative tools and techniques for Judgement Phase?*
- *What are the alternative tools and techniques for Development Phase?*

These questions indicate a gap area and identify a critical need for further exploration on the conduct of VM within MAHB. These questions above require to be addressed at the outset of VM study. Although the 3GP, VMM, FLOA and QM documentation did not specify such information, the following analysis from another (i.e. VMR) source will attempt to provide some answers to these questions.

6.5.3 Conduct of VM workshop

The 3GP, VMM, FLOA and QM documentations underline the requirement to conduct VM studies. In contrast the VMR document underlines the actual processes to be undertaken during a VM study in MAHB. The production of VMR is undertaken during the Recommendation and Action Plan phase of the VM Job Plan. It records all necessary information and conduct of events throughout the entire VM study including documentation used. The analysis of VMR is meant to counter-check between the existing policies and procedures against the actual VM process. Similarities and differences were observed and recorded for further exploration.

6.5.3.1 Analysis of VM Report

According to the VMM, the content of the VMR produced at the end of a VM workshop should contain the following information:

Table 82 MAHB Typical VM report content

Information type	***Processes***	***Final deliverable (s)***
Executive Summary	*Ideas judged, evaluated and developed*	*Acknowledgment of contributions by all parties involved*
Space model, cost model and LCC	*Sketches before and after design showing proposed changes*	*Action plan*
Results from Function Analysis	*Technical data supporting the selection of alternative*	*Agenda*
Ideas generated	*Cost Analysis*	*Attendance list*

Further analysis was conducted comparing content of the VMM against the VMR of all cases examined under this research. Table 83 indicates the findings:

Table 83 VMR contents comparison between cases

VMR Requirements	***CS1***	***CS3***	***CS4***	***CS5***	***CS6***
Executive Summary	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Space model, cost model and LCC	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Results from Function Analysis	*Yes*	***No***	*Yes*	*Yes*	*Yes*
Ideas generated	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Ideas judged, evaluated and developed	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Sketches/drawings before and after VM outcome showing proposed changes	***No***	***No***	***No***	***No***	***No***
Technical data supporting the selection of alternative	***No***	***No***	***No***	*Yes*	***No***
Cost Analysis	***No***	***No***	***No***	***No***	***No***
Acknowledgment of contributions by all parties involved	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Action plan	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Agenda	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Attendance list	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

There are three key areas that were observed missing from the reports across all cases. These were - sketches/drawings, cost analysis and technical data supporting the selection of alternative solutions. An exception to this was observed to Case CS5 where technical data was provided to support the recommendations made and CS1, C4, CS5 and CS6 did include Functional Analysis details in the report. There was no specific mention in any of the reports as to why this information was not included. However, further analysis through interviews and a detailed review of the contents of this report will reveal the reasons behind it and are included in triangulation section of this chapter.

6.5.3.2 Analysis of VM Workshop Management

The following analysis explores the logistics for workshop management across all cases. This includes workshop objectives, participants, study duration and other resources related to workshop management. All cases were analysed simultaneously to identify similarities, pattern and differences. VMR for all cases were reviewed and analysed through extracting information into a Microsoft Excel spread sheet according to assigned groupings.

There are altogether five headings under this sub-section that consist of the following:

- Workshop objectives
- Workshop participants
- Workshop duration
- Workshop documentation
- Application of forms under the VM Manual
- Workshop phases

Workshop Objectives

Each case was selected based on criteria set during the design phase of this research. Despite all cases having met the selection criteria, the aims and objectives of each case vary. The following indicates a summary of workshop aims for all cases in this research:

Table 84 Summary of KLIA2 VM Workshop Aims

Case	Study Summary	Intervention Point
CS1	The study was conducted to ensure efficient design and cost optimization. The study looks into the design of the DCA Operation Building and Control Tower.	*Design Planning*
CS3	The study was conducted to focus on developing a design resulting from initial VM study conducted under the same project package. This is the follow-up VM study of the same package with to further develop one of the recommended options.	*Design Planning*
CS4	The study was conducted to focus on optimisation of cost, design and suggest appropriate procurement of terminal approach road.	*Design Planning*
CS5	The study was conducted to optimise cost and design efficiency of main Terminal Building design including all systems and associated buildings.	*Design Planning*
CS6	The study was conducted to optimise cost and design of new sewerage line servicing the entire KLIA2 development scheme.	*Design Planning*

A further analysis was conducted on the objectives of each case as stated in their respective VMRs. The results are summarised in table 85 as follows:

Table 85 Summary of KLIA2 VM Workshop Objectives

Case	Objective 1	Objective 2
CS1	Cost Optimization	Increase design efficiency
CS3	Cost Optimization	Increase design efficiency
CS4	Cost Optimization	Proposed procurement strategy
CS5	Cost Optimization	Increase design efficiency
CS6	Cost Optimization	Increase design efficiency

It is observed that cost optimisation is the top priority in each case while increasing design efficiency comes second. This suggests that the main factor that drives all case to proceed with a VM study under KLIA2 is the need to optimize project costs. Although all project packages has already passed the budget challenge stage of required under the VMM, the pursuit of improving the project delivery through cost optimisation remains key. This is demonstrated by the intervention point taken for all cases during Design Planning phase of the projects as indicated in Table 85. This also shows that the implementation of VM in KLIA2 project has in fact been conducted during the early phase of the project as required under MAHB policies.

Workshop Participants

The attendance lists of workshop participants in all cases was analysed to identify composition, background and positions within the VM study. Table 86 summarises the profiles of workshop participants and the list is validated with the MHB VM unit against the invitation made to all parties d for analysis purposes.

Table 86 Breakdown Summary of Workshop Participants

Workshop Participants	***CS1***		***CS3***		***CS4***		***CS5***		***CS6***	
Internal to MAHB										
Client	*23.6%*	*8*	*21.7%*	*5*	*31.0%*	*9*	*21.0%*	*10*	*16.7%*	*2*
Airport Planning and Technical Team	*6%*	*2*	*8.7%*	*2*	*10.3%*	*3*	*10.6%*	*5*	*-*	*-*
Department of Civil Aviation (DCA) Representative	*8.8%*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
Sub-total	***38.4%***		***30.4%***		***41.3%***		***31.6%***		***16.7%***	
External to MAHB										
Architect	*3%*	*1*	*-*	*-*	*-*	*-*	*14.9%*	*7*	*-*	*-*
Mechanical/Electrical Engineer	*11.8%*	*4*	*13%*	*3*	*3.4%*	*1*	*4.3%*	*2*	*-*	*-*
Civil/Structural engineer	*8.8%*	*3*	*0%*	*-*	*13.8%*	*4*	*4.3%*	*2*	*25%*	*3*
Quantity Surveyor	*6%*	*2*	*13%*	*3*	*13.8%*	*4*	*6.3%*	*3*	*8%*	*1*
Project Management Consultant (PMC)	*8.8%*	*3*	*21.7%*	*5*	*3.4%*	*1*	*10.6%*	*5*	*25%*	*3*
Specialist	*11.8%*	*4*	*4.3%*	*1*	*10.3%*	*3*	*10.6%*	*5*	*-*	*-*
Interior Designer	*-*	*-*	*-*	*-*	*-*	*-*	*6.3%*	*3*	*-*	*-*
Sub-total	***50.2%***		***52%***		***44.7%***		***57.3%***		***58%***	
Facilitation Team										
Facilitators	***11.8%***	***4***	***17.4%***	***4***	***13.8%***	***4***	***10.6%***	***5***	***25%***	*3*
Total		*34*		*23*		*29*		*47*		*12*

Table 86 is further divided into three categories; internal, external and facilitation team. The internal team represents participants who are staff to MAHB either directly or through one of MAHB's SMEs. The external team refers to consultants who are involved with the workshop but were representing other companies, and the facilitation team is treated to be independent to the other two groupings. It is observed that clients make up the majority group for all cases except case CS6. On average, there are 6 persons from the client team (MAHB) in every workshop.

From analysis, case CS5 is the largest group among all cases with 47 workshop participants. This is due to the nature of this case itself that focuses on planning and design of the main terminal building and its integration system. This justifies a larger number of participants compared together cases. Despite CS5 being the largest workshop group; it is observed that on average the percentage of participants otherwise are relatively consistent across all cases.

In comparing between internal and external teams, on average the internal team represents 32% of all cases while the external team contributes 52% of the composition. The facilitation team only accounts for 16% as indicated in Figure 13.

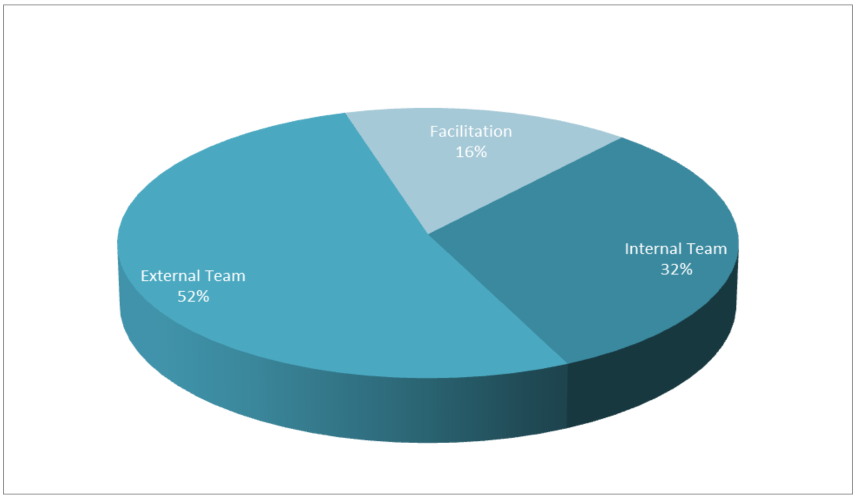

Figure 13 Workshop team composition

This percentage can be translated into a facilitator to participants ratio with the average case having a ratio of 1:7. Although this ratio seems generally to reflect a a good ratio, case CS6 is unique where for a small number of 9 workshop participant,, 3 facilitators were involved, bringing the ratio to 1:3.

The team composition for all cases generally indicates a similarr distribution of participants. The differences between the larger workshop group against the others is due to the nature and complexity of the project packages that demand higher involvement of various parties. The facilitator to participants ratio of 1:7 also suggests that a good level of faciliation was achieved to control a small participant group.

Workshop Duration

The workshop duration for each case are also analysed to identify and understand the amount of time spent for each workshop. The analysis comprises of observing the hours spent, the duration patterns for each workshop and where these sat within the Job Plan phases. The time observed in this analysis only covers the amount of time spent focussing on the overall phases and excludes any breaks/lunch time. Table 87 summarises the workshop duration for each phase of the Job Plan measured in hours.

Table 87 Workshop Phase Duration Across Cases

MAHB VM Phases	***CS1***		***CS3***		***CS4***		***CS5***		***CS6***	
Architect Presentation							*2.3%*	*0.45*		
Civil/Structure Presentation							*5.1%*	*1.00*		
M&E Presentation							*5.1%*	*1.00*		
QS Presentation							*5.1%*	*1.00*		
Information Phase	*23.4%*	*1.45*	*22.8%*	*1.05*	*22.8%*	*1.05*	*36.1%*	*7.00*	*25.6%*	*1.15*
Speculation Phase	*18.5%*	*1.15*	*23.9%*	*1.10*	*23.9%*	*1.10*	*7.7%*	*1.50*	*12.2%*	*0.55*
Judgement Phase	*18.5%*	*1.15*	*21.7%*	*1.00*	*21.7%*	*1.00*	*7.7%*	*1.50*	*25.6%*	*1.15*
Development Phase	*21.0%*	*1.30*	*21.7%*	*1.00*	*21.7%*	*1.00*	*17.8%*	*3.45*	*11.1%-*	*0.50*
Recommendation Phase	*18.5%*	*1.15*	*9.78%*	*0.45*	*9.78%*	*0.45*	*12.9%*	*2.50*	*25.6%*	*1.15*
Total hours spent		*6.20*		*4.60*		*4.60*		*19.4*		*4.50*

Due to the complex nature of the CS5 project, this case is the only scenario observed where specific presentation sessions were held for the participants. Presentations were delivered by consultants for the projects on the Architectural, Civil & Structural and Mechanical & Electrical Engineering aspects. Further analysis from the CS5 VMR found that the presentations were conducted at the outset of the Job Plan, that is prior to Information Phase. Each presentation ranged between 45 minutes to 1 hour. Although presentations were conducted, it was also observed that the Information Phase of CS5 was conducted for approximately 7 hours. This accumulates to a total 10.45 hours of time spent by MAHB in making sure all information and presentations were adequately supplied to workshop participants.

Unlike in CS5, in all other cases, the hours spent for workshops by are consistent. On average, CS1, CS3, CS4 and CS6 spent around 5 hours of workshop time rounded up to be equivalent to a 1-day workshop, while CS5 spent 2 days for the workshop. Each Job Plan phase duration was observed to be on average between 1 to 1.45 hours. This indicates that an equal amount of time was spent for each phase. An exception was observed for CS5 more time was spent on all phases, especially on the Development and Recommendation Phases of the workshop. It also noted that although CS5 ran a two day workshop, the amount of time spent on the Speculation and Judgement was relatively consistent with other cases with an average of 1.5 hours. However based on the CS5 VMR, the report indicates that despite consistent hours being spent compared to other cases, the conduct of Speculation Phase was undertaken as a parallel session. There were actually three groups running this phase simultaneously within on average a 1.5 hours period. Therefore, a 4.5 hours period was spent overall on the Speculation Phase by adding together all three groups.

The information phase is observed to have the most time spent across all cases as compared with other phases. It contributed between 23% to 36% of the total workshop time while the remaining phases used less than 20%.

In all cases for VM workshops the data indicates an equal distribution of time spent. This is so between cases and between phases of the Job Plan with the exemption of CS5. These results need to be compared against the complexity and nature of each case when considering the sufficiency of time spent and this will be further described in the section of this chapter on ‘triangulation’.

Documentation used during VM workshops

A review of the types and lists of reference documents used in the workshops across all VMRs returned a negative outcome as no lists of documents or references to any particular supporting information were recorded in the reports reviewed.

Application of forms under the VM Manual

Despite no references to the types and lists of documents used in workshops being recorded in all VMRs, the reports do refer to the forms used during the workshops. Table 88 below indicates all forms used across cases.

Table 88 Forms used during workshops

Forms List	***CS1***	***CS3***	***CS4***	***CS5***	***CS6***
Form 1	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Form 2	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Form 3	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Form 4a	*No*	*No*	*No*	*No*	*No*
Form 4b	*No*	*No*	*No*	*No*	*No*
Form 5	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Form 6	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

All cases appeared to use almost all of the forms stated in the VMM. However, Forms 4a and 4b (Criteria Evaluation Matrix) did not form part of all reports. This finding does not suggest that that the application of tools during Judgement Phase is neglected during the workshop. However, further analysis through interviews and surveys was conducted to discover whether any other alternative tools were being used as a replacement for those mentioned in the VMM.

Workshop Phase: Information Phase

Analysis conducted on activities during the information phase of workshops across all cases revealed consistent results. All reports contained a summary of activities performed during this phase that mainly focused on presentation and functional analysis. Cost models were also presented to all workshop participants as recorded in the VMRs.

All VMR reports recorded application of the “Project Must/Must Not” technique and Functional Analysis activities were also shown to be conducted during this phase of the workshop. The “Project Must/Must Not” technique as described in the report refers to the listing of all parameters that will guide the workshop discussion process. For instance in CS5, the “Project Must/Must Not” list consists of parameters that need to be considered when designing taxiways connecting with the main building.

Parameters identified in CS5 include areas such as requirements for line marking, percentage of platform compaction, numbers of bays required and airside service roads. These also include the limit of the design that focuses on deadlines and budgetary matters. The application of the "Project Must/Must Not" technique and forms are tools and techniques required under VMM, however, this discovery suggests an initiative by facilitators that has been made to improve the management of the information phase.

Secondly, the Functional Analysis (FA) results were recorded across all VMRs except for case CS3. Form 2 of the VMM is used to record all results from the FA process including Form 1 (Cost Model). The application of FA as identified in the cases is consistent with the requirements of the VMM.

Workshop Phase: Speculation Phase

Observations were made across all cases on the reporting of the speculation phase. However, all VMRs report only record lists of ideas generated as a result of the workshop brainstorming process. The techniques of brainstorming were used across all cases as described in the summary section of all VMRs.

Workshop Phase: Judgement Phase

Similar results were obtained for this phase whereby limited descriptions were made for all cases. Comparison across cases found that the application of Form 3 (Question Prompt Form) was used on all cases to record the evaluation process from the previous phase. However, the application of Forms 4a and 4b were not found in some case VMRs.

Workshop Phase: Development Phase

There are two observations evident across all cases for this phase. The first type of information recorded in the report was the "Value Implications of the 'Can We' Suggestion" form. This form gives an analysis of the shortlisted results/ideas from the previous workshop phase. It lists the advantages and disadvantages of those ideas including their estimated financial implications.

The second type of information recorded in the reports was an Action Plan that specifies the tasks to be undertaken as a result of both the judgment phase and value implication analysis of ideas coming out of the phase.

Workshop Phase: Recommendation Phase

Limited information was presented related to this phase in all VMRs. There are only two forms that were used to record findings made from the previous phase. Forms 5 and 6 were used to record VM recommendations. It is also observed that no references were made to any particular drawings/documents/specifications that were affected as a result of such recommendations. The information contained on both forms focuses only on any changes made to the designs of one particular element/section/component, cost estimate, and the potential savings generated from such recommendations. No drawings and sketches were observed to have been used to indicate an overview of changes across all VMRs.

However, despite this general lack of supporting information across all cases, there were exceptions for case CS5, which is the only case where technical information, **DWS** and supporting documentation were included as part of the **VMR**.

Summary of Documents Analysis

Analysis for all documents (**3GP, FLOA, QM , VMM, DWS**) , VMRs and all cases were made and compared. The analysis was divided into several themes that relate to the organisation of a VM workshop as based on literature.

General findings made from the analysis are that the application of policies and procedures (3GP, FLOA, QM & VMM) against the actual workshop processes based on VMRs reviewed were consistently implemented. All cases are observed to have adhered to the Job Plan and used tools and techniques as specified in the VMM with some value added exercises beyond those in the manual. All cases conducted VM workshops as a result of requirements mandated under the policies and procedures (3GP, FLOA, QM & VMM) by MAHB..

Despite the observation of a consistent pattern across all cases related to the adherence to Job Plan, tools and techniques, there were some minor deviations from VMM noted. All VMRs reviewed lacked consistency in (or ignored altogether) reporting all activities that occurred during each phase of the Job Plan. The 'reporting' was often focused on just attaching all of the forms associated with the application of the tools and techniques used, without a description of the processes involved. Secondly, the lists of documentation used as information and references in the workshop processes were not included in all VMRs where cases focused on cost optimisation and design efficiencies. This observation also extends to the supporting information driving the recommendations made from the VM studies and only one case included such supporting documentation.

The consistent patterns observed that result from this analysis, despite some minor differences, were made through direct analysis of all reviewed documents across all cases. However, the limitations of this process (i.e. recording and observing physical documents) is confined to just what has been recorded without knowing the reasons behind what has been recorded. Therefore, further analysis through interviews and by triangulating all findings from the document review and survey results is crucial in making solid inferences from findings related to the use of VMRs and the information they contain.

6.6 INTERVIEW ANALYSIS

This section will analyse data collected from the interview process conducted among workshop participants across all five cases (CS1, CS3, CS4, CS5 and CS6). Case study No. 2 (CS2) was excluded from the analysis due to termination of access by MAHB during the survey data collection phase of this research.

Focused interviews were conducted among the workshop participants involved in all five case studies selected for this research. The aim of the interviews was to obtain an in-depth understanding of how design development is managed through the application of value management studies. Analysis and results obtained from the survey are then used to assist in constructing interview questions to allow probing of various concepts and views during the interviews.

A qualitative approach is used to analyse interview data collected, namely Constant Comparative Analysis (Bryman 2010) and the Pattern Matching Method (Yin 2009). Interviews transcripts were coded using NVivo Version 9 (QSR International Pty Ltd., 2011) and further cross case analysis was conducted to identify significant patterns between data from the five cases.

6.6.1 Interviewee's Profile

Invitations were sent to all respondents to the survey questionnaire conducted in the earlier stage of the research. A total of 99 invitations were sent and 25 agreed to be interviewed. The following Table 89 indicates interviewee respondents' profiles:

Table 89 Interviewee's Profiles Registry

Ref	**Interview ID**	**Case ID**	**Background**	**Organization**
1	INV01	CS5	Civil Engineer	Client
2	INV02	CS1	Civil Engineer	Client
3	INV03	CS3	Quantity Surveyor	Client
4	INV04	CS1	Civil Engineer	Client
5	INV05	CS1	Accountancy	Client
6	INV06	CS6	Electrical Engineer	Client
7	INV07	CS4	Legal	Client
8	INV08	CS5	Quantity Surveyor	Client
9	INV09	CS5	Civil Engineer	Client
10	INV10	CS6	Architect	Client
11	INV11	CS5	Airport Planner	Consultant (PMC)
12	INV12	CS5	Quantity Surveyor	Facilitation Team
13	INV13	CS1	Civil Engineer	Facilitation Team
14	INV14	CS5	Architect	Facilitation Team
15	INV15	CS1	Aviation Engineer	Airport Technical Team
16	INV16	CS5	Aviation Engineer	Airport Technical Team
17	INV17	CS4	Structural Engineer	Consultant
18	INV18	CS6	Geotechnical Engineer	Consultant
19	INV19	CS3	Civil Engineer	Consultant
20	INV20	CS5	Architect	Consultant
21	INV21	CS3	Architect	Consultant
22	INV22	CS5	Quantity Surveyor	Consultant
23	INV23	CS6	Quantity Surveyor	Consultant
24	INV24	CS5	Interior Design	Consultant
25	INV25	CS5	Green Technology Specialist	Specialist Consultant

Based on Table 89, the breakdown of respondents according their team and case IDs are further summarised in Table 90 and Figure 15:

Workshop Participants	***CS1***	***CS3***	***CS4***	***CS5***	***CS6***
INTERNAL MAHB TEAM					
Client	*3*	*1*	*1*	*3*	*2*
Airport Technical Team	*1*			*1*	
EXTERNAL TO MAHB TEAM					
Architect		*1*		*1*	
Civil/Structural engineer		*1*	*1*		*1*
Quantity Surveyor				*1*	*1*
Project Management Consultant (PMC)				*1*	
Specialist				*1*	
Interior Designer				*1*	
FACILITATION TEAM					
Facilitators	*1*			*2*	
Total	***5***	***3***	***2***	***11***	***4***

Table 90 Interviewee's case representation

The client team represented the majority of respondents for the interviews conducted (40%), followed by the consultant team (36%), thus a fair distribution of participants involved in a typical VM workshop was available suggesting that a reasonably well-balanced set of views could be achieved.

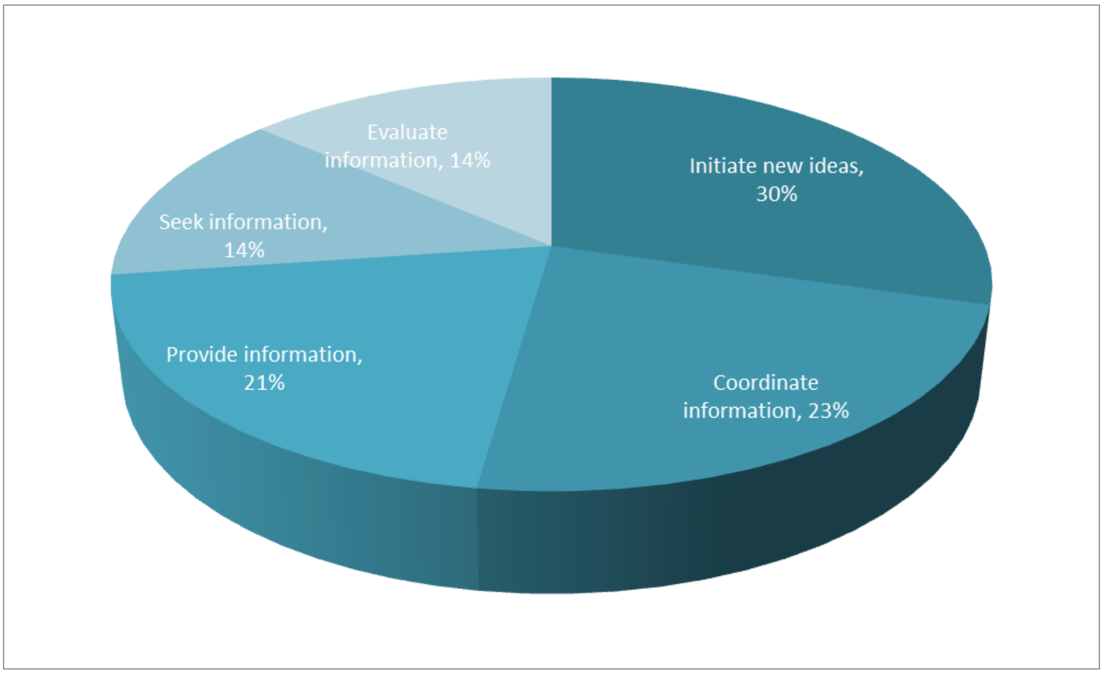

Figure 14 - Interviewees percentage breakdown

6.6.2 Average Interview Duration

Altogether 25 interviews were conducted among participants across all cases. All interviews were conducted at the MAHB headquarters adjacent to the KLIA2 site. The duration for each interview varied ranging from 20 minutes to 1.5 hours as indicated in Figure 15 as follows:

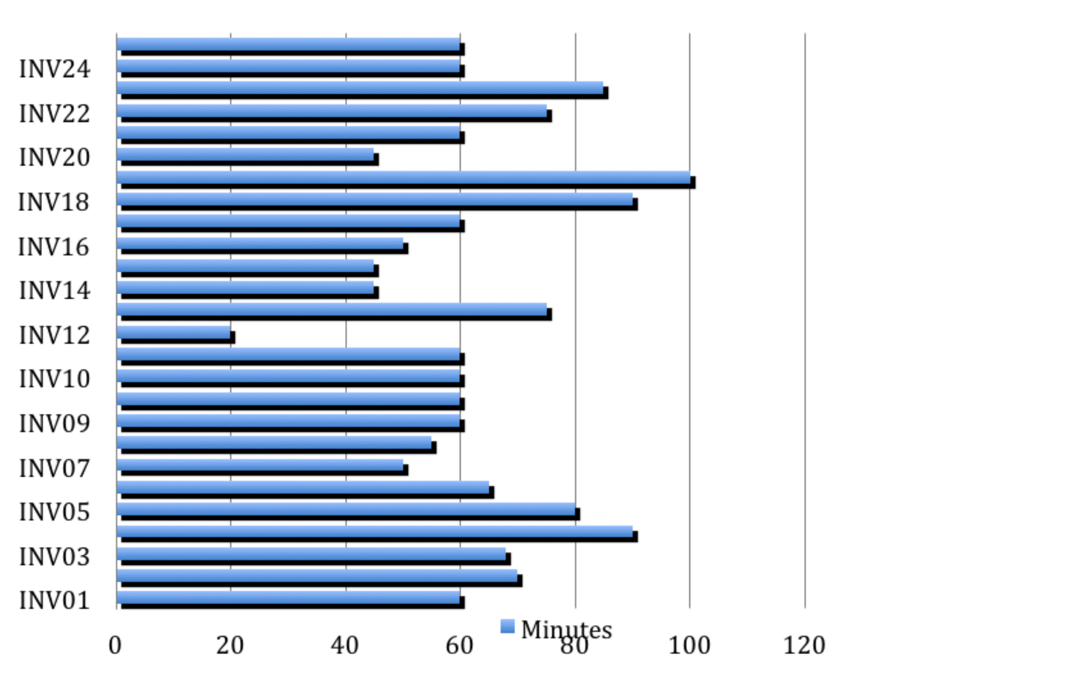

Figure 15 - Average interview duration

6.6.3 Themes generated/Data index

All interviews conducted were recorded and transcribed as described previously for further analysis. Using NVivo Version 9 (QSR International Pty Ltd., 2011), the CCA method was used to generate codes based on these transcripts. Excerpts from interview transcripts were assigned with specific codes that reflected VM themes and other related data. Each code begins with the letter "DVM" followed by a specific number used as an identifier. Based on all 25 interview transcripts, there were 55 themes generated from this exercise. The codes presented do not represent any particular order of listing (i.e. ascending or descending). Table 91 indicates the list of codes and themes generated from the CCA exercise.

Table 91 Themes generated from interview transcript

Ref	Code	Themes
1	DVM01	Constructability
2	DVM02	Culture
3	DVM03	Participation
4	DVM04	Design constraints
5	DVM05	Value Management Practice in MAHB
6	DVM06	Creativity
7	DVM07	Workshop information
8	DVM08	Decision Making
9	DVM09	Knowledge and experience
10	DVM10	System thinking
11	DVM11	Airport Planning Issues
12	DVM12	Construction Process improvement
13	DVM13	Team Representation
14	DVM14	Improvement in VM
15	DVM15	Multidisciplinary Involvement in VM
16	DVM16	Benefit of VM
17	DVM17	Communication in workshop
18	DVM18	Perception in VM
19	DVM19	Reason for VM study
20	DVM20	Tools and techniques
21	DVM21	Team Cohesiveness
22	DVM22	Validation of information
23	DVM23	Timing of VM workshop
24	DVM24	Control Mechanism
25	DVM25	Facilitation
26	DVM26	Contractors involvement in VM
27	DVM27	Tacit Knowledge
28	DVM28	Institutionalized thinking
29	DVM29	VM Study objectives
30	DVM30	Cost Optimization
31	DVM31	Explicit Knowledge
32	DVM32	Improve construction process
33	DVM33	Visualization aid
34	DVM34	Workshop
35	DVM35	Function Analysis
36	DVM36	Information database
37	DVM37	Knowledge of participants
38	DVM38	Experience of participants
39	DVM39	Limitation of VM
40	DVM40	Participant’s attitude
41	DVM41	Skills of participants
42	DVM42	Control of workshop flow
43	DVM43	Changes after workshop
44	DVM44	Cost cutting
45	DVM45	Support documentation
46	DVM46	Authority in workshop
47	DVM47	Stereotype thinking
48	DVM48	Membership role in workshop
49	DVM49	Distributed information
50	DVM50	Presentation of participant
51	DVM51	External team
52	DVM52	Fee earning potential
53	DVM53	Value management and facilities management
54	DVM54	Client involvement
55	DVM55	Client authority in workshop

Based on 55 generated themes from the transcription process, the top ten themes were selected as the main focus for this research. The selection was made based on the relationship of the significant themes back to the research questions, research objectives and the frequency of themes referred to by the respondents during their interviews. However, the analysis and discussions that follow were not only based on these main identified themes as relationships amongst the remaining themes were also used to support findings. The top ten themes selected are as follows:

Table 92 Top 10 related themes

Ref	**Code**	**Themes**
1	DVM01	Constructability
2	DVM02	Culture
3	DVM03	Participation
4	DVM33	Visualisation
5	DVM24	Control Mechanism
6	DVM06	Creativity
7	DVM07	Information
8	DVM08	Decision Making
9	DVM09	Knowledge
10	DVM10	System thinking

These ten themes were further divided into two broad categories to simplify the analysis process. The two categories are ‘people’ and ‘system’. The ‘people’ category refers to themes and responses that relate to the human factors contributing to VM application in improving project designs while the ‘system’ theme refers to themes and responses that relate to procedural matters of VM. Both of these categories were drawn from the literature reviewed and presented in chapters 2 and 3 of this thesis. Figure 16 displays a summary of the categorization.

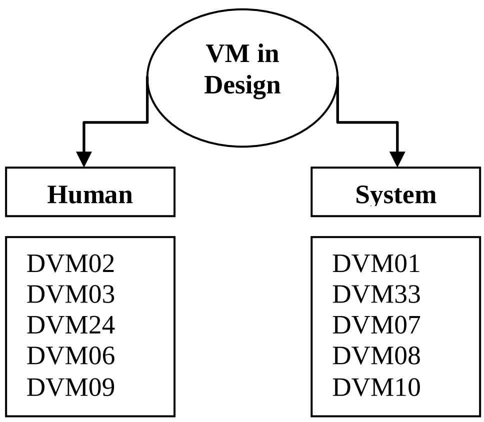

Figure 16 - Themes categorisation

6.6.4 Theme relationships with cases

Informing the themes generated from the interview transcripts, the following research questions are reiterated to form a guide to the analysis process:

1. *How the design planning process of a construction project is conducted through Value Management workshop?*
2. *What are the factors that influence human interaction and decision-making process of VM workshop participants?*
3. *How does multi-disciplinary participant involvement in a VM workshop affect the outcomes of the planning and design of a project?*
4. *What are the impacts of these interactions and decision process through VM has on the subsequent construction phase of a project?*

These questions focus on three concepts, the VM process for design development, participant's involvement and factors that influence their participation. Themes generated were extracted, grouped and mapped out against the cases. Figure 17 indicates a matrix of themes generated against the cases. This matrix aims to display a relationship between the themes that were discussed for all cases during the interview process.

	CS1	**CS3**	**CS4**	**CS5**	**CS6**	
DVM01	•	•	•	•	•	*Constructability*
DVM02	•	•		•	•	*Culture*
DVM03	•	•	•	•	•	*Participation*
DVM06	•	•	•	•	•	*Creativity*
DVM07	•			•	•	*Workshop information*
DVM08		•	•		•	*Decision making*
DVM09		•	•	•		*Knowledge and experience*
DVM10	•	•		•	•	*System thinking*
DVM24		•		•	•	*Control mechanism*
DVM33	•	•	•	•	•	*Visual aids*

Figure 17 - Themes relationship with cases

Based on this matrix, it is observed that themes DVM01, DVM03, DVM06 and DVM33 were highlighted by interviewees across all cases. Themes that were highlighted in more than two cases were DVM02, DVM07, DVM08, DVM09, DVM10 and DVM24. It may be observed from this tabulation that all 10 themes generated relate significantly to all three-research questions. However, this relationship needs further analysis and elaboration in terms of its context. Section 6.6.5 onwards analyses each theme in more detail.

6.6.5 Themes Exploration 1 : People Category

The people category constitutes themes generated from interview that attempt to address RQ (NO.2) focussing on the people factor in VM. There are five themes under this category, which consist of:

DVM02 Culture
Refers to attributes of participant behaviours, working styles, norms, beliefs and habits associated with the VM workshop.

DVM03 Participation
Refer to attributes relating to workshop participants' level of participation and involvement during VM process. This includes social interaction, motivation, contribution and relationship among workshop team.

DVM24 Control Mechanism
Refers to attributes relating to participants' management and facilitation styles during the VM workshop process

DVM06 Creativity
Refers to participants' creative thinking procesess and factors that influence attitudes/behaviour during the VM workshop process

DVM 09 Knowledge
Refers to participants' levels of knowledge and experience that contribute towards the VM workshop process.

The following sub-section explores responses of participants and includes verbatim quotations from interviews. There were altogether 25 interview transcripts generated from the analysis. Repetitions of quotes or statements that were of a similar nature were eliminated to avoid an overlengthy lengthy list of quotes. Therefore, verbatim excerpts of quotations were shortlisted as a true representation of ideas obtained from the analysis process. The presentation of data and analysis follows the methods suggested by Bryman (2012) and Maitlis and Lawrence (2007). Each theme consists of several components termed as first order concepts that represent s sub-group within each theme.

6.6.5.1 DVM02 Culture

This theme consists of two first order concepts, which are 'institutionalised thinking' and 'personality'. The institutionalised thinking concepts gather verbatim excerpts that relate to how each workshop participant reacts and thinks throughout the VM process. It is observed that the majority of interviewees indicated institutionalised opinions concerning the workshops. The institutionalised stand is reflected when individuals are observed to be making statements that only represent the view of their own discipline (i.e. architectural, structural, surveyors, clients, etc). In other words, the participants view each issue (based on the interview questions asked) based on their attachment to specific organisations or professions. Stereotypical thinking was also observed amongst interviewees who still think that VM is purely an avenue for cost cutting rather a technique to add value to projects. The observations concerning this theme are indicated in table 93 below:

Table 93 DVM02 Culture-Institutionalised thinking

First order concepts		**Representative Quotations**
Institutionalised attachment	*1.1*	*participants speak different language, for instance the QS and Finance will always see dollar and cents as their concern while designers may see only the design concept are their concern. However, participants should be able to see the same issue in the same mindset while still respecting other profession. [INV02]*
	1.2	*The designer sometime resists changing their design stating several reasons to support their resistance leaving the team making minor cosmetics change to the design. I am talking about major changes to design for instances the design of control tower or the airport roof. If I were the designer, I will feel the same too in complying with the need to change after all the handworks and research done in coming up with the design which could take months [INV04]*

1.3 *Participants are subject matter expert but they still have the idea the VM is a cost cutting method [INV05]*

1.4 *But unfortunately as an Architect, maybe they want to have their own perspective which is quite different from the client's imagination. Client maybe want to have a building with 800 million limit but the Architect maybe think that with 800 million they will design aesthetically a majestic building according to the 800milllion. Divergence of understanding. [INV07]*

1.5 *But of course there is a downside of this from my observation. Sometimes it is rather difficult to control the flow of the discussion when we have dominant participant who tend to control the discussion. [INV11]*

1.6 *Almost every ideas that I proposed were compared against the cost implication until I had enough and keep my mouth shut [INV12]*

1.7 *Some consultants are concerned about the design and cost but they tend to ignore the implication of their proposal had on the airport system integration. For me understanding how airport system works should be the main design driving factor. [INV14]*

1.8 *I think we should put the cost as the driving force for the workshop, then the process of developing design would be much easier. [INV15]*

1.9 *The end-user representative should be part of this study, if not the design will be left with our own (consultant) interpretation of their requirements. [INV18]*

The second component revealed how the interviewees' experiences as workshop participants gave them a view of the personality of the workshop (refer Table 94 below). It was observed that there is a mixture of a positive and a negative personality driving the workshops for all cases. The existence of an apparently divided workshop personality is inevitable due to the fact that there were a variety of participants in a single room looking at single issues. Resistance to change is cited by several interviewees as being a repeated issue in the workshops. This relates to refusal to accept design changes and/or proposals that potentially could assist in providing positive outcomes from the workshops for the project. It was observed that there was a rebuttal statement concerning this issue claiming a failure to appreciate efforts to uplift the image of projects among the consultants involved. In addition, the facilitator role in managing the entire workshop processes was also highlighted as making a positive contribution towards controlling participants' discussions.

Table 94 DVM02 Culture-Personality

First order concepts	Representative Quotations	
Personality	*1.1*	*the designer resist to change the design claiming the amount of re-work required in order to comply with new changes [INV03]*
	1.2	*Having similar design but different delivery plus it is more practical. But the limitation of our team when we propose that new roof/design to the client during the workshop attended by the client's consultant, especially the Architect. The Architect has their own ego because they thought that it is a definite design but not a conceptual design, so we don't have any say to change especially the architectural design. [INV12]*
	1.3	*The in-house will not be attending the workshop because of that ego. We want to criticise the design okay, but with the Architect in the client side, it is a limitation for us. [INV14]*
	1.4	*the participants should comes with an open mind and leaving their egos behind when attending the workshop [INV16]*
	1.5	*There are dominant participants in this workshop who refuses to accepts other people views [INV17]*
	1.6	*...some are just attending the workshop for sake of filling up the room for attendance and did nothing to improve the study outcome [INV18]*
	1.7	*.... clients are really ethusiastic in achieving value for money for the package. They appointed a really experience facilitator to guide our workshop process [INV19]*
	1.8	*...if its wasnt due to facilitator experience and his charisma, I dont think our workshop could yield a positive outcome....[INV20]*
	1.9	*I felt a little bit left behind knowing the representation for this workshop consist of well experienced consultant. I just leave the talking part to my boss while I jot down the ideas.[INV24]*
	1.10	*My facilitator handle our session really well. Despite dominants participants and concerted effort by certain consultant pushing for their ideas, he managed to retain the dynamic in our workshop [INV22]*
	1.11	*Other consultants failed to appreciate our effort in bringing this project for introducting new concept of 'airport within commercial environment' that is new in airport development. All their concern is how to change the design to fit minimal budget allocated. Their refusal to study on alternative design but instead cutting here and there is pretty much laborous to rectify. [INV20]*

6.5.5.2 DVM03 Participation

This theme consists of three first order components, which are 'representation', 'limitation to participate' and 'involvement level'. In the first concept (representation) as indicated in Table 95, it is observed that the majority of responses refer to the sufficiency of the team representation in workshops attended. There was agreement that almost all workshops attended represented a balanced mix between technical and non-technical workshop participants. However, there was also a suggestion that the inclusion of additional workshop members would enhance the VM process as highlighted by INV03.

Table 95 DVM03 Participation – Representation

First order concepts	Representative Quotations
Representation	*1.1 It should be attended by other stakeholder of that particular building. They should be part of the workshop participant. End-users for instance. Fire Service Department. Local Authorities. Because they will be the end parties that will be using the facility [INV03]*
	1.2 The argument exist in this workshop but it is done in dynamic and positive way. The contribution from different parties to the workshop is what makes this workshop interesting. [INV10]
	1.3 I observe that the VM study which I have participated comprises a mixture of technical and non-technical representative. [INV09]
	1.4 they invited a representative from MA Tech whom are expert in IT system to counter check the proposal being made. As a result some modification to the proposal is being made which I believe increase the value of the project. Imagine what would happen should MA Tech representative were absent, of course the participants will rely on the consultants advice and proceed with the proposal. It may cause issued when its being applied during construction phase [INV13]
	1.5 The transparency and accountability of all participant can be seen from this workshop. As all are subject matter expert. However, the inclusion of new people are also important to this workshop. What I meant by new people refer to participant with lesser experience level which could bring different perspective to the discussion. [INV15]

Interview responses regarding of the second component (involvement level) of participants during the workshop indicates that the combination of technical and non-technical participants in the workshop works as a ‘check and balance’. Respondents felt that the participant mix provided an extended insight into the issues discussed. However, according to some interviewees, the involvement level of participants also faced a challenging issue in retaining focus amongst workshop participants. Some interviewees also mentioned experiencing an inability to convey a clear message across the workshop as an issue [INV04].

Some respondents saw the workshop as providing a time where at least there was an opportunity to talk about project issues even in situations where there was minimal interaction. The VM is seen therefore as an avenue to promote communication among participants [INV22]

Table 96 DVM03 Participation - Involvement level

First order concepts		Representative Quotations
Involvement level	*1.1*	*Difficult to get people to focus since the participation is in and out. You can follow the argument. You can t contribute when you didn't follow the discussion [INV02]*
	1.2	*If you have knowledge but are unable to share that or make an argument, then it will not be open communication [INV03]*
	1.3	*Although the representative from other professional is there to help, but if the issue under study only relies on one specialist, then what's the point of having such VM if he couldn't provide his expert consultation [INV04]*
	1.4	*The technical will speak on the technical language while the non-technical participants will act as a layman by posing question which may not being anticipated from the technical team [INV14]*
	1.5	*Although their attendance may not give direct impact to the current VM study, it may provide a strong basis of communication and relationship builders between Legal Unit representative and other professional [INV18]*
	1.6	*getting expertise on board but not in anyway related to the project are also important in ensuring the Vm study to be effective [INV19]*
	1.7	*Sometimes when I am about to give my suggestion, we need to think whether our question or ideas is acceptable among other participant. [INV21]*
	1.8	*Despite some members are not involved in the discussion, VM provide an avenue for building communication as project team [INV22]*
	1.9	*Participants only speak when it involves items under their responsibility [INV24]*

The third component of this theme focuses on 'limitation of participants to be involved' during the workshop. A variety of limitations were cited from interviewees and amongst the most factors that limit participants' involvement were varying, or lacking experience levels, lack of preparation and understanding, difficulty to convince other people of one's own ideas, fear of being judged and substitution of participants attending the workshop.

These limitations can be further broken down into two broad categories. The first come from individuals within the workshop (i.e. varying, or lacking experience levels, lack of preparation and understanding, difficulty to convince other people of one's own ideas, fear of being judged). The second stems from the workshop system itself (i.e. lack of understanding and substitution of participants) where participants experienced difficulty in comprehending information given during the workshop.

Table 97 DVM03 Participation - Limitation to participate

First order concepts	Representative Quotations
Limitation to participate	*1.1 Is either they are not ready or limited in experience. The limitation of experience in this context I refer to their ability to recall specific information which could justify their recommendation without the need to make further reference after the workshop. This will inevitably affect the process of the workshop that needs decision to be made during specified workshop timeframe. [INV03]* *1.2 If the junior staff coming to this workshop, they should be accompanied by senior and more experience staff. This will avoid the risk of one particular expertise having lesser input than others. [INV06]* *1.3 I have experience a workshop in which the consultant for the project is required to make changes to the design of the project by way of introducing new alternative system. However the subsequent VM meeting we had with the consultant did not produce information /design /alternative to the solution citing not fully understand the required system. [INV09]* *1.4 I don't see any flaws with their knowledge, skills or rather experience, but how they disperse the ideas and getting people to agree with them sometime I find it disturbing. As if there their ideas worth than the others. This does not includes those who has good ideas but find it difficult to explain their though to others and leaving others to try to direct the discussion to reach understanding [INV10]* *1.5 I was afraid that they will comment me for this ideas that already have been highlighted or this ideas there is something that is not relevant. So that was the resistance for me to highlight the ideas [INV11]* *1.6 The first thing they should know how to participate in the VM workshop, what are their role during the session. Knowing what is the expectation from client at the end of VM, aim and objectives [INV13]* *1.7 Sometime the issue that we face is that the invited person could not attend the workshop but instead a representative were sent. Their input may not be as effective as expected and this will jeopardise the workshop outcome effectiveness. [INV21]* *1.8 Even though we call them to attend, sometime they just come and to hear the VM session. A silent observer.[INV25]* *1.9 .....they still have the idea the VM is a cost cutting method. So in this situation, even though they are giving their best knowledge, but they still have the mentality of this workshop will be a cost cutting workshop. [INV24]* *1.10 Difficulty to follow design briefing by consultants make me loose the interest to contribute due lack of understanding [INV20]*

6.6.5.3 DVM24 Control Mechanism

This theme consists of only one only first order component, which is 'discussion framework'. It is observed that interviewees were concerned about the mechanism of reviewing designs, and also the discussion structure within the workshop environment. The majority of responses within this theme were focussed on the efficacy of the structure that set the boundaries for discussion. A lack of a proper mechanism to review designs and control of participants' involvement in discussions are among the critical issues raised by interviewees.

The workshop mechanism was also criticised on the parallel session approach in one of the case [CS5] where participants are break into smaller group according to design trade (i.e. architectural, structural, civil etc). Despite the session providing good opportunities to review the design in a more focused manner and also speed up workshop time, the lack of connection between each group to combine and integrate their information was observed to be a major barrier for workshop efficiency.

Table 98 DVM 24 Control Mechanism

First order concepts	Representative Quotations	
Discussion framework	*1.1*	*Control means the team needs to be control by facilitator in making decision. All of consultants in this time are well experienced and has their own reputation and egos and this need to be manage properly by experience facilitator in bringing out the best from them without jeopardizing their reputations. [INV02]*
	1.2	*Its really hard to discuss about design when it is not structured and framework on how discussion is leading to is absence [INV06]*
	1.3	*Facilitator welcome all options in the workshop, but once all options are given, there should be one authority which could decide what can and cannot be on the project [the issue is whether the boundary of the workshop is set in advance is at doubt]. [INV08]*
	1.4	*Review mechanism that will allow certain things been recommended and certain things being implemented. [INV24]*
	1.5	*a constructability list should be able to guide the design development review [INV20]*
	1.6	*I think parellel session is good approach but if we have too many groups and all work in isolations, its really to know whether our proposal match up with others [INV14]*
	1.7	*Follow up of recommendation made from the workshop is crucial to ensure the execution is performed and our time are not wasted [INV21]*
	1.8	*There were no structure guide in assisting our discussion about the design. It was just like here the design and how are we going to reduce cost from this design [INV22]*
	1.9	*Everybody starts jumping into giving ideas about the design but there were no proper way of looking at it in a structured manner. We were left with abundance of ideas that goes wild beyond our imagination. Although this is encourage for creativity, i think some framework is necessary to set the boundary of our discussion [INV11]*
	1.10	*What is the point of having parallel session when there is not enough representation of consultant for each group. Plus, we were quite isolated*

from the other group and difficult to know whether our proposal affect other groups' ideas [INV20]

6.6.5.4 DVM06 Creativity

Creativity theme as indicated in Table 99 and Table 100 consists of two first order components, which are 'exploring creativity' and 'distraction to creativity'. Generally, the creative thinking processes operating in the workshops as highlighted by interviewees were generally seen as positive. 'Plenty of room for exploration' with 'freedom to express views' and 'replicating past experience in current issues' were among the positive attributes cited. The multiple backgrounds of respondents at workshops were also seen as contributing to the creative process [INV15]. Whilst interviewees made no direct reference regarding the application of specific tools or techniques, it cannot be concluded that they were fully satisfied that existing workshop processes enhanced participants' creativity.

Table 99 DVM06 Creativity - Exploring creativity

First order concepts		Representative Quotations
Exploring creativity	*1.1*	*The creativity is not limited in the hand of the designer. We take example people who are in the airport planning, they have been to every airport, they how the feel and end product of each airport. [INV02]*
	1.2	*my role has to change to suit my position rather than my own background [INV10]*
	1.3	*Airport planner will look from overall perspective and guide all of us to visualise the walkthrough of the design[INV13]*
	1.4	*you were allowed to give any ideas without being fear of being judge. Other will help you to improve your suggestion. It is more like hitchhiking of ideas in this workshop, from what I see. Its normal to have your ideas being rejected which I think people with more experience understand the limitation of such ideas.[INV15]*
	1.5	*Each participant has their own strength and experience which promote active participation among team members. Imagine the combination of all learned people in one workshop looking to solve a problem, how amazing it could be when the ideas were generated, combine and improves to solve the issues.[INV16]*
	1.6	*But sometime they highlight some areas but ideas which is most important part in VM they are lacking in contribution. So new technology or other kind of option are not being highlighted. Thats how VM will be not fully utilise [INV17]*
	1.7	*I try to replicate my past experience into this project in attempt to solve design problems [INV18]*

1.8	*Getting to visualise the change made in the design without having a hard evident is really hard for us [INV20]*
1.9	*I'm just a follower type of person, but an active team mates and facilitator definitely will spark my thinking process to get involved with the discussion [INV21]*
1.10	*I had a hard time to understand and visualise the section and plan and turn into 3D, so what I did is that I just visualise myself working in that space [INV21]*

The second component under creativity focuses on the 'distraction to creativity' that blocks participant creative thinking processes. This issue is observed to span across both the existing workshop system and people factors. The workshop system factor covers the issues of control of workshop participation, method of information presentation, complexity of issues and structure of discussion. These factors affect the level of concentration, focus, understanding and motivation towards creativity of workshop participants and was cited by most interviewees. The people system factor is observed to be focused on the personal attributes of individuals in terms of shyness to speak in public, the way others read body language and gestures during discussion, position within the company and over-dominant participants.

Table 100 DVM06 Creativity - Distraction to creativity

First order concepts	**Representative Quotations**	
Distraction to creativity	1.1	*participants are confused on the information presented due to the complexity of the information and the way it being presented. [INV04]*
	1.2	*I struggle to focus during the workshop due to participants comes and go as they wish for coffee breaks or washroom. Once I lose my focus, its pretty hard to regain back on track. [INV10]*
	1.3	*Having to constantly give ideas without knowing the boundary of the issue to be explored is rather difficult. I think the brainstorming approach need to be revised or perhap employed other techniques [INV12]*
	1.4	*Its not easy actually to listen to others people ideas and knowing it does not make sense. I need to address that issue during that point of time[INV11]*
	1.5	*If the same person keep on giving ideas while the rest goes 'that good' / 'i never thought of that' / 'ohhh' and so forth then somehow it will distract others from their thinking process [INV15]*
	1.6	*Even though we are not allowed to judge 'verbally' but I think our gestures and bodymoves may indicates to others that your ideas are actually bad! [INV17]*
	1.8	*I just leave it for my boss to talk, he is more experience [INV18]*
	1.9	*I felt a little scared sitting among experienced consultants and is best for me just to keep it on the low. [INV19]*
	1.10	*Giving an opportunities for all to voice their ideas is one big hindrance to creativity in brainstorming. You will keep on thinking that those people had already taken your ideas and you are back to square one trying to generate new ones. [INV21]*

6.6.5.5 DVM09 Knowledge and experience

This theme consists of four first order concepts, which are ‘experience level’, ‘refresher course’, ‘knowledge sharing’ and ‘functional analysis technique’. Interviewees often referred to similar issues, however, Table 113 displays representative excerpts from the interview process to show how respondents perceived these issues and concepts. Regarding ‘experience level’, interviewees acknowledged the level of experience and knowledge possessed by each workshop participant. However, there is one comment that specifically comments on the need for participant to possess experience/knowledge on airport planning systems [INV16]. This observation was made by an Aviation Engineer, who felt that having an appreciation and understanding of how airport systems work will affect how individuals react to design development of the airport project.

Despite the general acknowledgement of participants having adequate experience and knowledge, there were some interviewees who believed that refresher courses about VM were importance for workshop participants to undertake [INV22 and 24]. This finding was also supported by several claims made on functional analysis being the job of the facilitator [INV15, 22 and 23]. Difficulty to understand and interpret what is occurring during the VM workshops were regularly cited [INV15, 20 and 22] that prompted the need for refresher courses on VM. In addition, the need for more knowledge sharing was an additional issue raised by one interviewee who also observed limitations of junior staff participating in the workshops [INV25]. This observation indicates how a different perspective even from a person with lesser working experience, could produce new creative ideas.

Table 101 DVM09 Knowledge and experience

First order concepts		Representative Quotations
Experience level	*1.1*	*I don’t see any flaws with their knowledge, skills or rather experience, but how they disperse the ideas and getting people to agree with them sometime I find it disturbing. As if there their ideas worth than the others. This does not includes those who has good ideas but find it difficult to explain their though to others and leaving others to try to direct the discussion to reach understanding [INV09]*
	1.2	*I see that the knowledge and experience of the participants plays an important role to enhance the quality of output of the VM study [INV10]*

	1.3	*in my opinion they need to be a subject matter expert, the technical expertise. They must have the ability to highlight and ability to talk to people and persuade. To voice out their ideas [INV15]*
	1.4	*I think the participant should posses sufficient knowledge in airport planning. He should understand process involve in the airport planning system. Planning an airport is not the same as high rise building. Cutting the design here and there for sake of cost saving affect the entire airport integration system. [INV16]*
Refresher course	*1.5*	*awareness and refresher programme need to be continuos so that all staff will understand the importance of VM in MAHB. We try to get as much as possible to understand VM and conduct on their own without relying on VM secretariat. [INV22]*
	1.6	*Some introduction course about how VM works will help me with the entire process [INV24]*
	1.7	*i have no formal education about VM, what I have learned in VM was through experience attending numerous VM workshop. But still I struggle to put together how it works, because all this I while I only follow facilitator's instruction. [INV05]*
Knowledge sharing	*1.8*	*What I meant by new people refer to participant with lesser experience level which could bring different perspective to the discussion. This could also promote transfer of knowledge from senior to junior staff in this workshop. Sometime, junior staff come out with naive questions towards the design but it is strong enough to make others thinks and reflect. [INV25]*
Function analysis	*1.9*	*I still dont understand how it works [INV20]*
	1.10	*I just follow the facilitator's instruction when it comes to function analysis [INV15]*
	1.11	*the FA is a powerful tool if interpret it correctly [INV22]*
	1.12	*We just leave it to the expert (facilitator) to produce the FA. We just feed in the information [INV23]*

This section summarises the analysis of interview responses for the 'people' category regarding VM workshop application. Five themes were placed under this category focused on the people aspect that influences the running of VM workshops. Based on the interview transcripts, this theme has generated sub-themes/first order concepts that were then analysed. Positive observations were recorded on all themes, however there are still some issues that appear to impinge negatively on the workshop process. Issues such as VM knowledge, participation style, team interaction and workshop control mechanism require further attention.

The following sub-section will explore and analyse interviews placed under the system category of VM workshop application.

6.6.6 Themes Exploration 2 : System Category

In the 'system category' theme exploration, responses generated from the interviews address the research question focused on the methodology and procedures related to VM. There are five themes under this category as follows:

DVM01 Constructability
Refers to attributes of procedures and approaches used in design development practices through VM workshops.

DVM33 Visualisation
Refers to attributes of tools, techniques and approaches related to visualising ideas, design, and issues during VM workshop process.

DVM07 Workshop information
Refers to attributes of workshop information in terms of sufficiency, timing of distribution, quality and forms that affect participants' creative and decision-making processes.

DVM08 Decision making
Refers to attributes of workshop participants' decision-making processes and factors influencing those processes.

DVM10 System thinking
Refers to attributes of a systems thinking approach that were observed during the workshop process

6.6.6.1 DVM01 Constructability

This theme consists of three major first order concepts, which are 'multiple views in design', 'application of VM in design' and 'buildability'. The analysis made among interviewees on the application of VM in design indicates positive responses from the majority. They perceived VM to be a suitable intervention to discuss improvements in design and create a means of communication between parties associated with the construction project. They considered that there were plenty of design improvements that could be made through using VM in terms of better space functions, improved mechanical and electrical systems, IT integration, streamlining of forms, enhanced specifications, better ergonomics of design and many other benefits [INV04, 05, 08, 10 and 12]. Some observed the use of VM in design as developing a greater shared understanding between clients and architects with the chance for a second overview of the design [INV08 and 11].

Whilst the majority of interviewees extolled the benefits of VM in terms of producing design improvement, contradicting views were recorded for interviewee INV05, who stated that design development should not be parked under a VM initiative. He further clarified that due to the absence of an appropriate design review structure, the workshop participants could be left spending hours of time trying to find alternative solutions without having a specific focus or based on any formal decision framework. Table 102 below presents respondents views on application of VM in design.

Table 102 DVM01 Design development - Application of VM in design

First order concepts	**Representative Quotations**	
Application of VM in design	*1.1*	*At the planning level of the construction, it may help to improve construction on-site, but in reality, you need people working on-site to be able to provide first hand information on how to solve the issues. Or, if you are looking into suitability of the design in term of the forms, the specification, electrical and mechanical installation system so forth, VM is the best for this job. [INV02]*
	1.2	*if you are looking into suitability of the design in term of the forms, the specification, electrical and mechanical installation system so forth, VM is the best for this job.[INV04]*
	1.3	*they see VM is one way of improving the output of the project and helpful to the client in getting functional project aligned with the approved budget.[INV05]*
	1.4	*After all my experience, it is more on decision making platform for next course of action. It is not a final say, but a decision framework that will help the top management to make decision around the recommendation [INV11]*
	1.5	*.....there is a divergence of needs between the client and Architect's understanding of the project that can be adress in VM. Disparity between project requirement and understanding of the objectives.[INV08]*
	1.6	*I think the function of VM are not meant for design reduction but maybe more on substitution for design in term of material selection.[INV08]*
	1.7	*if we look at basic practice of VM, it is a step where VM team in the workshop carrying out a subsequent step after the design has been completed and BQ finalised [INV09]*

	1.8	*A decision can be made at the same time for any changes. So we can make people rethink and reconsider on the design. [INV11]*
	1.9	*A lot changes we made in this workshop relates to the space function with the architectural plan.Comfort level of space in the office comparing with public space design is different. [INV12]*
	1.10	*When we skim down the design, later when we add up, we add value for the project[INV10]*
Contradicting views	*1.11*	*I think in my opinion, the activities to improve the design should not be in the VM workshop. We dont have any structured mechanism to review the design properly. We normally end up looking for opporunities within the drawings to improve rather than a proper framework tha guides use. Like a constructability checklist for instance [INV05]*

Following the positive views of most interviewees on the application of VM for design development, the second theme takes this analysis further to justify this finding. The multiple views brought to bear on the design and thus the creation of new ways of doing things are a major influence in VM workshops in the professional opinion of participants. The majority of respondents gave similar observations about this issue indicating that there is more than one way of doing/achieving one thing. The process of getting the involvement of the correct mix of participants provides an added advantage allowing VM to develop designs based on experience and knowledge built from various professional backgrounds. The existence of multiple professional views is also observed to support those technical areas in the design development where it is beyond facilitator’s ability to handle technical issues [INV21].

The multi-disciplinary representation in the VM workshop is also seen to be able to leverage pools of tacit knowledge throughout the complete workshop period, where normally such knowledge would remain only in the consultants’ minds and they were often working in isolation. The opportunity to discuss and review designs through VM creates healthy interactions amongst participants and makes the tacit knowledge sharing possible.

Table 103 DVM01 Design development - Multiple views in design

First order concepts		Representative Quotations
Multiple views in design	*1.1*	*Designers can design base on their own interpretation of the project brief and translate into specific form. However, the design is not standalone and need to be assesses from different angle by the client and other consultant who has their own specific design or system that will integrate with the main design. [INV01]*
	1.2	*The designer may see their design from the aesthetical point of view but we could assist them to see in the bigger picture how the design will works. We were seeking for reasoning behind each design so that we are convince with the design [INV11]*
	1.3	*sometimes the design will carry certain message or concept behind it but only rest inside the designers mind. This is where in VM, we do ask question on their design so that we know what we are getting for from the design [INV18]*
	1.4	*The designer may see their design from the aesthetical point of view but we could assist them to see in the bigger picture how the design will works. We were seeking for reasoning behind each design so that we are convince with the design. [INV11]*
	1.5	*To be able to give variety of solution and alternative to single issues is what is expected in this workshop, as I believe there are more than single way of doing the same thing. [INV19]*
	1.6	*everybody is an expert in their own field, and they will propose their interpretation and we will decide during the workshop.[INV20]*
	1.7	*A decision can be made at the same time for any changes. So we can make people rethink and reconsider on the design.Okay for instance maintaining the elegance of style at lounge area, the opportunity exists when all parties were involved that combine different experience level of comfort to project and question the design [INV04]*
	1.8	*....during the workshop, the designed space will be presented and the workshop participant will assess the design against the space allocated and make suggestion were necessary to improve the design. [INV05]*
	1.9	*The creativity is not limited in the hand of the designer. We take example people who are in the airport planning, they have been to every airport, they how the feel and end product of each airport.[INV06]*
	1.10	*The suggestion may not necessarily address the issue, but sometime it give others input to generate solution that will benefit their own expertise. However, I think that some appreciation on costing aspect of the project should exist in the participant's mind as most of MAHB workshop will have cost optimisation as their main objectives.[INV07]*
	1.11	*The consultants presented their proposal and recommendation, the workshop was too technical in which the facilitator are not able to manage the technical information,as from client side, I need those information to be deduce to more simplified manner[INV21]*
	1.12	*Having similar design but different delivery plus it is more practical. But the limitation of our team when we propose that new roof/design to the client during the workshop. The Architect has their own ego because they thought that it is a definite design but not a conceptual design, so we don't have any say to change especially the architectural design. [INV22]*
	1.13	*I see this as an avenue for them to appreciate the construction process and to be more sensitive when dealing with legal issues concerning the construction project.[INV24]*
	1.14	*it is important for them to attend VM workshop to have different kind of view, different kind of ideas where by some people will overlooked the needs*

	and some people will have perception that their wants in the project are actually is the needs.[INV12]
1.15	*Conflicting of objectives often happen in this workshop. The commercial are concern on their potential revenue while the IT is concern on the ability to provide sufficient information at convenient location. This sometime will be an issue when both are not able to find solution [INV08]*

These multiple viewpoints are a major selling point of VM making it relevant for design development; besides having multiple views from each individual's standpoint, observation were made on suggestion by interviewees who raised issues about buildability of the design. Separation between design and construction phases makes it impossible to integrate constructability information in the design [INV14]. One way of bridging this gap is through introducing constructability design reviews within a VM workshop environment that could assist project teams to develop designs [INV05 and 15]. Interviewees make no reference as to how existing tools and techniques used in VM assist with design development of their current project packages [INV20 and 21], however, other alternatives such as constructability reviews were highlighted as an alternative [INV05 and 15].

Table 104 DVM01 Design development – Constructability

First order concepts	Representative Quotations	
Buildability	*1.1*	*we are concern as whether it is possible to be construct. [INV02]*
	1.2	*We have process to evaluate ideas in VM so even if the ideas has been rejected, at least the idea proposer will understand reason behind the rejection instead of prejudgment at the begining [INV11]*
	1.3	*Sometime contractors were having difficulties to construct the design required due to current site condition requires additional works to be done prior for the design can be built which are not captured in the contract. If the additional Is just minor preparation work with minimal cost impact then its fine, a VO can be issued. But what if the works involves redirecting underground services? [INV14]*
	1.4	*However, having said that we are divided into different room, so each room will focus on each trade i.e. architectural or costing etc, this I think will reduce the dynamic of discussion because each room consist of people with similar background. [INV17]*
	1.5	*One of the problem is a that segmentation into different room. Sometime we do not know others has been decided, if we don't have the runner. [INV20]*
	1.6	*our company invited a specialist to be part of the our team during the workshop. He will provide his expert judgment on the constructability of the design from contructoes point of view. Although he is not involved directly with the project, we appoint him as measure to increase our competetive advantage for this project. [INV13]*
	1.7	*We need a structured way of studying the design in making it more relevant*

	1.8 I think in my opinion, the activities to improve the design should not be in the VM workshop. We dont have any structured mechanism to review the design properly. We normally end up looking for opporunities within the drawings to improve rather than a proper framework tha guides use. Like a constructability checklist for instance [INV05]

when we produced our proposal [INV15]

6.6.6.2 DVM33 Visualisation

This theme consists of two first order concepts, which are 'real-time information' and 'visualisation constraints'. It is observed that difficulties to comprehend distributed drawings, presentations and make full use of them to make creative decisions were cited as major constraints in the workshop process [INV02, 04, 05 and 25]. Despite information being handed to all participants, it is observed that there was a general view that there was room for improvement in terms of the quality of information and mode of its presentation. The way that information was presented is observed to affect how decisions are made during the workshop [INV16].

Table 105 DVM33 Visualisation – Constraints

First order concepts	**Representative Quotations**
Constraints	*1.1 There is no guide as to how we should evaluate design in this workshop. I only speak when they ask my opinion, other than that, I dont contribute because I could not understand the complexity of the design. [INV02]*
	1.2 I find it difficult to undertand how this builiding comes together just by looking at the section and plan. Maybe its my limitation not from construction background but I think some modification and improvement on how information is presented could improve my contribution. If not, I will just keep quiet. [INV04]
	1.3 I dont really understand design information presented. [INV05]
	1.4 We were given a plan and section and were asked to find ways to reduce cost by way of trimming down the design. Its really hard to get this done if you are not familiar with the design and having trouble visualising it. [INV25]
	1.5 I need more time to study the design if I were only given just plan and sections drawings. If we had a 3D design or a walkthrough, that would have save heaps of time trying to visualise [INV16]

In exploring the visualisation constraints, plenty of suggestions and discussion points were recorded from interviewees regarding the distribution of real-time information. The majority of interviewees suggested that having more simplified forms of information that could cater for both technical and non-technical participants would be beneficial. The forms of information could range from effective presentation methods as well as introducing real-time software that could provide a walkthrough of the design [INV11, 13 and 15]. Building Information Modelling (BIM), AutoCAD and Autodesk Revit were suggested as possible tools to be used for design development in any VM exercise [INV13 and 15]. The findings from these responses indicates the need on the part of workshop participants to be fully informed during the workshop process in order to provide better solutions for the issues being discussed. A simple improvement of current presentation techniques during the Information Phase could be a starting point that leads to better informed decision making and creative thinking processes being adopted.

Table 106 DVM33 Visualisation - Real time information

First order concepts	Representative Quotations	
Real-time information	*1.1*	*A decision can be made at the same time for any changes. So we can make people rethink and reconsider on the design.Okay for instance maintaining the elegance of style at lounge area, the opportunity exists when all parties were involved that combine different experience level of comfort to project and question the design [INV02]*
	1.2	*a comprehensive presentation is essential for all participants to understand the whole situation. There instances where the participants are confused on the information presented due to the complexity of the information and the way it being presented. With due respect to the nature of the project under study and consultant technical background, some important aspect of information which is easily for non technical people to understands are also important. [INV03]*
	1.3	*And if we talk about interior design, the focus during the workshop will be on the ID concept of for the terminal building. From their presentation, we can see all arrangements, types of furnitures, features. At this point we can start to question the designer on the relevant of their concept and design selection [INV04]*
	1.4	*At 30% , there is a planning on what type of systems to be used for the project. for instance, types of air conditioning. But this planning exist in the mind of the consultant, so they have to present during the workshop (to us MAHB). So the MAHB will then discuss and make further decision based on the planning presented by the consultant. [INV06]*
	1.5	*Then during the workshop, the designed space will be presented and the workshop participant will assess the design against the space allocated and make suggestion were necessary to improve the design. [INV07]*
	1.6	*Sometime we experience conflcts between design documents during the workshop that could not be solve. Our time are wasted as we need to adjourn the workshop to next session. [INV09]*
	1.7	*If would be good if the changes to design can be made in real-time where all of workshop participants could communicate on the changes. [INV10]*
	1.8	*I think if we use some sort of software that could project the design of this facility, it would be good. Everybody with difficulty to visualise the design could easily understand and follow the discussion [INV11]*
	1.9	*Application of CAD or REVIT for this workshop could assist in helping me*

	to understand the complexitiy of the design [INV13]
1.10	I reckon BIM could be an alternative to hard printed drawings [INV15]
1.11	I think mind mapping is much better way to communicate the issue rather than the FAST diagram [INV16]
1.12	The facilitator uses fish bone diagram to assist us with problems identification [INV20]
1.13	If we had a 3D design or a walkthrough, that would have save heaps of time trying to visualise [INV25]

6.6.6.3 DVM07 Workshop information

This theme consists of four first order concepts, which are ‘multiple sources’, ‘information updates’, ‘recommendation support’ and ‘information distribution’. The focus of this theme is on the sufficiency, timing, forms and sources of information used during VM workshops. INV02 highlighted the effort made in searching for additional information to be used during workshops that was aimed at counter checking consultants’ recommendations. This measure is required to be taken to increase confidence in the client’s decision making. There was also a case where information used during a workshop was not updated and subsequent changes made were not effective due to the use of outdated information [INV05]. In terms of information required to support workshop recommendations, there were several instances cited where in the view of respondents, consultants came to workshops unprepared [INV17, 19 and 21]. This issue also influenced the overall workshop process with lack of time being given to study information distributed (i.e. 1.5hours) and timing of their distribution [INV23, 24 and 25].

Table 107 DVM 07 Workshop information

First order concepts	**Representative Quotations**	
Multiple source	*1.1*	*For instance in term of supply chain management and procurement of items, the Department should expand their work into researching within the market to be able establish a database which can be used as basis in VM workshop. This information can be used during VM study as supportive or main information should the recommendation made by the consultants are not convincing. This effort should be seen as lifting the trust from the consultant, but it should be seen as mere check and balance exercise to counter unproductive participants like I mention earlier. [INV02]*
Information updates	*1.2*	*Yes, there are plenty of information. Except when the NAM making changes to the projection which might not be forwarded to us during the airport planning period. The changes refers to the annual projection which might change in accordance to the activity of each states in the country. [INV05]*

Recommendation support	*1.3*	*each proposed changes need to be supported with necessary documentation which justifies the decision. Although it is not possible in a short period of time during VM workshop, this element is crucial to avoid any future issues during construction. [INV16]*
	1.4	*the subsequent VM meeting we had with the consultant did not produce information /design /alternative to the solution citing not fully understand the required system. [INV17]*
	1.5	*a comprehensive presentation is essential for all participants to understand the whole situation. There instances where the participants are confused on the information presented due to the complexity of the information and the way it being presented. [INV19]*
	1.6	*before the workshop being conducted, each potential participant should have get themselves well prepared will necessary information, proposal and references to be used in the workshop. This will help to reduce time during the workshop when supporting information is ready. You can avoid from having to later refer to specific information after the workshop which will affect decision made in this workshop. The workshop itself can be a decision making platform on next course of action if all information and references are ready. [INV21]*
Information distribution	*1.7*	*the duration given to understand all information against the duration given is really limited. I can only skim down the information at a glance without having opportunity to go through in details. [INV23]*
	1.8	*If information is distributed earlier prior to workshop, I have more time to immense with the information and come prepared to the workshop. [INV24]*
	1.9	*Information were given during the information phase, with just 1.5 hour to digest. I just listen to the consultants presentation. [INV25]*

6.6.6.4 DVM08 Decision making

This theme was built upon the requirement to build better communication among workshop participants to assist them in making decisions. There were various views on the decision-making effort made during VM workshops. The effects of the benefits of enhanced communication can be divided into front-end decision and post-workshop implication of such decisions. The front-end attributes were cited to include the needs for comprehensive information to support decision-making, inclusion of additional stakeholders in the process, information sharing, and applied tools or techniques [INV02, 10, 13, 17 and 18]. The post-workshop attributes were focused on reporting of the VM recommendations and outcomes of the study. Mainly the emphasis of responses appeared to be on the quality of information presented in the VM report that is used as a basis to support any issues during the later construction phase, arising from the decisions made in the VM workshop [INV15, 17 and 22]. The liability for the recommendations was also highlighted by one of the interviewees who felt that some sense of shared responsibility should exist towards the decision made during the workshop [INV15]. The issue of having to revert back to the original design where the construction team faced difficulties to trace decisions made during VM workshops (due to lack of reporting information within VM report itself) were also cited [INV02]. This issue was observed to be part of the overall weaknesses of the VM reporting system identified by this interviewee.

Table 108 DVM08 Decision-making

First order concepts	Representative Quotations	
Building communication	*1.1*	*Although their attendance may not give direct impact to the current VM study, it may provide a strong basis of communication and relationship builders between Legal Unit representative and other professional. [INV02]*
	1.2	*a comprehensive presentation is essential for all participants to understand the whole situation. There instances where the participants are confused on the information presented due to the complexity of the information and the way it being presented. With due respect to the nature of the project under study and consultant technical background, some important aspect of information which is easily for non technical people to understands are also important. [INV10]*
	1.3	*At 30% , there is a planning on what type of systems to be used for the project. for instance, types of air conditioning. But this planning exist in the mind of the consultant, so they have to present during the workshop (to us MAHB). So the MAHB will then discuss and make further decision based on the planning presented by the consultant. [INV13]*
	1.4	*We have process to evaluate ideas in VM so even if the ideas has been rejected, at least the idea proposer will understand reason behind the rejection instead of prejudgment at the begining. [INV17]*
	1.5	*all consultant were in the same workshop, a variety of views can be achieved will issues can be viewed from multiple angle. [INV20]*
	1.6	*I think we should move away from the brainstorming and find other techiniques to assist participants during Speculation and Judgment phase [INV18]*
	1.7	*Despite having criteria matrix system, we hardly used those forms. We stick to the old fashion discussion and consensus style of decision making. What's worry me is that no basis for such decision is recorded in the report. When any issues pop up on site that prompt for reasons behind such decision, we dont have the answer to it [INV08]*
	1.8	*Some decision were made through discussion and consensus instead of hard technical tools or technique [INV17]*
	1.9	*If the recommendation made during workshop is binding to the contract, the report should be comprehensive enough to relfect necessary informations and details [INV22]*
	1.10	*One thing that make me wonder about the decision made during workshop is the liability of the recommendation. Although its made by the team, but if things goes wrong during later stage, we need hard evident to justify why we make such decision at the first place [INV15]*
	1.11	*We experience a time when we need to revert to the orginal design prior to VM workshop due constructability issues. But when we try to investigate*

reasons behind such decision made during VM, we couldnt find solid justification for such move. [INV02]

6.6.6.5 DVM10 Systems Thinking

This theme refers to the references made by interviewees on assessing the various complex issues that stem from the design of s project such as an international airport. Interviewees raised the issue on the need to have proper interaction between the issues discussed during the workshop rather on other specific issues. INV13 for instance observed that there was a separation of his workgroup during the Speculation Phase, where his group, working on individual issues, was unable to successfully connect their proposals with those of another group. This was due to the problem of group separation where specific issues were examined without interacting with others and connecting to form the bigger picture. Similarly, INV21 related an experience where a proposal made during a workshop did not consider the actual construction duration that would result. INV25 observed that the Speculation Phase needed to be repeated as the ergonomical elements of the design were largely ignored due to over-emphasis on the commercial spaces. There were positive responses concerning the benefits of active participation among workshop participants keen to discuss issues during the workshop [INV05 and 08]. However, there was a requirement expressed for establishment of a proper structure or direction to guide the entire process during the workshop [INV10].

Table 109 DVM10 System thinking

First order concepts	**Representative Quotations**
System thinking	*1.1 Having a parellel workgroup system in VM will create a gap in connecting ideas developed between each separating workgroup [INV18]*
	1.2 We do involve in an active interaction among participants discussing about issues [INV05 and 08] but we are lacking in the direction to see those issue [INV10]
	1.3 I support the idea of having facilitator to summarise finding made after the Speculation Phase, but if we have interaction in between workgroup during the workshop, I believe better solutions can be achieve. This will reducing our time guessing whether our ideas does impact other workgroup's ideas. [INV13]
	1.4 Although in this workshop we strive our best to achieve objective for our client, but we also need to consider long term effect of our decision at the back end (i.e. construction phase) of our project. [INV15]

1.5 *I didnt notice anyone raise an issue about construction duration or supply chain of such proposed ideas. They merely weight against the cost/benefit and decide from there. [INV21]*
1.6 *If the team view the issue from the outset of the project (i.e. in larger scope), I think we would be having different direction for our workshop [INV24]*
1.7 *The design of Aerobridge although it cost the air carrier (end-user) additional cost, but on the other hand it help to cater for less disable airport user. [INV09]*
1.8 *We only focus to solve commercial space allocation in design and somehow missed the ergonomic part of user comfort in the airport. Due to that, we backpedalled during the speculatio phase and start looking back at other interacting system within the design [INV25]*

All ten themes generated through use of the constant comparative analysis methodology have been analysed and tabulated. There are 55 themes generated from this process but only ten were shortlisted. The top ten themes were selected based on relationships that address research questions and objectives of this research. There were several positive aspects of team participation in VM workshop observed throughout the analyses - the culture that exists among workshop participants, the team dynamics, facilitation styles and experience contributing towards a smooth workshop process. At the same time, several limitations were also revealed during workshop process that affected airport design planning in terms of visualisation, constructability, systems thinking, workshop information and participant's creative thinking processes. These limitations according to interviewees, were responsible for slowing down the performance and pace of workshops towards achieving better results for subsequent design and construction stages of projects.

The analyses of interviews spans across all five cases and covers the entire workshop phases of respective project packages. The summary of all ten themes against each workshop phase is tabulated in Figure 18. This visually illustrates the relationship that each theme has on workshop phases as identified through the interview process and supported by the researcher's site diary. The diagram indicates that almost all themes identified have a direct relationship with each of the workshop phases. The pre and post workshop phase is observed to have only a limited relationship between the themes compared to the remaining phases.

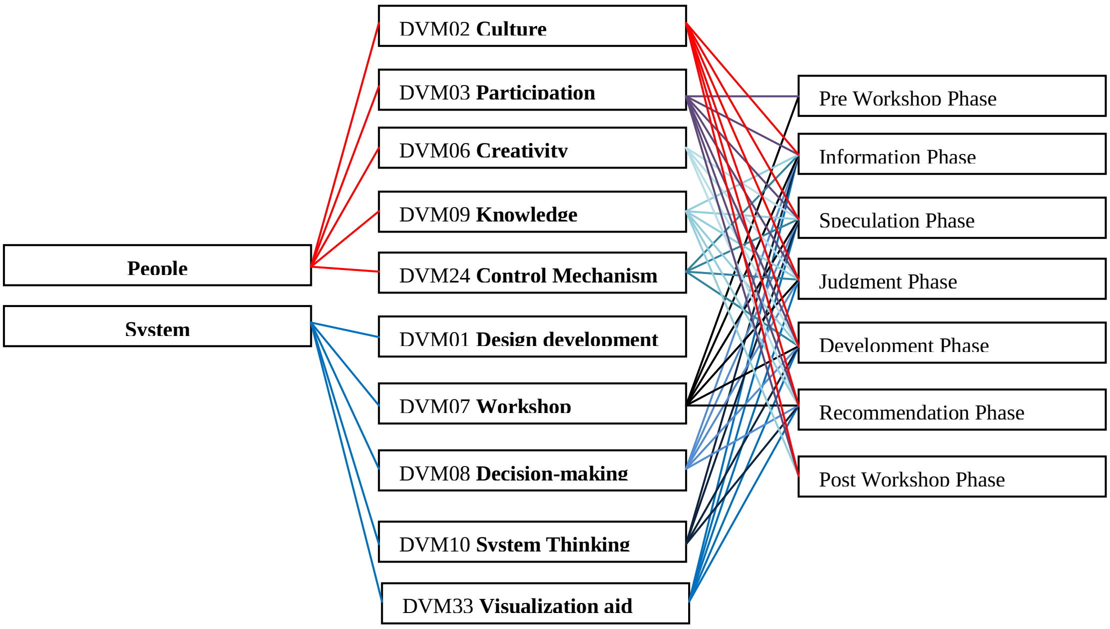

Figure 18 - Themes relationship with workshop phases

Throughout the analyses process, the generation of themes that attempt to answer the research questions and meet research objectives has lead to a unique relationship being observed among the VM processes of all cases. The results of analyses, interpretation of transcripts and grouping of themes indicates the influences of each theme on performance outputs of the workshop process. The existence of these themes appears to reflect actual attributes that influence team participation in responding to airport design planning issues found in the cases. For instance DVM33 (visualisation) revealed the limitation faced by the workshop participants trying to visualise the design in the context of an airport system. The absence of appropriate visualisation tools was observed to affect the reactions and involvement of participants in the workshop process. Similarly in DVM10 (systems thinking), lack of consideration of the workshop issues from a strategic perspective may have lead the workshop output to ultimately follow a different direction. While DVM 24 (control mechanism) observed the absence of proper discussion structure, which often derailed workshop participants' focus on the actual workshop objectives.

Therefore, the generation of these themes from analyses and interpretation of the data collected leads to identification of the ten attributes that influence workshop participants' involvement and contribution during VM workshops. These findings will be further validated through triangulation with other results and findings (i.e., document analysis and survey) in Section 6.7 before a framework of these attributes is generated. The generation of framework and its validation will be discuss in Chapter 7 of this thesis.

6.7 TRIANGULATION OF RESULTS

This section will discuss the triangulation of data analysis results. 'Triangulation' refers to a process of using more than single source of data for research validation purposes (Hussein, 2009), in the case of this research, interview, survey and document analysis. There are two approaches taken in conducting triangulation , the 'within-method' that refers to triangulation within a single research method (i.e. qualitative) while the second is 'between-method' that combines two methods (qualitative and quantitative) (Hussein 2009).

The process of triangulation analysis for this research relies heavily on the qualitative approach (i.e. interview and document analysis) as the primary method, while the quantitative approach is a complimentary method (Hussein 2009). All together ten attributes generated from the interview process are analysed and crosschecked against the remaining two methods (i.e. survey and document analysis). The results of this triangulation confirmed the findings made for all data collection methods.

6.7.1 Culture attribute

This attribute consists of two first order concepts comprising 'institutionalised attachment' and 'personality'. The former was derived from interviews based on interviewee's constant references to the forms of attachment by workshop participants that reflected their organisational representation. Workshop participants were perceived to be conducting themselves and thinking in line with their own professional viewpoint but giving less attention to the needs of other professions or participants

There are several traits that were identified based on analysis of the transcripts relating to this attribute. Resistance to accept change in the design [INV04: Case **CS1**], dominant participants who think they are the leader of the workshop [INV11:

Case **CS5**], stereotypical thinking of VM workshops only aiming to reduce cost [Case **CS1**: INV05 and INV15, Case **CS5**: INV15], different interpretation of the workshop issues [Case **CS4** : INV07 and INV18] and too much focus on individual roles but failure of such individuals to see the impact of their ideas on others [Case **CS4**: INV07 and Case **CS5:** INV14]. These traits appear to bias participants' thinking because of their representation of the ideas of particular working organisations. However, interviewees INV02 [Case **CS1**] and INV14 [Case **CS5**] raised a valid concern on breaking this professional attachment on the grounds that it would challenge participants to think only at the same level regarding the workshop issue rather than having a more diverse view. They asserted that working or thinking individually without considering the impact on other attributes would affect the way VM workshops attempt to solve arising issues.

To further explore these findings, results from the survey analysis have been integrated into this discussion. In terms of team composition, 93.2% of respondents believed that the current team composition is sufficient as indicated in Table 62. But only 6.8% disagree with this. This result shows that no major issues were perceived on the team composition of workshop participants. However, there was some level of concern amongst interviewees regarding the interactions that exist among participants. Table 74 indicates the resulting list of factors that are seen to limit respondents' ability to contribute during the workshop process. Based on this result, 19.4% of respondents claimed that dominant participants affected their contribution in a workshop. Cross tabulation of this result was also conducted against VM workshop participants that further reinforced findings made from the interviews. Results in table 75 indicate that dominant participants are highly related to workshops where architectural concerns are the main issues in the workshop.

Furthermore, there are also additional observations related to this result where 18.5% of respondents think there are other factors that affect them as well. These include participants' involvement only as a representative and not a decision making authority in the workshop. One interviewee stated that:

"Sometime the issue that we face is that the invited person could not attend the workshop but instead a representative were sent. Their input may not be as effective

*as expected and this will jeopardise the workshop outcome effectiveness" [INV21 : Case **CS3** : Architect]*

*"Even though we call them to attend, sometime they just come and spending their time to hear the VM session. A silent observer" [INV25 : Case **CS5** : Green technology specialist]*

Both of these excerpts demonstrate the dilemma that was faced by workshop participants who were constrained by institutionalised thinking. Similar findings were also observed on the personality traits under 'culture' attribute. Firm personality of the facilitator was often cited by the interviewees who observed positive as well as negative interaction among workshop participants as indicated in Table 76. The positive interaction that existed within the workshop environment is highly related to findings made from the survey which recorded that 17% of respondents are motivated to be involved in workshop interactions due to the facilitator's leadership. This finding ranks highest among other listed factors of contribution that also include, speaking opportunity, knowledge and experience as well as time sufficiency. The influence of the facilitator's leadership on participant interaction culture was identified from the interviews and the following two quotations reflect this:

*...if its wasnt due to facilitator experience and his charisma, I dont think our workshop could yield a positive outcome....[INV20 : Case **CS5**: Architect]*

*"My facilitator handle our session really well. Despite dominants participants and concerted effort by certain consultant pushing for their ideas, he managed to retain the dynamic in our workshop" [INV22 : Case **CS5** : Quantity Surveyor]*

Such representative , coupled with results obtained from the survey on limits of participant contributions indicates that interaction among workshop participants is a core issue. Despite having the right team composition with the majority having working experience between 6 -15 years (86.4% refer Table 38), the dependency on facilitator's leadership still plays an important role in creating motivation among team members in the workshop. This also suggests that strong firm personality and thinking styles of facilitators have significant influence on workshop participants' contributions toward the workshop process.

6.7.2 Participation attribute

This attribute consists of three first order concepts, which are 'representation', 'involvement level' and 'limitation to participate'.

In terms of representation, the majority of interviewees were in agreement that workshops they attended were represented by an appropriate mix of participants [Case **CS1**: INV13, 15, Case **CS5**: INV09, INV14, INV24 and Case **CS6**: INV10]. This finding is further supported by the survey results which indicate 93.2% of respondents believed that the current team composition is sufficient as indicated in Table 74. The combination of technical and non-technical participants was seen to contribute towards the dynamic of the VM process [Case **CS5**:INV09]. Apart from the survey results, analysis across all VM Reports for all cases indicates the breakdown of workshop participants by organisation as shown in Table 110.

Table 110 Workshop participants for all cases

	CS1	CS3	CS4	CS5	CS6
Client	8	5	9	10	2
Project Management Consultant (PMC)	3	5	4	7	4
Facilitation Team	4	4	4	6	3
Airport Management	5	1	-	6	-
Engineering	8	3	6	6	2
Architectural	1	-	-	7	-
Quantity Surveying	1	3	4	2	1
Interior Designer	-	-	-	3	-
Specialist and Multi-disciplinary team	4	1	2	1	-

Based on the VM Report analysis, the distribution of participants based on organisations for all cases was spread evenly. Each case had its own representation from different professional backgrounds including the client's representative. There were some cases observed that did not have any representatives from specific professions, e.g., airport management representatives were not involved in **CS4** and

CS6 due to the nature of the project package under study that focussed on the terminal approach road, while architects were not involved in **CS3**, **CS4** (approach, terminal and perimeter road) and **CS6** on sewerage lines. Interior designers were only involved with the main terminal building package [**CS5**]. Therefore, this suggests that the distribution of professional representatives in each case fairly corresponds to specific project packages.

As for participants' involvement levels, there were several key areas that can be summarised from interview transcripts. The involvement of various professions in all workshop is highly regarded as a positive driving force for workshop processes [**CS3**: INV19, **CS4**: INV18, **CS5**: INV14 and INV22]. The inclusion of multiple viewpoints looking into the same issues was perceived to improve communication amongst project teams [INV18, 19 and 22]. Despite these positive observations being made on multi-disciplinary involvement, some interviewees felt that workshop participants were only interested to contribute within their area of responsibility towards that project package [**CS5**: INV24]. Some interviewees raised a concern on the need to attend the workshop when the VM study issue only focuses on one area of specialisation [**CS1**:INV04]. The response made from INV04 indicates a perceived lack of understanding of multi-disciplinary involvement in VM workshops and the conduct of workshop as a whole. However, this evidence appeared as outlier against other views and for that reason may not be considered conclusive.

Results from the survey analysis are used to identify reasons behind the scenarios mentioned by participants regarding involvement levels. Majority of respondents are from the consultant groups that account to 56.8% of total response and followed by Client's representative with 34.1%. Personal function in the workshop result indicates that 29.5% of respondents think that their participation in their workshop is to initiate new ideas, followed by coordinating information (22.7%) and seeking information (13.6%) [Refer Table 77]. Further, cross tabulation between personal function and membership role in workshop shows higher percentage of respondents who initiates ideas are from the consultant's category while involvement of decision-making authority in the workshop focuses on evaluating information. This finding is consistent with most interviews response who find multi-disciplinary involvement in VM workshop is significant with fair representation and specific role to be played.

The observation on lack of understanding of multi-disciplinary involvement in workshop [**CS1**:INV04] is considered as isolated response that is not reflective across entire interviewees.

The limitation to participate in the workshop process revealed a unique result. Majority of issues that emerge from interviews stem from workshop participant's weaknesses rather than existing system in place. Several key issues were recorded across all interviewees that comprises of limited participants experience [**CS3**: INV03, INV21, **CS6**: INV06], unprepared participants [**CS1**: INV13, **CS5**: INV09 and INV25], lack of self-confident [**CS5**:INV11] and complexities of information presented [**CS5**:INV20]. However, result from survey analysis indicates contradicting findings from the interviews. In term of factors that limit participant's contribution during workshop, time limitation and dominant participants were among the top factors [Refer Table 86]. Other factors were the third in the list with suggestion made by respondents focussing on the existing workshop system rather than individual participants. It represents 18.5% (n=23) of the total response. Majority of suggestions made were corresponding to INV20 [**CS5**] comments on complexities of information presented. Among the suggestions receives includes:

a. *I could not visualise from the drawings how to solve the issue*
b. *The drawings use as reference is insufficient and rather confusing*
c. *How can I contribute when the only drawings issued during the workshop are from PowerPoint with limited visibility on the details*
d. *Coming from non-construction based professional, it take some time to understand and visualise the drawings*

Similar suggestions were obtained from survey result regarding motivation factor to contribute during workshop process. Despite facilitator's leadership is the main driving factor for workshop participants with 17%, other factors were selected as the third main factor with 15.2% (n=34). Respondents provided suggestion for their response which are observed to be corresponding to the limitation as raised by [**CS1**: INV13, **CS3**:INV09, **CS5**: INV20 and INV25]:

a. *Clarity of information presented during presentation phase*

b. Clarity of information distributed to participants
c. Minimise pre-judgment of ideas by others
d. Refrain from ideas criticism
e. Control mechanism among participant during discussion as some participants clearly dominate the session

Based on both suggestions made on limitation and motivation factor survey questions, the focal point of respondents' concern in on the form of information distributed, presented and discussed during the workshop affect their involvement. Sufficiency of information distributed were not part of the concern despite no record was obtained across all VM reports on list of reference documents used. However, the form of information presented either by the consultants or physical information is the main concern across all workshops.

6.7.3 Control mechanism attribute

The control mechanism attribute was generated based on interviewees' concern on the need to have better structure in conducting VM workshop. These observations were made across all cases in this research. Within this attribute, there are two key areas that were observed. It consists of workshop structure and control. The form of workshop control that were observed among interview respondents are concern with participant's interaction, problem-solving and decision-making approach across all cases. INV02 [**CS1**] and INV08 [**CS5**] provide their insight on the need to control how participants interact during workshop process through facilitator's leadership. INV02 were concerns on multi-disciplinary representation with years of experience are difficult to control. INV02 were cited:

*"The team needs to be control by facilitator in making decision. All of consultants in this time are well experienced and has their own reputation and egos and this need to be manage properly by experience facilitator in bringing out the best from them without jeopardizing their reputations" [INV02: **CS1**:Civil Engineer]*

The same incident were observed by INV08 of case CS5 where the need for better control and authority within workshop process is essential in setting the boundary for workshop. INV08 was quoted:

*"there should be one authority which could decide what can and cannot be on the project" [INV08 : **CS5**: Quantity Surveyor]*

An analysis from VM report on application of forms in VM workshop across all cases in Table 88 revealed that all forms were used except for Form 4a and 4b [Criteria Weighting Matrix]. Form 2 [Question Prompt] in particular that focuses in setting the boundary for the workshop process is being used for case **CS5.** This suggest that INV08 is not referring to the application of form during workshop, but instead referring to the control of participant's interaction when solving problem and decision making during workshop. This is supported by INV08's claim:

*"how we move from one issue to another during the course of speculation and evaluation phases need to be control. I think the brainstorming technique is good but it give too many freedom for us to go around until we were lost half way through the process" [INV08 : **CS5**: Quantity Surveyor]*

INV08 were referring to technique used during Speculation phase which is the brainstroming and how workshop process move on from phase to another. Survey and documents analysis results are used to identify pattern on the techniques used throughout the workshop process. During information phase where identification of study issues is conducted, result from Table 64 indicates presentation and brainstorming are the most frequently used technique with equal percentage of 29.8% and followed by FAST diagram with 25.3%. This result can be validated through documents analysis result on VM report. Result document analysis as indicated in Table 83 further summarised that all reports contains result from FAST diagram except for case **CS3**.

On speculation phase technique to generate ideas, Brainstorming is the most frequently used technique during Creativity phase with 36.6% and followed by Evaluation Comparison techniques with 29.8% as indicated in Table 67. Analysis results on VM report ‘Executive Summary’ section across all cases confirmed that brainstorming is the main technique used to generate ideas. On evaluation phase technique, no records were observed across all VM reports on appropriate technique used. Furthermore, result from analysis as indicated in Table 88 shows Form 4a and 4b [Criteria Weighting Matrix] were not used for all cases.

The structure of workshop itself were raised by INV14 and INV22 of **CS5** who states that:

*“I think parellel session is good approach but if we have too many groups and all work in isolations, its really to know whether our proposal match up with others” [INV14:**CS5**: Architect]*

*“There were no structure guide in assisting our discussion about the design. It was just like here the design and how are we going to reduce cost from this design” [INV22:**CS5**: Quantity Surveyor]*

Both of these statements indicate two concerns which are the conduct of parallel session and lack of guide to structure the discussion of the design. The parallel session conduct only appears in CS5 where the workshop participants were divided into several group according to specific elements of design, while the remaining four cases had only single session. The integration of discussion made between each group during workshop process in CS5 is the main concern among CS5’s respondents. They observed that each individual group only work within their own group without connecting their ideas/proposal with other group. This creates an issue where participants were left to direct their own path of discussion without knowing how their proposal will work with other group. INV 25 gave an example of this issue:

“we were discussing on the design of the roof for the main terminal building. We come out with variety of design solution for the roof in order to solve the workshop value study based on our interpretation of the design problem. However, the setback we face when we presented our ideas at the end of Speculation phase and found out that our proposal is not workable. This is due to the lack of consideration on the

integrating rainwater management system that is under Structural Engineer's responsibility. Unfortunately, he was in different group studying on other structural elements" [INV25: ***CS5****: Green technology specialist]*

The concern on parallel session having to lose connection with other group during Speculation phase is observed to be pulling the phase backward. Both of these issues are seen to be taking workshop participants into different direction Example given by INV25 indicates both on the loose connection in between group as well as lacking in structure to guide the study process. Despite response from INV20 of **CS5** shares similar experience of the issue, he suggested on the application of constructability guide to assist workshop participant for problem solving and decision-making. This suggestion will be discuss further in the Constructability attribute of this sub-section.

The triangulation analysis found that brainstorming were the main techniques used during VM workshop process across cases with support from presentation technique. However, the concern on appropriate structure used to control and guide workshop participants' interaction during discussion requires further improvement.

6.7.4 Creativity attribute

This attribute consists of two first order concepts, which are exploring creativity and distraction to creativity. Both of these concepts were generated throughout the interview that mostly touches on the aspects of improving creativity process among workshop participants and the roadblocks for improvement.

The exploration of creativity consists of interviews excerpts that focuses present scenario of creative thinking process across all cases. Numbers of interviewees acknowledge that creativity process is not solely in the hand of the designer and other participants are also contributing to the creative process of the workshop [Case **CS1**: INV02, INV15, **CS5**: INV16]. They further assert that fair opportunity was given for all workshop participants to express their ideas without any judgment. Other experienced participants will assist in improving suggestion along the way (i.e. hitchhiking) where active participation is observed [INV15 and INV16]. In further understanding this finding, survey analysis that focus on personal function, traits and creativity technique are used to explore this issue.

Findings from personal function analysis in Table 60 indicates that 29.5% of respondents think that their participation in the workshop is to initiate new ideas while 23% focuses on coordinating information and 21% provide information during workshop phase. A cross tabulation analysis further reinforce this result in which higher percentage of respondents who initiates ideas are from the consultant's category while decision making authority in the workshop focuses on evaluating information. Personal function result is tabulated in figure 19. This shows a spread of function that exists within workshop environment for all cases. The distribution of function is consistent with the participant's distribution in the workshop where consultants is the majority while client has lesser representation.

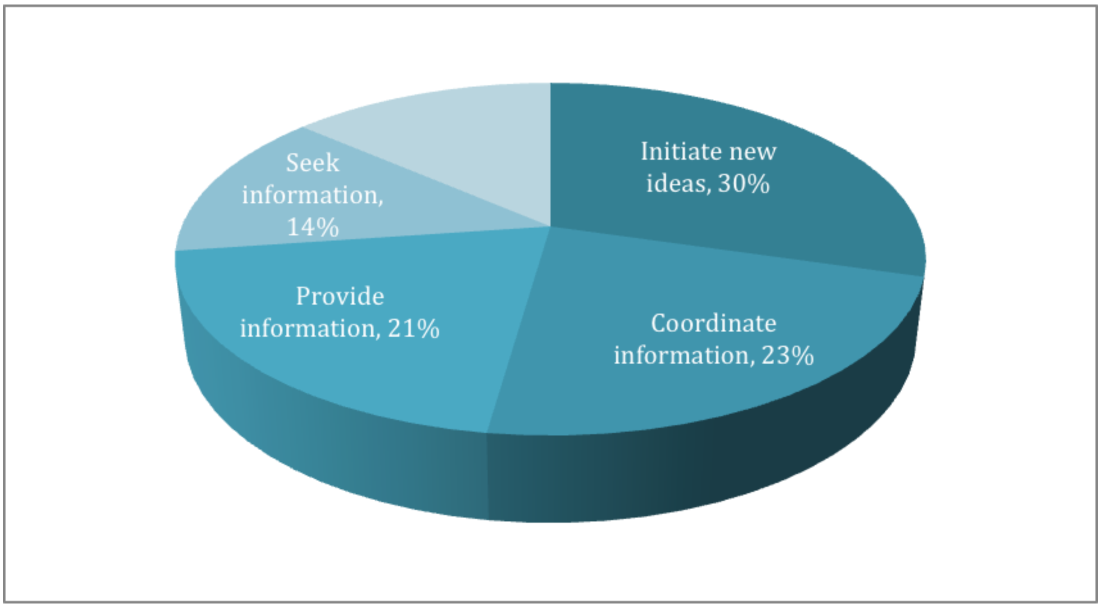

Figure 19 Participant's personal function in workshop

Personal traits to problem solving result were also important in trying to explore the issue further. Based on survey result on Table 77, tacit knowledge is the highest frequencies among respondent with 21.4%, followed by being cooperative (17.5%), having explicit knowledge (17.5%) and strategic thinking (10.7%). These four traits are the largest frequencies observed among all respondents across all cases. One example was taken on the application of tacit knowledge during workshop process. INV18 of **CS4** were quoted saying:

*"I try to replicate my past experience into this project in attempt to solve design problems" [INV18:**CS4**:Geotechnical Engineer]*

The transfer of previous experience into current workshop process demonstrates participant's application of their tacit knowledge as part of creative process in workshop. Majorities believe that their tacit knowledge has influence on the workshop process. This finding also support statement made by INV16 who state that:

*"Each participant has their own strength and experience which promote active participation among team members. Imagine the combination of all learned people in one workshop looking to solve a problem, how amazing it could be when the ideas were generated, combine and improves to solve the issues."[INV16: **CS5**: Aviation Engineer]*

Apart from personal function and traits, the application of creative technique during workshop process is also explored. Result in Table 66 shows that Brainstorming is the most frequently used technique during Speculation phase with 36.6% followed by Evaluation Comparison techniques 29.8% and idea hitchhiking with 17%. The application of brainstorming as main tools during Speculation allows for generation of ideas without having pre-judgement. The freedom of expanding ideas where quantity is the priority were significantly influenced by the way how each workshop participants perceived their role and personal traits in the workshop.

In term of distraction to creativity, the interview respondents raised several key issues. It consists of distraction that comes from other participants, the techniques used and superior-subordinate relationship influence. Distractions from workshop participants were observed by interviewee INV 10, 15 and 17. INV10 of **CS6** observed that frequent coffee/washroom break during workshop phases where participants enter or leave the room somehow distract other concentration.

*I struggle to focus during the workshop due to participants comes and go as they wish for coffee breaks or washroom. Once I lose my focus, its pretty hard to regain back on track. [INV10:**CS6**:Client]*

INV15 and INV17 shared similar observation during their own workshop process where they states that:

*"If the same person keep on giving ideas while the rest goes 'that good' / 'i never thought of that' / 'ohhh' and so forth then somehow it will distract others from their thinking process" [INV15: **CS1**: Aviation Engineer]*

INV17 observed that the non-verbal communication of participants does influence the form of reaction during VM process that indirectly limit others creativity.

*"Even though we are not allowed to judge 'verbally' but I think our gestures and bodymoves may indicates to others that your ideas are actually bad!" [INV17:**CS4**:Structural Engineer]*

In term technique used, most interviewees have no issue on the application of brainstorming technique. However, they are concern on the conduct of the technique itself where it leaves too much freedom to participants. Interviewees observed that there is no boundary or limit that guides them using the technique. It is almost a free-wheel session. Case CS5 was observed to experience this issue:

*"Having to constantly give ideas without knowing the boundary of the issue to be explored is rather difficult. I think the brainstorming approach need to be revised or perhap employed other techniques" [INV12:**CS5**: Quantity Surveyor]*

*"Everybody starts jumping into giving ideas about the design but there were no proper way of looking at it in a structured manner. We were left with abundance of ideas that goes wild beyond our imagination. Although this is encourage for creativity, i think some framework is necessary to set the boundary of our discussion" [INV11:**CS5**: Airport Planner]*

A cross comparison with interviewees from other cases did not yield result that is consistent with CS5 observation. However, Case CS3, CS4 and CS5 observe a unique issue of superior-subordinate relationship influence. Interviewees from both cases observed that the working position of participants attending the workshop somehow contribute toward the distraction. INV18, INV19 and INV22 were quoted saying:

*"I just leave it for my boss to talk, he is more experience" [INV18:**CS4**: Geotechnical Engineer]*

*"I felt a little scared sitting among experienced consultants and is best for me just to keep it on the low". [INV19:**CS3**: Civil Engineer]*

*"I felt a little bit left behind knowing the representation for this workshop consist of well experienced consultant. I just leave the talking part to my boss while I jot down the ideas." [INV22:**CS5**: Quantity Surveyor]*

In further exploring all three issues, result from survey on factors that limits [Refer Table 74] participant's contribution is used. The result shows disparity between what has been observed from survey against the interview. The superior-subordinate relationship influence that stem from experience level only ranked 4th among limitation factors compared to time limitation, dominance and workshop information. No reference was observed on the application of neither technique nor other individual distraction.

6.7.5 Knowledge attribute

This attribute consist of four first order concepts, which are experience level, refresher course, knowledge sharing and function analysis technique. This attribute was generated based on reference made by interview respondents on the level, application and sharing of knowledge opportunity that exists within VM workshop environment.

The level of knowledge and experience level of workshop participants across all cases were acceptable as observed by most of the interview respondents [INV01, 02, 03, 05, 08, 09, 10, 13, 16, 18, 20, 22, 25]. They observed that workshop participants having essential experience level to deal with the nature of VM problem surrounding their respective project package. However, several irregularities were observed among few interviewees on the way knowledge and experience being dispensed. For instance, INV09 and INV16 of case CS5 observed that:

*"I don't see any flaws with their knowledge, skills or rather experience, but how they disperse the ideas and getting people to agree with them sometime I find it disturbing. As if there their ideas worth than the others. This does not includes those who has good ideas but find it difficult to explain their though to others and leaving others to try to direct the discussion to reach understanding" [INV09: **CS5** : Civil Engineer]*

*"I think the participant should posses sufficient knowledge in airport planning. He should understand process involve in the airport planning system. Planning an airport is not the same as high rise building. Cutting the design here and there for sake of cost saving affect the entire airport integration system." [INV16: **CS5** : Aviation Engineer]*

Both excerpts provide an example of the irregularities observed within CS5 environment. INV09 observed limitation on the way participants dispense their knowledge/experience during workshop that is perceived to be ineffective. While INV16, suggest better appreciation of airport planning system as pre-requisite to avoid unnecessary cost cutting. INV15 from CS1 observed both situations that exist in his project package:

*"in my opinion they need to be a subject matter expert, the technical expertise. They must have the ability to highlight and ability to talk to people and persuade. To voice out their ideas" [INV15: **CS1**: Aviation Engineer]*

Survey analysis results on working and workshop experience are used to explore this scenario. In term of working experience, Majority of respondents (86.45) has worked in the construction industry between 6 to 15 years. The Project Manager and Value Engineer have a representation in the most experienced group (with more than 20 years experience). While on 6.8% of workshop participants have less than 5 years working experience.

Although respondents' working experience are substantial on their current project package, this may not reflect on the actual level of experience in VM study or project with similar nature to their current project. Analysis results on respondents past experience in VM study prior to the current project are used. Based on the result, 84.1% of respondents had experience in VM study. Cross tabulation analysis between experience and type of project they were involved revealed that they are involved with Civil engineering type of project (25%) followed by 22.7% on building and 20.5% on mechanical engineering projects. This indicates that respondents had an experience participating in value management workshop that has similar characteristic with the current case study (i.e. Airport), which combine civil, building and mechanical elements. Therefore, the level of knowledge and experience that exist within participants of each case are acceptable. Observation made by INV09, 15 and 16 are rather unique or isolated cases that had minimal influence by participants' knowledge level. Despite participant's substantial level of knowledge and experience, there are recommendations made by several interview respondents on refresher course about VM [**CS4**: INV 17, 18 and **CS5**: INV20]. They felt that continuous refresher course on VM will educate and enhance understanding about the conduct of VM. This recommendation was made to focus on external consultants who are involved with current project packages.

A cross reference with MAHB procedures indicates that internal staff and SME's under MAHB are required to attend course on VM prior to their involvement in any workshop. However, this course was not extended to external consultants working for MAHB projects. The absence of this course have raised several observation made by INV15, 20, 22 and 23 [Case CS1, CS5 and CS6] on their difficult to comprehend function analysis technique as indicated in Table 101. They were concern on the difficulty to follow and understand how function analysis works to solve workshop issue. While some interviewees choose to leave it to the facilitator and just follow his instructions.

The knowledge attribute as observed across cases shows that the high level of knowledge and experience among workshop participants due to their vast working experience. Those experiences were coupled with previous VM workshop experience that has similar nature with their project packages provide greater contribution during the workshop process. However, concern on the level of understanding of function analysis technique itself requires further refresher course. Current MAHB staffs were provided with training and courses on VM application while nothing is available for external consultants working for this project. Improvement in this area [i.e. provide training and courses] is expected to improve overall level of knowledge and understanding on VM among workshop participants.

6.7.6 Constructability attribute

This attribute consists of three first order concepts, which are application of VM in design, multiple views in design and buildability. This attribute was generated based on interview respondents' reference on the application of VM in design planning and concern on the output made from workshop in term of its constructability on-site.

Positive observations were made on the application of VM in design planning of all existing cases. The application of VM is perceived to be influencing the design improvement in term of its specifications, forms, electrical and mechanical integration [INV04], improvement in project function definition, requirement and budgeting [INV05], space function allocation and user comfort level [INV12], improve design performance [INV10], project delivery and construction planning [INV20], supply chain [INV21], airport system integration [INV16] and facilities management [INV25]. However, there is a contradicting view on VM application in design was observed. Despite acknowledging VM could assist to improve project function, INV05 from case CS1 argue that:

"I think in my opinion, the activities to improve the design should not be in the VM workshop. We dont have any structured mechanism to review the design properly. We normally end up looking for opporunities within the drawings to improve rather

*than a proper framework that guides us. Like a constructability checklist for instance" [INV05: **CS1**: Client]*

INV05 raise a concern on the mechanism use to review and study design in VM workshop. Exploration of this issue has been analysed and discussed in Section 6.7.3 [Control mechanism attribute]. Specific suggestion is observed made by INV05 on the application of constructability checklist as a guide to be use in VM workshop. This finding and suggestion is compared against results of survey analysis on workshop reference documents. Based on result in Table 70, drawings are the most frequently used reference document on all workshops followed by Life-Cycle Costing and Construction programme. These three documents are used throughout VM workshop process as reference in design planning. Suggestion made from survey of this question shared similar characteristic as what has been suggested by INV05. The Building Information Modelling [BIM] is suggested to be use as a tool to assist during workshop phase. Both suggestions (i.e. on Constructability checklist and BIM) provide a new approach to improve the existing conduct of VM workshop. Although based on interview result only INV05 provide this suggestion, results from survey that yield larger a response on this issue has supported this finding.

The multiple views in design concepts stem from interviewee's observation on active participation among participants and acknowledgement on individuals' traits that will benefit VM workshop outcome. Majority of interviewees were in the opinion that multi-disciplinary involvement that offer multiple perspective when looking into a design planning provide check and balance system during the workshop [INV01, INV11, INV18, INV19, INV20, INV04, INV05, INV06]. It also allow for re-generation of existing ideas into much better design solution [INV07] and input of different methods of construction [INV22]. Each individual participant are perceived having their own expertise contributing to the workshop [INV20].

The perception of each individual participants has their own expertise is further reinforced with survey finding in Table 77 which found that possessing tacit knowledge is the highest frequencies among workshop participants with 21.5%, followed by being cooperative (17.5%), explicit knowledge (17.5%) and strategic thinking (10.7%). These traits are ranked the highest priority among ten other traits.

In term of buildability concept, it is observed that interview respondents were concern on the ability to construct proposed design based on VM outcome. Several interviewees raises doubt on the proposal made during workshop that has not taken into account all necessary parameter to construct such design apart from cost saving [Case CS1: INV02, INV15 and CS4:INV14]. INV05 from CS1 were quoted:

"We normally end up looking for opporunities within the drawings to improve rather than a proper framework that guides us. Like a constructability checklist for instance" [INV05: ***CS1****: Client]*

This suggests that attention to particular buildability issues of the design may have escaped from CS5 VM workshop as they tend to find opportunities within the drawings. This issue has taken it toll during construction phase for CS5 when the proposed design could not be construct due inadequate planning and information. INV14 were quoted:

"contractors were having difficulties to construct the design required due to current site condition that requires additional works to be done prior for the design to be built. This is issue is not captured in the contract. If the solution is just minor preparation work with minimal cost impact then its fine, a VO can be issued. But what if the works involves redirecting entire underground services?" [INV14 : ***CS5*** *: Architect]*

This observation was made in CS5 that demonstrate lack of consideration on buildability issue during design planning of the workshop which ends up with great deal of ramification. Clearly, no structured way of approaching the design planning during VM workshop is observed from interviews. Most of them criticise on the lack of structured approach to carry out the design planning apart from existing VM techniques. However, approach taken by participants from CS1 indicates a proactive measure to minimise such impact. INV13 who is from VM Facilitation team has invited an external construction specialist to be part of VM study. The external consultant is assigned to advise the facilitation team on the constructability of any proposal made during the workshop. INV13 was quoted:

"our company invited a speclialist to be part of the our team during the workshop. He will provide his expert judgment on the constructability of the design from contructoes point of view. Although he is not involved directly with the project, we appoint him as measure to increase our competetive advantage for this project." [INV13 : CS1: Facilitator]

Although constructability is one of the concern raised by interview respondents, a survey result on respondents' perception on VM outcome [Refer Table 79] of their case revealed slightly contradicting result. There are four variables (V1, V2, V3 and V4) that achieved the highest response agreement from respondent with 77.20% (Mean = 3.86). Respondents perceived key outcome areas of their workshop were focussed towards improvement in development scheme, proposed alternative design solution, construction method and cost saving measure for the project. Despite contradicting result between interview and survey on VM key outcome area in term of constructability of the design, the issue is observed only by INV14 in CS5. The remaining interviewees of this case make no reference to the issue. However, they share similar aspiration of improving the workshop process through application of better structure to review design.

6.7.7 Visualisation attribute

This attribute consists of two first-order concepts, which are constraints and real-time information. This attribute was generated based on interview respondents' reference on the limitation they faced with visual presentation of information during workshop process as well as room for improvement.

The constraints that most of interview respondents raised focus on two main issue which are complexity to maximise visual presentation and insufficient time to comprehend design information. In term of visual presentation, several interviewees were quoted having difficulty to understand the drawings:

"I find it difficult to undertand how this builiding comes together just by looking at the section and plan. Maybe its my limitation not from construction background but I

*think some **modification and improvement on how information is presented** could improve my contribution. If not, I will just keep quiet." [INV04: **CS1**: Client]*

*"I dont really understand design information presented." [INV05 : **CS1** : Client]*

*"a comprehensive presentation is essential for all participants to understand the whole situation. There instances where the participants are confused on the information presented due to the complexity of the information and the way it being presented. With due respect to the nature of the project under study and consultant technical background, **some important aspect of information which is easily for non technical people to understands are also important**." [INV03: **CS3**: Client]*

*"I **need more time to study the design if I were only given just plan and sections drawings**. If we had a 3D design or a walkthrough, that would have save heaps of time trying to visualise" [INV16: **CS5**: Aviation Engineer]*

*"Its really hard to get this done if you are **not familiar with the design and having trouble visualising it**." [INV25: **CS5**: Green technology specialist]*

This scenario were observed among case CS1, CS3 and CS5. Interviewees raised their concern on the difficulty to comprehend design information presented. The design information as highlighted is referring to the physical drawings and form of presentation of design used during workshop. No reference were made on other reference documents such as procedures, policies, By-Laws and Building Codes. There were in the opinion that drawings alone are not sufficient enough to demonstrate the entire design scheme. One of the main reason cited by one of the interviewee was limited time given to study the drawings. A cross check with document analysis result on VM reports for all cases revealed an average time given for each phases of the Job Plan. Information phase is the main slot where workshop participants will listen to presentation and study distributed informations. Result from Table 111 indicate a summary of duration for information phase for each cases indicated in hours [Source: Document analysis on VM reports].

Table 111 Information phase duration

VM Phases	CS1	CS3	CS4	CS5	CS6
Architect Presentation				*0.45*	
Civil/Structure Presentation				*1.00*	
M&E Presentation				*1.00*	
QS Presentation				*1.00*	
Information Phase	*1.45*	*1.05*	*1.04*	*7.00*	*1.15*
Total	***1.45***	***1.05***	***1.04***	***19.4***	***1.15***

Based on the summary, the average time spent for information phase is between 1 hour to 1.45 hours for all cases. Exception is observed on case **CS5** where the more time are spents with additional consultants presentation slots. **CS5** is observed to to have spent 19.4 hours for presenting information to workshop participants due to complexity of the project package [Main Terminal Building design]. Time limitation to comprehend design information may been proven for cases **CS1, CS3, CS4** and **CS6** as claimed by INV03, 04 and 05. However INV16 observation on case **CS5** is considered as isolated case when compared to the actual time allocated for information phase.

Based on the backgrounds of the quoted interviewees, INV03, 04 and 05 were representing client's organisation while the remaning INV16 and 25 were from consultants. Although workshop participants who attended this workshop consist of well professional with sufficient amount of working experience, these findings [i.e. understanding of design information and time limitation] indicate a subtle issue that may have been missed during workshops organisation.

In attempt to explore into much deeper this subtle issue, several interviewees has provided with an insight on how they perceived as an improvement to the current system. Majority of interview respondents were in the opinion that the application of real-time visualisation will assist workshop participants to grasp design information effectively within short period of time and make necessary contribution during workshop process [INV04, 07, 10, 11, 13, 15, 16, 25]. Among the suggestion made for improvement focusses on the application of visualisation software such as CAD, AutoDesk Revit and Building Information Modelling [BIM]:

*“If would be good if the changes to design can be made in real-time where all of workshop participants could communicate on the changes.” [INV10: **CS6**: Client]*

*“I think if we use some sort of software that could project the design of this facility, it would be good. Everybody with difficulty to visualise the design could easily understand and follow the discussion” [INV11: **CS5**: Airport planner]*

*“Application of CAD or REVIT for this workshop could assist in helping me to understand the complexitiy of the design” [INV13: **CS1**: Civil engineer]*

*“I reckon BIM could be an alternative to hard printed drawings” [INV15: **CS1**: Aviation engineer]*

Based on these quotes, the understanding of design information issue transcend information phase and covers other workshop phases as well. The issue is not only confine on understanding design information distributed, but it includes making full use of such information to generate solution to value study. This covers speculation, evaluation and development of VM workshop. Suggestion given from survey on technique used during speculation and factors limiting participant’s contribution in workshop process further reinforce finding made on visualisation issue. Survey result [Refer Table 68] indicates that 22.7% of respondents perceived that existing speculation technique can be improve by introducing additional technique such as :

a. *Interactive Value Management System [IVMS]*
b. *Mind mapping*
c. *Building information modelling [BIM]*

18.5% of survey respondents [Refer Table 74] also felt that their limitation to contribute during workshop process were partly influenced by the form of information presented during workshop process that relates to visualisation. This is observation is supported by their suggestion which can be summarise as follows:

a. *I could not visualise from the drawings how to solve the issue*

b. *The drawings use as reference is insufficient and rather confusing*
c. *How can I contribute when the only drawings issued during the workshop are from PowerPoint with limited visibility on the details*
d. *Coming from non-construction based professional, it take some time to understand and visualise the drawings*

This observation provide a new insight on what interviewees and survey respondents perceived as issues that were considered subtle but vital in influencing their involvement level during workshop process. No reference were made in any procedures, policies and documentation produced by MAHB on the application visualisation software to assist with the workshop process. Such initiative were in the hand of the consultants who prepared relevant design information for the workshop. Therefore, is it important to note that application of visualisation tools/software during workshop process are among factor that need to be address in improving design planning excercise in VM.

6.7.8 Workshop information attribute

This attribute consists of four first-order concepts, which are multiple source, information updates, recommendation support and distribution of information. This attribute was generated based on interviews reference made on workshop documentations in term of distribution timing, quality and sufficiency.

INV02 of case CS1 from client's organisation emphasis on the need to expand MAHB existing research of latest products, materials, construction techniques and tools to be used as reference during VM workshop. INV02 was quoted:

*"in term of supply chain management and procurement of items, the Department should **expand their work into researching within the market to be able establish a database which can be used as basis in VM workshop**. This information can be used during VM study as supportive or main information should the recommendation made by the consultants are not convincing. This effort should not be seen as lifting the trust from the consultant, **but it should be seen as mere check and balance***

exercise *to counter unproductive participants like I mention earlier." [INV02: CS1: Client]*

This suggestion was meant to provide a check and balance system during workshop process. INV02 observed that dependency on information/suggestion from appointed consultants alone can sometime become unreliable especially when they come unprepared. INV09 and INV17 [**CS4** and **CS5**] also observed similar issue in their project packages when their workshop is required to be adjourned to another date due conflicts in design documents that could not be solved:

"Sometime we experience ***conflicts between design documents during the workshop*** *that could not be solve. Our time are wasted as* ***we need to adjourn the workshop*** *to next session." [INV09:* ***CS5****: Client]*

*"the subsequent VM meeting we had with the consultant did not produce information /design /alternative to the solution citing not fully understand the required system." [INV17:****CS4****: Structural engineer]*

INV05 observed on changes in airport master plan were not incorporated in VM workshop reference documents for **CS1**:

"Yes, there are plenty of information. Except when the NAMP [National Airport Master Plan] committee ***making changes to the projection which might not be forwarded to us during the airport planning period****. The changes refers to the annual projection which might change in accordance to the activity of each states in the country." [INV05:* ***CS1****: Client]*

Suggestion made by INV02 indicates pro-active measure on part of client's organisation in improving VM workshop delivery. Apart from that, this ensures that updated information was used during workshop processes, which ensure decision made comply with relevant requirements. This effort [i.e. initiate own information database for VM workshop] is observed to be feasible due to numbers of client's representative across all VM workshop of the case study consist of in-house professional experts from various backgrounds [i.e. engineers, architects, quantity surveyors, construction managers].

Workshop information related to participant's own preparation prior to workshop phase contributed toward the overall VM workshop effectiveness as observed by some interview respondents. They observe that time were wasted during workshop process when some participants come unprepared and lack of documentations to be used during workshop [INV16, 17 and 21]. There is no survey result that could confirm on this issue apart from those cited interviewees. This is due to the assumption made at the outset of VM workshop where consultants are expected to prepare for the workshop. Therefore, such finding is considered insignificant to this research.

Timing of workshop information distribution is crucial across all VM workshops. INV23, 24 and 25 raised their concern on limited given during workshop to study all information. This was due to timing where workshop information is distributed and time allocation.

*"the duration given to understand all information against the duration given is really limited. I can only skim down the information at a glance without having opportunity to go through in details." [INV23:**CS6**: Quantity Surveyor]*

*"If information is distributed earlier prior to workshop, I have more time to immense with the information and come prepared to the workshop." [INV24: **CS5**: Interior designer]*

*"Information were given during the information phase, with just 1.5 hour to digest. I just listen to the consultants presentation." [INV25:**CS5**: Green technology specialist]*

On average time spent for every workshop phase is between 1 hour to 1.45 hours [Refer Table 87]. This slot contain several workshop activities the comprises of studying design information, tackling issues and decision making process. Activities are compressed within short period of time and therefore participants requires more time for them to make necesssary preparation prior to the workshop. Result from survey on timing of workshop information distribution confirmed on this issue. Table 53 indicates that 65.9% of workshop information were distributed during workshop phase of value management study. This suggests that 65.9% of respondents were using the allocated 1-1.45hours of their time to study the information and proceeding with other workshop activities. Only 34.1% have experienced information were distributed prior to workshop phase. Based on this triangulation, it can be summarised that CS5 is obviously fall under category where information were distributed prior to workshop phase due to its project complexity. The remaining cases CS1, CS3, CS4 and CS6 did not specifically address this timing; however, result from survey is sufficient to indicate timing of information distribution is conducted during workshop phase as reflect in document analysis summary.

6.7.9 Decision making attribute

This attribute relates to how workshop participants involved in the decision making process that affect VM outcome and construction process on-site. Communicating findings made from VM workshop and factors that influence decision-making are observed to be vital elements for VM workshop.

The first element observed is the comprehensiveness of information used during workshop in bridging communication between workshop participants [INV02, 02 and 13]. INV02 highlights that inclusion of workshop participants from non-construction background that may have benefitted from complete information. INV02 refers to the client's Legal unit representative that was present in case CS4 as part of participants but was appalled with complexity of information but have limited consideration on legal aspects. Similarly, INV13 observed that communication of relevant information by all consultants are crucial for the team to make decision:

"At 30% , there is a planning on what type of systems to be used for the project. for instance, types of air conditioning. But this planning exist in the mind of the consultant, so they have to present during the workshop (to us MAHB). So the MAHB

will then discuss and make further decision based on the planning presented by the consultant." [INV13: CS1: Facilitator]

The completeness of information is part of decision making yet, a structured approach to making decision and liabilities attached to it are also important aspects that interviewees observed to be crucial in their workshop. In Speculation and Judgement phase, INV18 suggest for alternative technique to be used replacing brainstorming:

*"I think we should move away from the brainstorming and find other techiniques to assist participants during Speculation and Judgment phase" [INV18: **CS4**: Geotechnical engineer]*

INV08 and INV17 were concerned on the techniques used during Judgement phase specifically:

*"Despite having criteria matrix system, we hardly used those forms. We stick to the old fashion discussion and consensus style of decision making. What's worry me is that no basis for such decision is recorded in the report. When any issues pop up on site that prompt for reasons behind such decision, we dont have the answer to it" [INV08: **CS5**: Client]*

*"Some decision were made through discussion and consensus instead of hard technical tools or technique" [INV17: **CS4**: Structural engineer]*

Alternative technique during workshop phases is analysed and triangulated in Section 6.7.3 [Control Mechanism attribute] of this chapter. However, specific tools that were used by workshop participants during Judgment phase were not reflected in documents analysis of all VM reports. Based on the analysis result, all cases did not use both form 4a and 4b that refer to "*Criteria Weighting Matrix forms*" as indicated in Table 112.

Table 112 Criteria weighting matrix application

Forms List	*CS1*	*CS3*	*CS4*	*CS5*	*CS6*
Form 4a	*No*	*No*	*No*	*No*	*No*
Form 4b	*No*	*No*	*No*	*No*	*No*

However, it is observed that the approach of discussion and consensus were used to make decision during this phase as highlighted by INV17. Despite discussion and consensus are deemed to be alternative techniques as suggested by the facilitator, reasoning behind each decision made from the workshop process should be clearly reported in VM report. Cross check with all VM reports, no specific justifications were made to support VM workshop proposal. This leads to INV15 observation on effect of such decision has on the project at later stage.

INV15 raises a relevant observation on the liability attach to each individual proposal made during VM workshop process:

*"One thing that make me wonder about the decision made during workshop is the liability of the recommendation. Although its made by the team, but if things goes wrong during later stage, we need hard evident to justify why we make such decision at the first place" [INV15: **CS1**: Aviation engineer]*

This observation were based on experience that were faced by **CS1** project package when VM proposal made during the workshop are not supported with sufficient information and justification of such proposal:

*"We experience a time when we need to revert to the orginal design prior to VM workshop due constructability issues. But when we try to investigate reasons behind such decision made during VM, we couldnt find solid justification for such move." [INV02: **CS1**: Client]*

Results from triangulation for this attribute clearly indicates that there several components that affect decision making process in VM workshop. The completeness of information and structured approach to decision making influenced participant's involvement level during the workshop as well as creating liability to the proposal. The impact fulfilling this component requirement is two-fold; firstly it assist for high-level of interaction among participants to contribute and secondly it promote accountability for the workshop team as a result of the liability the made from the proposal.

6.7.10 System thinking attribute

This attribute was built upon observation made on the need to have a system thinking approach within the workshop environment. This attribute emerges as a result of analysing all interviews without any relationship with document analysis or survey result.

System thinking that was observed across all cases was considered minimal. This is due to numerous references made by interview respondents on concerted effort by all parties to comply to cost cutting of the existing design. However, limited reference was made on the strategic part or implication of the proposal has to the supply chain or airport system at large.

The lack of system thinking itself is observed in case CS5. The parallel working session during Speculation, Evaluation and Judgment phase has received numerous responses concerning its effectiveness. This is observed by INV14, 20 and INV18 [CS4] who commented on CS5 parallel session:

*"Having a parallel workgroup system in VM will create a gap in connecting ideas developed between each separating workgroup" [INV18:**CS4**: Geotechnical engineer]*

*"I think parallel session is good approach but if we have too many groups and all work in isolations, its really hard to know whether our proposal match up with others" [INV14: **CS5**: Architect]*

*"What is the point of having parallel session when there is not enough representation of consultant for each group. Plus, we were quite isolated from the other group and difficult to know whether our proposal affect other groups' ideas" [INV20: **CS5**: Architect]*

The isolation of working groups itself in CS5 was seen as slowing down the workshop process due to lack of connection of proposal made between groups as observed by INV25:

*"We only focus to solve commercial space allocation in design and somehow missed the ergonomic part of user comfort in the airport. Due to that, we backpedalled during the speculation phase and start looking back at other interacting system within the design [INV25: **CS5**: Green technology specialist]*

The parallel working groups approach is a good technique that increases focus on design planning by breaking design components into several working groups. However, the setback observed were on the connection between each group that seem to be working on their own. The impact of this loose connection has disregarded the integration of their proposal with other working groups. Continuous effort of working in isolation group increases the chances of failing to view workshop issue in a bigger picture. Interviews transcripts that were analysed demonstrate concerted focus on "hard" workshop issue instead of the "soft system" at the outset of the project package.

INV09, 15, 21 and 24 are the only interviewee respondents who observe the need and importance of system thinking in VM workshop environment. They were quoted:

*"The design of Aerobridge although it cost the air carrier (end-user) additional cost, but on the other hand it help to cater for less disable airport user." [INV09: **CS5**: Client]*

*"I didn't notice anyone raise an issue about construction duration and supply chain of such proposed ideas. They merely weight against the cost/benefit and decide from there." [INV21: **CS3**: Architect]*

*"If the team view the issue from the outset of the project (i.e. in larger scope), I think we would be having different direction for our workshop" [INV24:**CS5**: Interior design]*

Such observation and consideration on having to look issues in larger scope may have escaped from all cases due to other factors that influence VM workshop process as analysed from Section 6.7.1 – 6.7.9 of this chapter. The divergence of workshop culture, participation, lack of control mechanism on participants and problem-solving, visualisation that influence creativity and decision making, knowledge as well as timely workshop information are proven to be too much to consider apart from system thinking. What has been highlighted by INV15 in CS1 has shed some positive lights on the need to consider broader perspective when approach design planning in VM workshop:

"Although in this workshop we strive our best to achieve objective for our client, but we also need to consider long term effect of our decision at the back end (i.e. construction phase) of our project. [INV15:CS1: Aviation engineer]

Chapter 7: Discussions

7.1 INTRODUCTION

In Chapter 6, results from analysis and findings were summarised as 10 key attributes that drive multi-disciplinary involvement in design planning during a VM workshop. Findings were made based on analysis across all five cases [CS1-CS6], where VM workshops on airport design planning were conducted. This section will now further discuss these attributes within the detailed context of the VM workshop and its associated processes. There are four research questions that are specifically addressed in this chapter are as follows:

1. *To identify factors that influence participants' involvement in VM workshop during design planning phase of a construction project.*
2. *To examine the form of human interaction and decision-making process between VM multi-disciplinary participants that attempt to solve workshop issues.*
3. *To examine the impact of human interaction and thinking process has on construction processes of projects.*
4. *To develop a framework that governs decision making for design planning of a project from human aspect perspective.*

Results from all five case studies based on the survey, document analysis and interview transcripts, have generated a vast amount of information. Using these data sources, observations and analysis were carried out that determine the application of VM in terms of contribution to the design planning process is influenced by two major aspects, which are human and system. The human aspect focuses on how workshop participants react, participate, are involved, contribute and make decisions throughout the workshop, within the context of the design planning phase of a project. The way in which the system aspect influences and supports the levels of response of workshop participants during workshops was also examined.

Discussion is divided into three major sections, the first two being human and system aspects of the VM workshop process. The third section focuses on the inter-relationships that these two aspects have on the VM process. The individual attributes generated from this analysis are grouped together under each of the following sections.

7.2 HUMAN APSECT IN VALUE MANAGEMENT

Human aspects in a VM workshop play a significant contributory role enhancing the effectiveness and outcomes from the study. The human aspect is characterised by an organized and facilitated team approach comprised of individuals with their related job function (Kelly et al. 2004; Shen and Liu 2003). The involvement of multi-disciplinary participants from various backgrounds increases the opportunity to improve design-planning activities and is one of the key factors that contributes toward the success of VM studies (Dell'Isola, 1982; Kelly & Male, 1993; Norton & McElligott, 1995). However as observed, the involvement of a multi-disciplinary team alone in a VM workshop does not guarantee the subsequent success of a project. Findings from this research on this issue are that multi-disciplinary team involvement is influenced by several attributes that drive the ultimate contribution towards the workshop process.

The case study conducted in MAHB across all project packages [CS1-CS6] observed that there are four key attributes that influence how workshop participants respond to the consideration of design planning during a VM workshop. These attributes are participation, culture, creativity and knowledge.

7.2.1 Participation

The concept of ‘participation’ in VM was introduced by Leung et al. (2003), it emphasises critical attention on the human factor within the VM workshop environment. Their study (bid 2003) shows that there is a high degree of correlation between participation and decision-making in the VM process. However, their study also observed that this was confined within the behavioural context of workshop participants and mainly consisted of attributes such as job satisfaction, job commitment, team cohesiveness, decision quality and conflict resolution. Findings made from the analysis revealed that participants' membership roles in the workshop partly influenced the form of their participation levels during workshop. Despite the possibility of multi-disciplinary involvement indicating multiple views of the issue together with a focus on a shared objective, this notion was observed not to be realised based on the findings made in this research.

Clear role identification was observed in this research, for instance, consultants (who made up 56.8% of total workshop participants) were seen to be acting in their capacity as consultants through initiating new ideas during the workshop process. However, out of these, only 29.5% believed that their personal function in the workshop was to generate solutions for the design planning while 13.6% of them saw themselves attending the workshop in order to obtain more information about the project packages. The client's side (34.1%) assumed the responsibility of evaluating information/findings made during the workshop. The remaining 9.2% made up by the facilitation team only saw themselves as purely there to facilitate the workshop process. It was also noted that there was limited inter-role exchange between workshop participants, the majority of whom preferred to remain within their own specific professional responsibilities and acting only according to their own personal function. One of the interviewees stated that:

"Participants only speak when it involves items under their responsibility" [INV24:CS5: Interior Designer]

This finding is consistent with that of Leung et al. (2003) and relates to job commitment. Commitment to their job and its responsibilities that is held by individual participants influences the way they participate during the workshop process. Workshop participants across all cases were observed to be working within their job scope boundaries and making less connection of their ideas with those of other professions. Quantity Surveyors participate primarily on matters that relate to the financial aspects of the project, while designers are only focused on the design of the project. This finding is generally viewed in a positive light as each individual in a VM workshop is treated as a subject matter expert and the collective participation of the group allows for a much wider perspective of solutions to be derived for one single issue (Kirk, Turk and Hobbs 2002).

Despite the rigidity of the discipline role-playing, the mix of participants does increase the chance of examining issues in wider perspective, but there were also some limitations found, which limit their levels of involvement. The survey results revealed that time constraints, dominant participants and visualisation were amongst the main limiting factors. The findings from interview results add to this list with limited participant experience, lack of preparation prior to workshops, self-confidence levels and complexities of information during the workshop phase, together with workshop time constraints. These limitations were observed across all cases. Out of five cases observed, only one case [CS5] conducted a two-day workshop, while the rest were all one day duration. On average, each of the phases allocated for these workshops was within 1.0 to 1.45 hours. For CS5, more time was allocated to the front-end of the workshop, the pre-workshop and information phases took 19 hours to get workshop participants well informed about the project. However, related to remaining phases of the workshop [Speculation and Judgement], all cases spent similar average times of between 1.00 to 1.50 hours.

The phenomenon of dominance among participants across all cases replicates findings made by Shen et al. (2004) who observed that individual dominance in discussion and interaction during the workshop process affected the levels of participation and team spirit among participants. The third factor that limits participation levels during workshops, based on survey results, indicates a unique response. The majority of respondents claimed that complexity of understanding technical information in terms of visualisation and comprehension during workshops affected their participation. Findings from interviews further reinforced this visualisation limitation in terms of causing difficulty to relate existing issues of the study against the information presented during the workshop.

The mediums used to communicate design information across all workshops were consistent based on the documents analysis results. Drawings, specifications, procedures, policies and by-laws were used as part of the overall workshop information. However, the forms of presentation of the design in the case of complex projects needed more than just physical drawings according to interview respondents. They observed that the inclusion of more dynamic tools when presenting information during the VM workshop lead to better understanding and involvement levels among participants. No complaints were observed concerning the sufficiency of information distributed for workshops, concerns were raised purely on the medium used to deliver the appropriate message. One of the interviews noted:

"...a comprehensive presentation is essential for all participants to understand the whole situation. There are instances where participants are confused on the information presented due to the complexity of the information and the way it being presented. With due respect to the nature of the project under study and consultant technical background, some important aspect of information which is easily for non technical people to understands are also important." [INV03: CS3: Client]

This issue was raised more prevalently amongst the non-technical workshop participants, although they were significantly involved in providing non-technical input during workshops. For example, INV03 representing MAHB's commercial department [with no construction technical background] was able to give input on commercial spaces but she found it difficult to be involved in workshop discussions due to her having only a limited comprehension of workshop information provided. This led to her decision to stick purely to facilitator instructions and being one of the relatively silent participants who only spoke when they were specifically asked a question.

Although multi-disciplinary participation and involvement brings in a wider perspective on design planning issues, findings from the analysis indicates that further improvement is required to existing VM practice to overcome issues such as have been mentioned above. It can be observed that the significance of individual role-playing in workshops had minimal impact on the levels of participation among workshop participants. Despite the negative connotations expressed regarding time constraints, it didn't actually affect the levels of participation. However, the involvement of technical and non-technical participants during design planning is inevitable when a complex project is involved, and thus more attention should be paid to ensure streamlining of information used during the workshop that caters for both technical and non-technical participants; this could significantly increase the levels of participation among workshop participants.

7.2.2 Culture

According to Parker (1998), conformance to proper patterns, customs or methods is categorized as forming a series of “Cultural Blocks” that can impact on the creativity of the VM process. Confirming the findings from the literature review, the interviews also captured evidence of the same barrier elements from participants of the workshop. 19.4 % of the respondents disclosed that their ability to contribute ideas in the workshop was limited due to the superior-subordinate relationship existing in the workshop environment. Interview respondents particularly observed this situation during the Speculation and Judgement phase of the workshop. Respondents were questioned further to identify what they perceived as being the main cultural blocks to the creative process in workshops. The respondents stated that although they believed that workshops encourage positive dynamics among participants, there was an acknowledgement that of reluctance amongst participants to fully engage in the discussion. This was due to a perception of needing to adhere (and not to exceed) the levels of authority that they represented.

I accompanied my boss to this workshop and I had one recommendation, which I thought suitable to address the design problem. Out of respect to my boss, I kept quiet, as he didn’t speak out on the issue during the workshop. After exhausting all ideas, one senior participant recommended the ideas that I had in mind and all participants accepted the recommendation. [INV23: CS6: Quantity Surveyor]

The scenario described above was not imposed by the workshop, but instead was a self-imposed restriction and arose out of adherence to a cultural protocol. Such cultural barriers indirectly hamper the creative process in VM workshops, which are built upon open a communication concept and a learning paradigm. The researcher observed that there are two factors, which contribute significantly to the self-imposed cultural blocks on participants; these are (a) age, and (b) level/position in the organisation. In relation to the age factor, one respondent remarked that:

"To my surprise one of the good ideas came from a person not affiliated to any particular professional background, and also he is a junior executive" [INV3: CS3: Client]

The age factor generally affects participants at junior staff levels, who are still new to the construction industry. Because the younger participants hold a subordinate position, it was observed by respondents that respect to a higher superior should be adhered to. Conversely, the elder respondents with higher seniority did not face any such issues with the cultural blocks faced by younger respondents. Instead they had problems dealing with dominant participants who tended to try and force others to agree with their views and refused to accept the views of others in the workshops. As a result, they directed their comments to, and imposed their views on, the less experienced participants in order to be able to convince them (and others) to accept their suggestions.

"We respect the aspiration of the junior staff in this workshop but we need credible people on board as the project is of national interest. If they could come forward and justify their ideas convincingly and using supported facts, then we don't see why their ideas can't be accepted." [INV10:CS6: Client]

Green (2007, pg.651) commenting on the diffusion of knowledge in VM practice found that there is "no universally accepted codification that extends across institutional networks". He is of the opinion that a professional who engages in a VM workshop normally diffuses knowledge according to his or her institutional representation with little inter-institutional connection. This research supports Green's view (2007) where several references from respondents were made regarding the institutional attachments that exist among workshop participants. Resistance to accept criticism of, and changes to, designs, the stereotypical perception of VM as only a cost cutting tool, dominant participants who always perceive their opinions to be correct and different interpretations of the workshop issues are amongst frequently cited issues. This suggests that workshop participants are actually thinking and acting within their institutionalised boundaries and will only permit minimum interference from other workshop participants. Such a cultural perspective reflects their own professional institutional views, which are only focused on one side perspective paradigm. Despite the aim of VM being to achieve shared values and benefits for the client, the cultural blocks described before are clearly still a major dilemma among workshop participants. An example observed in case CS6 was of a participant pushing to defend his design and giving little room for criticism:

"I don't see any flaws with their knowledge, skills or rather experience, but how they disperse the ideas and getting people to agree with them sometime I find it disturbing. As if there their ideas worth than the others. This does not includes those who has good ideas but find it difficult to explain their thought to others and leaving others to try to direct the discussion to reach understanding" [INV10: Client]

Dominant participants and stereotypical perceptions of VM are probably going to always remain attached to VM. This finding is consistent with that of Shen et al. (2004) who found that dominant participants influence interaction amongst all participants during the workshop process. It was observed across all cases that 28% of the respondents feel that the facilitator's own professional background has indirectly impacted their perception of the need for utilising the VM methodology. The majority of the project packages were facilitated by a professional with a Quantity Surveying background. The stereotypical thinking often links the QS involvement in VM with a cost cutting approach prevailed in the perception of 28% of the respondents. Although an investigation of the relevant VM reports of one particular case study [CS1] clearly indicated an attempt at minor cost saving, but this was overshadowed by the major design improvements that resulted from the workshop. The responses related to facilitation methods and to how a workshop is conducted have proven to support that stereotypical thinking still exists amongst many practitioners in many of the cases in this research.

The important finding concerning the different interpretation of the workshop issues by participants is a serious cause for concern. This concern arises as it was found that the majority of workshop participants indicated that for each issue discussed during workshop, their contribution almost unilaterally referenced their affiliation to their institutional attachments. For instance, the Architects generally expressed ideas through the lenses of design solutions, aesthetic value and user-friendly designs, while the Engineers focused more on safety measures with a lot less emphasis on the aesthetic value. Workshop participants were observed that they rarely contribute to problem solving that transcend their owns' professional affiliation and remain within their own boundary. This is due to their respect to other profession who are subject-matter expert and believe that each individual has its own capacity to diffuse their professional knowledge towards the design.

The pressure to conform in workshop, as suggested by Shen et al. (2004) is very much in the hands of the facilitator. One workshop participant rated the influence of the facilitator as the highest contributory factor to workshop process rand success, regardless of which phase the workshop was being conducted in and said:

*"My facilitator handle our session really well. Despite dominants participants and concerted effort by certain consultant pushing for their ideas, he managed to retain the dynamic in our workshop" [INV22 : Case **CS5** : Quantity Surveyor]*

This example is just one of the representative observations made regarding the facilitator's influence during the workshop process. Clearly many respondents felt that the facilitator's influence plays an important role in design planning workshops and studies across all cases observed. The existence of multi-disciplinary professional involvement, which should provide a positive impact, seems to diffuse ideas and solutions generated from participants because they are drawn from within their own institutional attachments thus making different interpretations of workshop issues and somehow pulling the workshop focus away. Differences in opinion and superior-subordinate stigma add to the pressures to conform to one particular way of doing things. The leadership role assumed by the facilitator is the only way out as perceived by the workshop participants in getting back to grips with the real issues of importance. That said, the role and facilitation style adopted by facilitators is beyond the scope of this research and therefore more detailed exploration into this facet of VM workshop issues will be the focus of future research.

In summary, the culture attribute of VM workshops in design planning is highly influenced by the participant's institutional attachments, ways of seeing things and pressure to conform to one particular institutional influenced view of the focal problem being examined in the workshop. Individuals' contributions remain within their own professional responsibilities with minimal cross-profession reference. The positive side of this culture attribute is that individuals respect others' expertise levels and experience, however, the limitation observed is perceived to be in gaining more respect from dominant participants for others, irrespective of their position, personal attributes or working experience.

7.2.3 Creativity

Creative problem solving, the ability to think creatively and indulging in 'out-of-the-box' thinking are indispensable elements of a value management study (Mandelbaum and Reed 2007; Ellis, Wood and Keel 2005). It is the idea-producing process that focuses the VM workshop in generating as many solutions as possible to particular issues. The benefits of the creative problem solving process were observed across all cases where particular attention was placed on the creativity, techniques and participants' individual traits that influence the creativity process. The findings made transcended across the Speculation, Judgement and Development phases of VM workshops.

The workshop process appeared not to impose any restrictions on participants' creativity in solving issues during workshops, because of the provision of equal opportunities to voice out their opinions. Participants did not face any issues with lack of opportunity to provide their own solutions to the design process. However, it was observed that as well as each individual participant diffusing their ideas through the lens of institutionalised attachment, their personal functions in the workshop were also accounted for. Survey results indicate that there is significant correlation between personal functions against participant's membership roles in the workshop. High correlations were observed from the consultants group, where their role is to initiate new ideas during workshops. Consistent results were also observed amongst the client's group where their role focuses on evaluating information received during workshops. Additional functions included providing, seeking and coordinating information as well as generating ideas during the workshop process.

The relationship of this finding to the finding described earlier on the creativity of workshop participants should be viewed beyond the realm of the ‘hard’ revised solutions made on the design planning itself. It has to be expanded to also consider the inclusion of participants’ previous knowledge and experience into the creative thinking process. As suggested by Parker (1998, p.91), creative thinking techniques offer assistance to a mental process in which past experience is combined and recombined to form a new combination which will satisfy a need. Several interview respondents demonstrated an application of past experience into the current workshop process and one was quoted as saying:

*“I try to replicate my past experience into this project in attempt to solve design problems. I could see that previous experience in airport design planning exercise has helped to challenge other participant’s thinking in finding best solution for single issue” [INV18:**CS4**:Geotechnical Engineer]*

The imparting of past experience into a current workshop also has a connection with participants individualisation traits. Survey results also revealed that higher percentages were recorded against the concept of tacit knowledge being frequently used across all three phases of a workshop [Speculation, Judgement and Development]. Apart from relying on physical information [i.e. drawings, specification, procedures, by-laws, etc.], tacit knowledge exerts great influence on participants’ creativity in solving design-planning issues in VM workshops. This reflects similar observations made by Polanyi (1962) as cited in Lam (2000) where it was concluded that a large part of human knowledge is tacit and 83% of construction knowledge is not written down in any form, but lies within the experience of the experts themselves (Song et al. 2009). The creativity of participants was observed to combine their tacit knowledge and personal function during the workshop, thus making a significant impact towards design planning across all cases.

Brainstorming is the most frequently used technique across cases that used the Evaluation Comparison technique and ‘ideas hitchhiking’ to support the creative thinking process. Despite consistent application of this technique across all cases, participants raised concerns on the limitation of brainstorming techniques. They expressed a view that the technique leaves too much freedom in the hands of participants to generate ideas that may ultimately prove to be less effective. Respondents felt that there is a need to introduce some form of guidance or structure to assist workshop participants to be as creative as possible during the use of this technique. The idea of a ‘free-wheeling’ session and ‘no-judgment rule’ in the Speculation phase for instance should be undertaken within some form of boundary that limits the generation of ideas that may not add value. This is inconsistent with the findings of Fong et al. (2001) where the effectiveness of the brainstorming process can be assessed through a ratio of numbers of ideas generated against the numbers of workshop participants present. The accumulation of a quantity of ideas was not of great concern amongst workshop participants across all cases, however, they did perceive that when a project is too complex in nature, a framework for creative thinking needs to be evolved. Relatively, respondents perceived that a framework or set of guidelines was not meant to curtail ideas generated; however it should be seen as setting the limits on how focused solutions can be generated.

Another crucial point observed with regard to the creative thinking process was the limitation that participants experienced during the VM workshops. The control of workshop participants required more attention according to comments received on all cases observed. Although participants complied with the no-judgment rule during the Speculation phase, there were instances noted that were limiting the effectiveness of participants’ creativity process. The distraction comes from the workshop participants themselves who distracted each other by having non-related conversations, regular coffee breaks and demonstrated non-verbal gestures towards any ideas proposed that they thought were unworkable or impossible. This limitation however is considered to have minimal impact on the creative process and relates more to the personal attitudes of workshop participants. However, in case CS5, the running of a parallel session during the Speculation and Judgement phases indirectly affected the creative thinking process among participants. Parallel sessions whilst observed to provide undivided focus towards particular issues, at the same time loose the connection with other working groups. This situation was raised graphically by one respondent who felt that despite his group working to find s good solution for the design, they needed to appoint one member of their working group to get information from another group to decide and assess whether this other groups’ proposals/solutions would affect their group’s proposal.

The affects of creativity on design planning of a VM workshop are highly influenced by the diffusion of the tacit knowledge of the actual workshop participants. The brainstorming technique although used across all cases were observed to be ineffective due to the way it was generally conducted. The free-wheeling and no-judgment rule don not affect participants' creative thinking, however, the introduction of a proper structure to guide the creative process is perceived to be able to increase participants' mental processes and focus.

7.2.4 Knowledge

Understanding the design process and knowing what information is required for specific design activities is important in order to effectively utilize construction knowledge in design (Pulaski and Horman, 2005). This is also what has been observed across all cases. The majority of workshop participants had been working in the construction industry for a substantial period. 84.1% of total respondents had experience of attending VM workshops in their previous projects with almost half of them attending a workshop of a similar nature to the existing project [i.e. KLIA airport design planning]. The amalgamation between working experience and VM workshop experience across all cases observed indicated a positive result in terms of adequate workshop experience representation.

The only exception that was observed with regard to knowledge attributes was in the comprehension of VM workshop processes and techniques used. Many respondents were of the opinion that the application of Functional Analysis [FA] during the workshop was rather difficult as a method for them to understand. Respondents were quoted as having concern on how FA works to solve workshop issues using two-word abridgment and FAST diagrams. They found it difficult to follow the process and mostly left it to a facilitator to take the lead and they then followed that lead. This finding is similar to finding made by Ellis et al. (2005) in the UK and Spaulding et al. (2005) in Australia. These authors observed that workshop participants had difficulty making sense of FA and often misused, or even avoided, it due to a lack of knowledge. The appreciation of FA and how it works is relatively relying on individual's capacity itself (SAVE International).

Workshop participants were observed as needing (but taking) instruction when the application of FA was applied to analyse issues from the design. Participants only fed information during the construction of the FAST diagram, question prompts and two-word abridgment. On the other hand, facilitators were of the opinion that such a lack of understanding is a non-issue for them as they perceived that the participants' expert opinions about the existing design solution were far more important than their appreciation of the FA itself. They would rather take the responsibility to construct the FAST diagram themselves and take the pressure off the participants. Despite such a response, participants perceived shared equal knowledge about the workshop process is essential in VM, which in turn encourages healthy interaction among participants. They prefer the problem-solving and creative process to be carried out in a two-way direction where participants fully understand their own and each other's actions during workshop.

Further analysis of this issue revealed that the majority of respondents having difficulty in comprehending FA were from the external VM team. In this case, they were appointed consultants who were working on the project, but were external to the MAHB organisation. Internal MAHB's staff (e.g., in-house consultants and SMEs) had no issues with FA due to the initiative taken by the MAHB to train through VM courses. Although the majority of respondents had experienced VM workshops in their past projects, the struggle with comprehending the FA process still exists across current cases observed.

7.3 SYSTEM ASPECT OF VALUE MANAGEMENT

The system aspect of VM focuses on the non-human related organisational and managerial content of VM workshops. It involves methodology, procedures, application of techniques and value-added practices. Three attributes were placed under this category that were observed to be significantly affecting VM practice across cases.

7.3.1 Information

Kelly, Male and Graham (2004) suggested that facilitators should compile and distribute all information pertaining to the workshop ahead of the workshop phase. This allows for necessary preparation on part of workshop participants prior to workshop phase. Observations were made across cases regarding this situation. Only case CS5 was observed to have distributed workshop information during the pre-workshop phase due to the perceived complexity of the project package itself (the design of Main Terminal Building [MTB]). The remaining cases experienced workshop information being distributed only during the Information Phase.

The timing implication of such information distribution was further analysed among workshop participants and from the results of the VM report analysis. Many of the interview respondents claimed they had limited time to study and make necessary preparation for the workshop based on the information distributed during the Information phase. Cross analysis revealed that on average, 1.00 to 1.45 hours were spent on this phase. Breakdown of activities during the Information phase was observed across all cases and subsequently analysed. The Information phase is where the presentation of the project package by relevant consultants is involved, briefing by facilitators on workshop objectives and targets, and finally the conducting of the FA. The compression of all activities to fit in within 1.00 to 1.45 hours justifies the concern of respondents about the time constraints. Unlike other VM practices as suggested by SAVE International (2007), and Kelly, Male and Graham (2004), there is a dedicated Functional Analysis phase that focuses on performing an issues analysis of the project. This allows for more time being spent on information presentation and study of such information.

The extent of information distributed in workshops across all cases was almost identical. Drawings, specifications, procedures, by-laws, VM manuals, consultants' presentation slides, Gantt charts and cost plans mainly comprised information used during VM workshops. Although it can be argued that participants who are involved in all workshops are the actual consultants to the projects and therefore they are considered to be familiar with the nature and complexity of the project information, however, results from the research suggest the opposite. There are still workshop participants who find it difficult to comprehend information distributed due to time constraints. This is observed mainly among participants who are internal to MAHB but do not possess the necessary experience or background in construction. Thus, the time they took to comprehend such information and make connection with their role as workshop participants was minimal.

Information distributed by clients and facilitators at VM workshops relates to the project packages under study. However, any discussion of design issues that requires commitment to finding new supporting information was observed to be only under the responsibility of the consultants for the project. This scenario is observed to occur during the Development phase of a VM workshop. One of the workshop participants interviewed, who represented the client's organisation, noted the use of additional measures in CS3, where in-house consultants were required to conduct a similar information search based on new ideas generated as an outcome from the VM process. The aim of this was to enable check and balance between consultant's proposal and the participants' own findings. The reasoning behind such an initiative was further justified by the respondent where she experienced a workshop that needed to be adjourned for an extensive period of time due to consultants persistently not producing supporting information to support the VM outcomes.

The issue of the information attribute in design planning can be summarised into two contexts. The first context is a concern with the client's management of the VM workshop through appropriate planning and preparation. This includes timely distribution of information prior to the VM workshop phase and consideration of the time taken by participants to understand such information. Secondly, during the Development phase, the engagement of client in-house consultants for preparation of supporting information, which increases the sense of shared responsibilities and values among workshop participants.

7.3.2 Visualisation

Workshop participants are an entity of the construction project that are involved from inception right up to the eventual hand-over of the project. Their position in the VM workshop is crucial in setting the direction for the project outcomes. The degree of interaction of workshop participants can somehow be significantly affected by the tools and techniques used, and information circulated.

The dilemma faced with regard to the limitation of time to comprehend information distributed during workshops also affects other attributes according to this research. Visualisation is one of the crucial concerns that were observed. Workshop respondents were given limited time during workshop phases to familiarise themselves with information content and make full use of such information to assist them with decision making and creative thinking. The time constraints coupled with complexity of information distributed added up to create pressure to conform to workshop demands. Workshop participants felt that such a compression of activities and complexity of information influenced the way the workshop objectives were communicated to them, which in turn affected the success of their participation.

Communication of information was observed to be one of the key factors that workshop participants perceived as seriously affecting their participation. Physical drawings [architectural, engineering, systems, etc.] and specifications, which are used across all cases, alone are not sufficient to demonstrate and communicate the entire design planning scheme for a complex project. Communication of design therefore affects workshop participants and prevents them from fully engaging in discussions and making sense out of information. Overall, the majority of workshop participants were looking for an improved information delivery system that would enhance their participation during the workshop process.

Accurate information assimilation by participants influences workshop processes throughout all phases of the workshop. The Information phase uses information to describe the nature of the issue of interest, problems to be studied and the overall design planning of the project. The Speculation phase uses information to find possible solutions to study problems through the generation of ideas. The Judgment phase uses information to make comparisons between existing designs and short listed potential solutions, while the Development phase focuses on using such information to redevelop existing (or develop new) designs. The issue observed from the research, in summary, recognised that poor comprehension of workshop information by workshop participants during the Information phase had indirectly affected their participation levels, and had significantly negatively affected the entire workshop process.

Adoption of a different approach to only utilising the traditional drawings and specifications in VM workshops, in terms of bringing in information technology [IT] applications (are viewed as the way forward among workshop participants. They assert that IT, particularly using software that visualises design and other relevant associated and integrated project information, could assist in reducing participants' time spent comprehending design information. Such an innovation is perceived to be an effective solution to current problems considering e short period of time generally allocated across workshop phases of the existing case study. The ability to communicate design information in real-time and 3D, increases participants' engagement, creativity and participation during the workshop process.

According to Yee, Walker and Menzfield (2012), in the field of design research, the purpose of visualisation comprises three contexts: *"(a) for reflection and exploration, (b) as a tool for analysis and knowledge generation and (c) as a communication, facilitation and discussion tool"*. Visualisation serves to assist decision makers by facilitating them to visualise the future outcomes of their decisions. Taking the context of Yee et al. (2012) observations into the current research, the application of visualisation tools is expected to increase workshop participants' involvement during the workshop process. The three contexts share similar characteristics to the traditional VM process where exploration of issues, knowledge generation and communication building all exist within the VM study environment.

Apart from communicating design information to workshop participants, the application of real-time visualisation is also perceived to promote two-way interaction between the designer and other workshop participants. They could therefore more easily provide suggestions and feedback during workshops through the facilitated approach where changes could be made and visualised instantly. This notion on the application of IT in VM was first introduced by Green (1997a) through his *Participative Information Management Strategy* [PIMS]. PIMS was built upon an integration of IT at the most strategic level of VM and use of a 'soft system methodology' to promote shared understanding and commitment among workshop participants towards the design process of a project. However, in the field of VM, there is still limited exploration of IT applications within the workshop environment, apart from the use of the *Group Decision Support System* [GDSS] (Shen & Chung, 2002), the *Group Support System* [GSS] through *Interactive Value Management System* [IVMS] (Fan & Shen, 2010; Fan, et al., 2008; Fan, Shen, & Lin, 2007; Shen, Chung, Li, & Shen, 2004) and data mining in VM (Shen, et al., 2008). Such previous research leans towards creative problem solving through the application of software that assists workshop participants to make decisions. Findings with regard to visualisation from this research points to the use of IT applications from the perspective of better presenting design information, and acting as a supporting technique to increase participation and shared understanding amongst workshop participants.

In summary, visualisation is not confined only to the depicting of overall design schemes beyond the three-dimensional. Current advances of technology have pushed the boundaries to incorporate other aspects of the design, which includes construction sequencing, equipment access, work accomplished and problem areas (Alshawi & Underwood, 1999). One of the key observations made about the use of visualisation is on the benefits to be derived from the application of *Building Information Modelling* [BIM], which is observed to be a future development that research can be undertaken on.

7.3.3 Constructability

Analysis of key outcome as perceived by respondents' areas across all cases has produced four top concerns, which are:

- *Improvement in development scheme*
- *Alternative design solution*
- *Construction method*
- *Cost saving measure*

Interview results expanded this list into much more detailed components of which the outcomes are shown in table 113 as follows:

Table 113 VM outcomes summary

Specification	Design form	Electrical system
Mechanical system	Project function	Space function
User comfort level and ergonomics	Design performance	Delivery and construction planning
Supply chain	Airport system integration	Facilities management

The expansion of such outcomes for recommendation to approving authorities after the VM workshop phase requires a much greater consideration of these aspects related to project delivery. It is observed that workshop participants focus on generating design solutions throughout the workshop process based on distributed information and application of specific tools and techniques to assist with the decision making process. However, the approach of studying and analysing design information across all workshops was conducted based only on a discussion of issues without a structured way of analysing how to actually approach the design planning process. One of the interviewees was quoted as saying:

" we normally end up looking for opportunities within the drawings to improve rather than a proper frameworks that guides us. Like a constructability checklist for instance" [INV05: CS1: Client]

The constructability concerns raised in this observation seem to be missing from the reports of the case study workshops. Concerted efforts were made by participants to introduce various design solutions during workshops, however, less attention was given towards the parameters required to construct such design solutions. The search for opportunities within the design itself were only generally conducted from the perspective of cost reduction, where participants are more concerned about generating possible savings rather than improving the constructability of the design. A scenario was observed in one of the case studies where the outcome made from the VM workshop was reverted back to the original design, prior to the next VM workshop, due to proposed changes failing to consider constructability of the design.

There are two major findings that arise from use of this attribute in improving design planning process under a VM study. Firstly, it allows the inclusion of construction experts either internal or external to the study team increases the chances of getting value-added constructability feedback from the decisions made at the workshop. Although one may argue that the workshop participants are already considered experts in their own field, results obtained on the participation attribute suggest a variance to this notion. Each individual in the workshop performs based on their institutional attachment and rarely gets involved in an inter-profession contribution. Secondly, structured constructability guidelines are suggested during the workshop process. This would set a limit, boundary and attributes that need to be reviewed when gathering design information for, and discussing and using it, during the workshop process. Such infusions are relatively subjective where the structure could be a 'live' document that merely acts as a guide for development of discussion and decisions, but not as a '*one-size-fits-all*' document. Therefore, both suggestions are perceived to be a good starting point from which to improve current VM practices.

7.4 INTER-RELATED ASPECTS OF VALUE MANAGEMENT

This section will discuss attributes generated from the analysis that have a dual relationship with both the human and system aspects of VM. The function of these dual attributes affects the performance of each aspect individually and so they should be seen as driving factors for the overall attributes of VM in design planning.

7.4.1 Decision Making

VM was built upon the premise of a structured decision making approach that adds value to the project functions. The structured approach has been observed across all cases in this research, which demonstrates that positive measures are being taken in making all decisions. Each individual phase has its own approach and techniques that are used to assist with the creative thinking processes and decision-making. Presentation techniques were used during the Information phase, brainstorming during Speculation while discussion and consensus were used during Judgment phase. Despite the completeness of information, the timing of its distribution, visualisation, creativity and culture also all play important roles that influence decision making; this gives a strong indication that the approach being currently taken in MAHB's VM implementation is moving in the right direction. It is observed that all VM workshop outcomes were implemented during the construction phase of the KLIA2 project, the exception of one case where the design from the VM workshop outcome needed to revert back to the original design. However, in this case, the evidence suggests that the team itself has followed an appropriate decision making process despite several issues having to be faced along the way.

The approach of applying a discussion and consensus approach across all cases has promoted the concept of shared understanding among workshop participants. This finding reflects Green (1997) notion on GDS, as it recognises workshop participants making sense of situations in different ways, and yet invariably needing to ultimately act in a collective manner. Green (1994) stresses that VM makes no pretence at finding optimal answers and it is more concerned with establishing a common decision framework around which the design team can think and communicate. Constructing a shared perceived reality is a key driving factor in VM which is oriented through a team-based approach in designing (Green & Liu, 2007).

Although use of a GDS managed to push through all recommendations made during the VM process, there is one issue that was observed to be a dilemma faced as a result of using this practice. The issue of liability towards the any VM outcome was never highlighted during the workshop process across all cases. This issue became evident when one of the cases studied was facing an issue with the proposed outcome whereby it needed to be reverted back to the original design. Investigation were made to trace the reversion decision from VM reports and amongst construction personnel, but no clear reason could be found as to how or why the decision was made in the first place. Such incidents suggest that a form of shared responsibility and liability needs to exist within VM workshops alongside shared understanding.

7.4.2 Control Mechanism

This attribute arose based upon consistent references being made across all cases on the need to have appropriate structures in place to control workshop processes and participants' interactions. It was observed from all cases that workshop phases were adhered to in accordance with the procedures stated in the MAHB's VM Manual. Key decision points were reached and decisions made using appropriate techniques and tools before moving to the next workshop phase. Application of tools and techniques during the workshop process requires more flexibility with regard to adapting to particular study situations and specific design problems. This has not been the case found in this research as all cases observed used consistent tools and techniques to analyse different sets of circumstances in the VM studies.

Comparing between cases CS5 and CS6, where the former focuses on Main Terminal Building and the latter on a new sewerage line, similar techniques were used to analyse different sets of design issues with varying degrees of complexity. Workshop participants in CS5 observed the limitations of such techniques and suggested using some alternative techniques as described in an earlier discussed attribute [Visualisation]. The degree of project complexity itself is crucial as participants are often required to study all drawings and make necessary value added solutions to the existing workshop issues where the project is not a simple one. Parallel sessions, as observed, can provide relief of pressure to that participants feel considering complex issues, but still the minor issue of not integrating ideas across all working groups is actually holding the VM process back. On the other hand, CS6 (the design of new sewerage line), with less complexity also adopts similar VM techniques and approaches but still spends the same amount of time for Judgement and Development phases as CS5. This leads to participants complaining about the severe time constraints that they faced while attending VM workshops. The pressure to conform to little time and need to therefore use standard techniques and ending up doing the same thing regardless of how complex the projects were, needs critical review and treatment to find a way forward.

The working culture that exists within the workshop environment itself also contributes significantly to VM outcomes requiring better control mechanisms to be applied by the workshop organiser. The 'cultural block' that exists among workshop participants means that often they are actually shying away from the possible exploration of new design solutions from an integrated multi-disciplinary perspective due to the need for cultural (institutional) adherence. Each individual participant assumes their own preferred particular membership role and works within their institutional attachment, making less connection with decisions beyond their professional judgement capacity. As a result, dominant participants often take the lead in discussions and solution proposals, while the rest provide minimal input. In this situation, the facilitator is perceived as a ‘saviour’ from this situation in most of the cases observed. However, when it comes to large and complex project packages such as CS5, the control possibly escalates within each working group. The inability to control all working groups in an integrated way at the same time is crucial to controlling workshop effectiveness.

Hunter and Kelly (2007) stressed that the pressure for shorter VM workshops emanating from clients was increasing. Striking a balance between project complexity and a short allocation of workshop time from the client is an arduous dilemma to juggle. The acknowledgement of different working cultures and approaches to be taken into account when organizing a VM study, the pressure for shorter versions of VM studies and workshops has increased the need for research into finding a more productive VM model (Hunter & Kelly, 2007a; Lenzer, 2001; Thiry, 2001). Design planning of a project is a complex task that demands a high level of strategic thinking while at the same time needing to maintain the rigour of ensuring that nothing is missed out from the planning. Therefore knowing the correct approach, tools and techniques to be used for particular kinds of value studies is crucial in ensuring better control over workshop outcomes.

7.4.3 System Thinking

The stereotypical paradigm of VM being just a cost cutting exercise still exists among the workshop participants of this case study. This is proven by the reported concerted effort in the design planning process by way of looking for opportunities to re-design and reallocate space with the aim of attracting a cost reduction. Such a motivation is denied by the research participants, but the actual VM activities conducted in workshops suggests otherwise. Isolation of working groups, multiple understanding of similar workshop issues, looking for opportunities within design, space allocations based on revised GFA [Gross Floor Area] and setting cost targets at the beginning of the workshop leads to this paradigm being a reality. A classic example was noted in case CS3 where the VM recommended design was reverted to original design due to its poor constructability.

This issue was not entirely the responsibility of workshop participants alone, but resulted in part from the VM organisational system within MAHB. The majority of survey respondents were of the opinion that VM study for all cases was initiated as a form of *Standard Operating Procedure* [SOP] to comply with the *3PG*, *FLOA* and *Quality Manual* documents. In this case, the driving factor for the VM workshops in the first place was due to complying with such policies. This also suggests that VM workshops within the MAHB environment are actually treated as a routine exercise. The effect of complying with such policies increases the chances for projects to obtain approval from the financier and thus makes them more viable in the eyes of the stakeholders. But what is not present in this reality is the process of 'sense-making' of the design-planning problem (Thiry 2000). Concerted efforts were made to improve the existing airport design by introducing various 'hard' design solutions designed with the hope of reducing cost. However, such activities were found to have missed capturing the crucial design issues in a broader perspective and taking into account the full and relevant implications. The value study of the airport design actually lends itself to a 'hard system thinking' approach, thus making it more relevant to a Value Engineering approach built within a *positivist* paradigm (Green 1997b). This contrasts starkly with the theories of Thiry (2000) who asserts that allowing for sense making time in workshop permits a broader paradigm of thinking that leads to collaboration between participants, thus making the outcomes of the workshop more relevant. This notion was first derived from the work of Green (1997) on the *Soft System Methodology* [SSM] that views workshop problems from the lenses of the social constructivist. It is an acknowledged fact that human activity systems are subject to different interpretations from different points of view, each of which are equally valid.

Addressing the need for project improvement through VM that extends beyond the procedures of the requirement itself, is part of applying SSM into an existing VM methodology. This is where the driving factor for objective attainment is 'value improvement' rather than cost reduction. Such a notion should exist within MAHB's organisation when planning for VM workshops that involves a high degree of complexity. Assessing the needs of workshops from different perspectives could attract higher commitment among workshop participants, which in turn leads to a higher degree of participation. Allowing for participants to look at issues from a wider perspective and using an alternative application of tools and approaches, encourages a system-thinking process that views ‘problems’ as part of an overall system rather than as sub-components of the system.

System thinking in the VM workshop encourages the workshop organiser, client, facilitator and participants to view workshop problems in a wider context. The effect and connection that each component of a design has on other sub-components, as well as its integration with them, are all encapsulated within design planning activities. This underpins the need for undertaking a VM study rather than just engaging in a just a cost cutting exercise. Consideration of this aspect needs to be incorporated within MAHB’s procedures on VM when deciding on the need for a study. Relying on a financial threshold clause to permit a VM study may indirectly lend itself more to a traditional Value Engineering exercise rather than a VM study. Therefore, the system thinking itself should be the driving force for application of VM within an organisation based on seeking value improvements, rather than just cost savings for their projects.

7.5 FORMATION OF FRAMEWORK

This research based on an analysis of the VM application in design planning through multi-disciplinary involvement, has summarised ten attributes that influenced the way workshops a organised. The influence that these attributes have on a VM workshop governs the organiser’s planning, facilitation style, paradigm, interaction, tool and techniques, and control over the design planning process. Key attributes generated are summarised in the following Table 114:

Table 114 Finalised attributes

Attributes	Descriptions
System Thinking	Understanding of workshop needs that govern overall workshop process and outcome
Control Mechanism	Structure that govern workshop system and human interaction
Decision Making	Structure that govern decision-making process
Culture	Understanding of working culture diversity of participants
Knowledge	Provision on knowledge management within workshop structure
Creativity	Application of appropriate tools that support creative thinking process
Participation	Understanding of participants' dynamics and participation
Information	Provision on control and supply of workshop information
Constructability	Provision on structured constructability review in workshop
Visualisation	Provision on visualisation techniques for design communication

The generation of these attributes based on analysis has found certain inter-related attributes that are dependent for governing a VM workshop. Such dependencies and inter-relationships are further clustered together to form a framework that can guide future VM workshop organisation. The framework that was created from this process is illustrated in Figure 20 as follows:

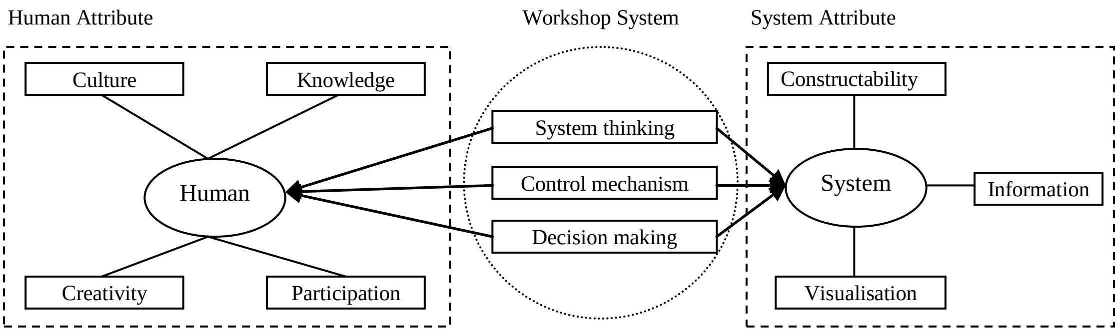

Figure 20 Preliminary framework

7.5.1 Evaluation and validation of framework

The generation of the attributes and subsequently the development of the framework as a result of the research data analysis process still need to be validated. This research adopted the use of an expert panel as its validation method that used survey questions to obtain feedback and comments on research findings made.

The survey was conducted through use of open-ended questions distributed to an invited panel of experts. The panel consisted of working professionals, academicians and facilitators who are involved in the field of VM. Ten invitations were sent but only five experts consented to participate in the validation process. Table 115 indicates the respondents involved with the validation process:

Table 115 - Validation Panel Members

Respondents	**No.**
Value Management Facilitator	1
Architect	1
Academician (Quantity Surveying & Value Management)	2
Contractor	1

The validation process required panel members to review the generated attributes and preliminary framework against a set of criteria. The criteria were aimed to assess whether the attributes and framework are sufficient to (a) support the research objectives, and (b) the possible future practical implementation of the framework. The criteria against which the research was validated were as follows:

1. Attributes and framework addressing research, problems, aim and objectives.
2. Clarity of attributes description
3. Terminology
4. Relationship between attributes
5. Practical application of framework
6. Framework design

Each panel member received a copy of the survey questions, a summary of the research project, attribute descriptions and the preliminary framework design. The survey responses returned by the panel members were analysed to incorporate the suggestions and comments made for the improvement of the framework.. The feedback received from panel members demonstrated a positive response on the findings made. However, all panel members offered suggestions for improvements to be made to the design of the proposed framework to increase understanding for future VM workshop organisers.

7.5.2 The Framework

Based on the feedback received, revisions were made to the framework in improving its design to better communicate the message to future workshop organizers and participants of all the required attributes an improved multi-disciplinary team involvement. The overall terminology used was retained, but the layout of the framework was revised as indicated in the figure that follows:

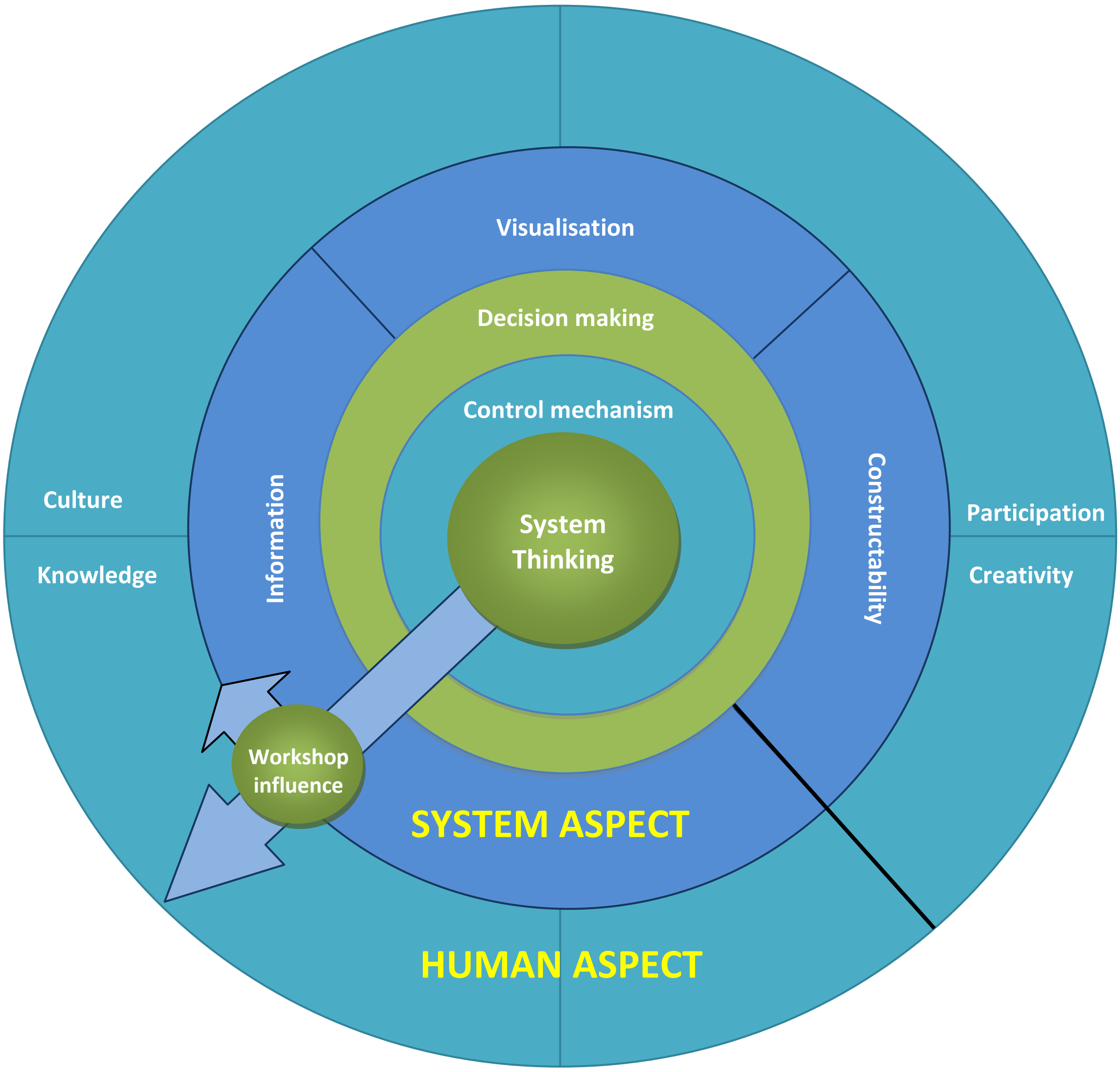

Figure 21 The revised framework

7.6 SUMMARY

The application of VM on design of construction projects focused on it's application at the front-end phase is faced with multi-dimensional challenges. The design planning process that incorporates VM as an approach to add value to existing designs is influenced by various factors that can significantly affect workshop outcomes. These outcomes will then be translated into the physical construction on-site based on information and designs developed from the preceding VM process.

The effectiveness of communicating VM outcomes from the planning to construction phase of a project requires strategic planning and high-order thinking processes. This is where the application of VM in the design planning process needs to adapt to changing demands and flexibility of design to support the construction process on site. Having a standardised VM methodology is proven to be insufficient based on cases analysed in this research. The rigidity of the VM methodology as practised on the case study needs to be relaxed to suit the differing nature of projects examined under a VM study.

The creative and decision making processes in VM workshops across the research case studies observed were affected by attributes that shaped workshop governance, participation, interaction and outcomes. Multi-disciplinary involvement through the workshop process played a significant role in deciding the overall workshop outcomes. However, this contribution is somehow affected by the way a workshop is organised, managed and applied to suit specific project situations.

Findings made from this research have revealed ten attributes that influence VM workshop organisation and that involve multi-disciplinary team involvement. These attributes cover two major aspects of VM workshop management that are the human and system aspects. Each aspect was highly dependent on the other, which impacts significantly on the overall VM workshop outcomes. Based on these attributes, a framework has been designed to support future VM workshop organisers in considering all of the relevant multi-dimensional factors that can influence the VM process when considering the design planning.

Chapter 8: Summary and conclusions

This research uses a multiple case study approach and the research design is exploratory based on constructivist paradigm that studies multi-disciplinary participant involvement and interaction during the VM workshop process. The data collection method consisted of a survey, document analysis and semi structured interviews. Six case studies [inclusive of one pilot case] were selected within the on-going construction project packages of an international airport in Malaysia. 25 interviews were conducted across all cases amongst the construction project teams that were involved in various VM workshops as participants. As a result, this study identified various attributes prevalent in the examined VM workshops and used the analysed data and attributes to develop a framework that will guide future organisers of VM workshops focused on construction project design planning. This last chapter will summarise and conclude the research process and assimilate the findings made.

8.1 CONCLUSION FROM RESEARCH QUESTIONS

This research was initiated to examine aspects contributing/hindering multi-disciplinary involvement during VM workshops focused on the design planning of construction projects. According to the extant and recent literature, involvement of multi-disciplinary teams in VM workshops is indispensable and has been proven by numerous previous research studies. This research takes another step forward in looking at multi-disciplinary team involvement from both the human interaction and thinking process standpoints. Four objectives were set at the beginning of this research that consists of:

1. *To identify factors that influence participants' involvement in VM workshop during design planning phase of a construction project.*
2. *To examine the form of human interaction and decision-making process between VM multi-disciplinary participants that attempt to solve workshop issues.*

3. *To examine the impact of human interaction and thinking process has on construction processes of projects.*
4. *To develop a framework that governs decision making for design planning of a project from human aspect perspective.*

In attempt to fulfil these objectives, three research questions were designed to guide the researcher in investigating the topic in greater depth. The following subsections will discuss findings made in terms of answering these four research questions, which were:

1. *How the design planning process of a construction project is conducted through Value Management workshop?*
2. *What are the factors that influence human interaction and decision-making process of VM workshop participants?*
3. *How does multi-disciplinary participant involvement in a VM workshop affect the outcomes of the planning and design of a project?*
4. *What are the impact of these interactions and decision process through VM has on the subsequent construction phase of a project?*

8.1.1 Research Question 1

The process of design planning involves multi-disciplinary stakeholder involvement that goes well beyond normal construction project team activities. The stakeholders involved comprise of technical and non-technical participants involved in addressing all the design requirements and construction planning needs for the project. VM workshops conducted for the case studies undertaken for this research were driven by the policy needs of the client (MAHB) that set the threshold value of projects, which necessitated VM studies to be undertaken. The VM process operated in the MAHB formed part of the Standard Operating Procedure [SOP] for every new project initiated, in order to gain approval from public and private financial sources. Each project needs to complete a VM study in order to increase value for the project while at the same retaining optimum development costs for the client. Thus, the completion of a VM study is part of the overall requirements for a project to be approved by the client top management to permit further development.

Across all cases observed, the conduct of the VM process adhered to the internal procedures issued by the client's organisation. The operation of such procedures complies with the National Guideline on VM conduct and is also consistent with international VM standards.

The design planning process as observed across all case studies went through all phases of the workshop. The VM workshop approach as operated across the case studies shared similar characteristics with the Charette described in chapter 2, where the point of intervention was taken as VM4 after a concept design had been produced. Although procedural documents analysed do not make specific reference to adopting a Charette approach, the conduct of the workshop itself in terms of participants, approach and timing resembled a Charette. There were three main groups of workshop participants, which are clients, facilitation team and consultants and within the group itself, the facilitator and client were treated as the internal team while the consultants were external. The involvement of the client during the workshop created an authoritative driver for the workshop participants as well as the in-house consultant representatives of the client organisation. However, the existence of the internal and external teams was not reflected in the extant or current literature. The emphasis in the literature reviewed emphasised the external team as having no direct involvement in the design process. However, external in the context of the case study VM workshops relates to the access to VM support systems in terms of training opportunities and knowledge transfer, these will be discussed relative to Research Question 3 in a later section.

Key participants in workshops generally consisted of client, facilitator, airport planner, airport technical team, project consultants, specialist, local authority, airport commercial representative and legal representative. Each of the cases observed contained an almost similar representation of participants.

During the workshop phase, it was observed that there was a consistent application of similar tools and techniques across all cases. Functional analysis was used during the Information phase to identify the specific study problem(s) and ensure that workshop participants were at the same level of understanding on project issues. Presentation and brainstorming techniques were used to generate ideas and solutions to problems identified during the Information phase. Out of five cases, only one case [CS5] adopted a parallel session for studying the design planning issues. This process involves breaking workshop team into several working group with specified system/elements of design. The separation of participants into working group corresponds with technical requirements of the design system/elements. Is it observed that such approach was taken due to the complexity of the project package that consists of main terminal building design.

Drawings, specifications, policies, procedures and statutory by-laws were used as the main workshop references. Airport planners and consultants took turns to present and run through all design information during the Information phase to assure same level of understanding among all workshop participants. Functional analysis, brainstorming, ideas evaluation and decision-making were made consistently in line with the VM methodology. Despite the appropriate methodology and approaches having been adhered to, the design planning issues studied in the case study depicted different paradigms and perspectives from the way workshop process and outcome produces. The design planning exercise in these VM workshop(s) depicted a cost cutting exercise based on the conceptual design. This was apparent where all cases used drawings purely to find opportunities to reduce construction costs, instead of focusing on improving project delivery on-site. Secondly, it was also observed that the reduction of GFA was targeted at the outset of the VM study and then used as point of reference to reduce design and space allocations within the drawings. Improvement to airport passenger planning and integration of various systems to support airport running were also incorporated into the overall solution but the cost factor was most definitely the main focal point that drove the workshop process.

Brainstorming was the main idea generation technique used across all cases. However, findings among workshop participants revealed that the technique itself lacked an appropriate structure to guide participants to be fully engaged in providing substantive contributions during workshops. This was particularly so when the project packages being considered involved many complex elements and interfaces that required specific guidance to assist with problem solving. The level of freedom applied in the brainstorming process was acknowledged by respondents , but the fact that there were no boundary limits to the process meant that workshop participants felt the need to rely solely on the facilitator’s leadership instead of self-initialising their own contributions and ideas. Several factors were also observed to have influenced the use of the brainstorming technique in workshops, where ‘cultural block’ and ‘institutionalised attachment’ driven thinking remained relatively dominant throughout the process.

The VM outcomes were observed to have purely focused on achieving cost reduction instead of design improvement that would better facilitate the construction process. Many of the responses from workshop participants indicates that relatively less attention was given to how each proposed design was going to be built but instead more weight was place on the percentage saving that could be generated. In summary, the process of design planning using the VM workshop methodology, as investigated in this research has adhered fully to the MAHB’s policy requirements and application of the preferred and legislated standard VM methodology. The conduct of workshops actually reflects and simulates a Charette approach that normally focuses on conceptual design and involves the facilitator, client and design team. The only difference in the VM workshop focus in the cases examined in the research was that the workshop teams generally put more emphasis on cost reduction than on design improvement and / or the subsequent ease of airport construction and operation. Despite the involvement of various stakeholders who could probably add value to the entire design planning process, the outcomes achieved by all case workshops suggested the opposite.

Factors contributing to such observations are discussed in the following sub-section, which also includes some suggested improvement measures that could be practically implemented in future VM studies.

8.1.2 Research Question 2

Researchers in the VM field constantly reiterate that applying a structured approach to define project function is at the heart of the VM methodology. The structured approach relates to the style of workshop, tools and techniques to be applied that assist participants' creativity and decision-making processes during VM workshops. Throughout this research, several factors have been identified that have influence over the way that participants interact throughout the creative and decision making processes. Two major groups of factors were identified, which are 'human' and 'system' aspects of VM.

The human aspect comprises of four attributes - participation, culture, creativity and knowledge. Participation attributes were found to influence the role-playing position of workshop participants. A dilemma exists within the observed workshop environments as participants only contribute on areas of discussion that are within their discipline and professional responsibilities and roles and thus they remain disconnected from considering and developing proposals that affect or connect them with other professions. Such role-playing is observed to limit the level of participation among workshop participants, where they are concerned solely on issues and decisions within their own professional boundaries. Participation during the Speculation and Judgment phases also affect the participants lacking a non-technical background, where if substantial improvement was made to the way that workshop information is communicated, improvements could be wrought to their level of contribution during the VM workshop process.

The culture attribute of the workshop suggested a more dynamic form of interaction but culture blocks were observed in some of the cases where the "superior-subordinate" stigma still existed among a few workshop participants. This finding was highly related to those dominant participants who tend to take a lead across major discussion activities among workshop participants. Workshop participants were also observed to be making their contributions based on their institutional representation that only allows them to perceive issues from one perspective. This leads to different interpretations of workshop issues among VM participants. At the same time, the facilitator's leadership during the workshop process was highly regarded as a motivational factor that influenced workshop participants to be fully engaged during discussions and the problem solving processes. The facilitation styles were perceived to be a driving factor for reconciling participant dynamics during discussions.

The creativity attribute focuses on participants' involvement in applying techniques and based also on their professional working backgrounds. It was found that the application of the brainstorming technique provide an opportunity for participants to expand their thinking and provide a better contribution towards solving workshop issues. However, participants perceived that there was still room for improvement on the way of conducting the brainstorming technique. The technique itself was adopted due to its methodology that focuses on generating a large quantity of ideas. Despite this positive aspect, the application of brainstorming, particularly when related to a design planning project, due to the complexity and nature of such projects, may require this technique as currently applied to be altered. Respondents felt that the introduction of a structure which can better guide workshop participants to think in a more focused manner during the brainstorming process could have set a more acceptable boundary instead of a more free-wheel based session. For instance, in discussing issues on the design of the baggage handling system [BHS], the brainstorming process could be improved through the inclusion of a checklist that provide parameters on appropriate designs to support the effective operation of the BHS. Such a checklist could provide assistance to workshop participants to facilitate thinking to produce more relevant solutions to the issues. The professional working background was also noted to be influencing participants' creative thinking levels. The majority of respondents agree that the application of their own tacit knowledge during creative and decision-making processes assisted them throughout the workshop process.

The knowledge attribute relates to workshop participants' levels of understanding of the VM application and methodology. According to the literature, participants' ability to understand and comprehend functional analysis [FA] plays a significant role in attracting them to be highly engaged with workshop discussions. In the cases in this research, the majority of respondents were found to have a limited understanding of FA, which therefore led to them being non-responsive during the early workshop and greater participation only transpired with the facilitator's leadership. Participants perceived that following the facilitator's directions and appreciating the facilitation style in controlling the workshop process assisted them when they found FA to be too difficult to make sense of. In terms of their level of VM understanding, internal participants [i.e. internal to MAHB] had no issues with the conduct of the VM workshop. This was due to existing policies offering continuous support in terms of providing training and courses on VM. On the other hand, the external teams were purely relying on their previous VM experience and the leadership of the facilitators to successfully get them through the workshop process. The level of knowledge and understanding of VM was observed to be a crucial factor that influences participants' creative and decision-making processes. This is due to the nature and complexity of projects under study that demanded a high level of engagement, which doesn't give sufficient time for a good VM learning experience. Therefore, experience and knowledge in VM is crucial to be present amongst potential workshop participants to ensure the smooth running of the workshop process.

The system aspect of VM comprises of information, visualisation and constructability attributes. These attributes influence workshop participants' involvement through the application of assisted tools, materials and documentation.

The information attributes is concerned with the timing of workshop information distributed to the workshop participants. It was observed that the distribution of workshop information during the Information phase of the workshop is perceived to influence participants' ability to comprehend information within a relatively short period of time. The Information phase was observed to run for between 1 to 1.45 hours and during this period, activities such as presentations, functional analysis, information studying and briefings were compressed into the period. This left little time for participants to become sufficiently familiar with the workshop information. It has to be noted that amongst the workshop participants were some project consultants that had been involved with the project from the beginning, therefore familiarity with information for them was not an issue. However, consideration should be given to the very different situation pertaining to the non-technical background participants who were only invited to join the discussions at a key point during design planning stage instead of having continuous involvement from the beginning.

The visualisation attribute significantly influences the way that participants view and communicate workshop issues. It goes beyond studying traditional physical drawings and understanding the documentation delivered as information during a VM workshop. The improvements suggested by workshop participants and validated via expert panel consideration were focused on a greater use and application of IT in VM workshops. This topic has been researched by several authors who investigated tools designed to assist decision-making and creativity processes. Findings from this research saw the generation by respondents of a wish list where application of Building Information Modelling [BIM], use of AutoCAD and 3D visualisation software were perceived to potentially increase participants' understanding of the workshop discussions. This was due to the ability of such software to depict complex design and other information in a more intelligible form. This reduces the time for participants to be familiar with workshop information and allows for changes to be made in real-time. The introduction of visualisation software combined with the use of a more structured guide for applying the brainstorming technique, according to respondents, provides a great opportunity for the VM workshop to test out possible proposed solutions without compromising the time and quality of the eventual output.

Constructability attributes are concerned with developing a structured method to assist workshop participants to approach design planning in terms of finding solutions that correspond specifically to buildability matters. It has been observed that much of the focus across all workshops in this research uses creative and decision-making tools/technique to encourage participants to think, however, limited references in the literature were made to studying approaches that are designed purely to promote or improve the buildability of the proposed design. The inclusion and consideration of buildability parameters in VM workshops, as an addition to existing tools/techniques, could improve participants' engagement levels. This could be included during brainstorming sessions as previously discussed, where setting of parameters that assist participants thinking directions is perceived to impact significantly on the outcomes from the VM process. The way that participants engage in the creative thinking and decision making processes requires some form of structured and flexible approach that can help to improve VM outcomes related to subsequent construction impact.

It can be summarised that there are seven attributes that affect multi-disciplinary creative and decision-making process in a VM workshop. The relationship between all seven attributes is highly dependent upon each of them and through the research validation process, it is posited that consideration and integration of all of these attributes could improve participants' involvement during the VM process.

8.1.3 Research Question 3 and 4

Workshop participants work on mutually understanding shared objectives and improving the output of the VM study. This improvement can be implemented through considering factors that influence the level of participation among workshop participants as discussed in the previous sub-section. In terms of the VM workshop from the organiser's point of view, the implementation of VM should be conducted beyond just the paradigm of cost efficiency policies that place dollar values as the major outcome. The perspective needs to extend further by considering a systems thinking approach that views the workshop study as a whole system that can affect and impact on the design planning process. The systems thinking paradigm in VM is essential in considering the whole study from a much wider perspective. Eliminating the stereotypical perception of VM as purely a set of cost cutting tools should be the starting point for a new paradigm shift. The outcome of the VM study is highly dependant on the effectiveness of the workshop participants to be fully engaged in relevant discussions, undertake creative thinking process and generate success factors as suggested by Shen et al. (2003). The ability to infuse system thinking at the outset of the VM process on the part of the organiser and workshop participants creates a different set of goals that will drive participants to make a better strategic contribution that can impact beneficially on the construction phase and operations as a whole.

Each construction project has a unique output as a result of varying degrees of complexity of different projects. The application of a standard VM methodology that applies to all forms of project packages is observed to have minimal impact on the outcomes and the solutions. This is where appropriate establishment and operation of an control mechanism for the workshop process on the part of the organiser plays a significant role in tailoring workshop proceedings according to the nature of the project. This control mechanism encompasses attributes that aim to govern the workshop process through a flexible application of tools, techniques, participants controls, interaction and appointments. The case studies of this research adopted such measures in governing the workshop process where a structured approach to decision-making is adhered to. Further future improvement may be achieved by improving the flexibility of the VM methodology when tailored to different types of projects.

Finally, the outcome from VM workshop process is based on a collective team decision-making effort. Such outcomes require a unified understanding of workshop study problems and a concerted effort to propose possible solutions for improvement. VM workshop participants of construction projects are a real asset to the client and the decisions made during the workshop process become a benefit rather than a liability for the project. The influences of workshop participants that affect VM outcomes are not only confined within the workshop environment itself, but they extend to the post-workshop phases where accountability for the workshop recommendations is considered. Consideration of the accountability and liability for VM outcomes should be made transparent within the workshop environment, in order to ensure that any future ramifications during the construction phase can be more easily solved.

8.2 RESEARCH CONTRIBUTION

This research has made several findings that are expected to benefit future VM implementation for clients initiating construction projects. The attributes identified and the framework generated as a result of the research have expanded the contribution of this research beyond the VM field alone and the following sub section discusses the contribution made by this research to the extant body of knowledge.

8.2.1 Contribution to body of knowledge

The field of VM which traces its inception back to the early 1940's has matured over the subsequent period of time. The transition of the methodology and application from VE to VM has contributed significantly in defining project function, cost reduction, improving quality and adding value to project outcomes. Over the almost seven decades that have passed since the VM methodology was instigated, many authors have researched into, or written about, the benefits and attributes of VM.

This research began with the aim of studying multi-disciplinary involvement in the construction project design planning process through the application of VM. A focus on the problem of how well the design and construction phases of a project can be seamlessly connected through proper front-end planning processes drove the study design and a case study approach was selected as the most appropriate research method to collect appropriate data. The expected deliverable is simple, and that is, identifying and analysing those factors that influence the level of participant involvement during the VM workshop process, which in turn has been found to significantly affect the workshop and VM outcomes. However, as the research ahs progressed, it has revealed through the depth of observation applied, other issues of interest beyond multi-disciplinary involvement alone.

Publications in the VM area such as those of Green (1997) on soft methodologies in VM, Kelly and Male (1998) and Fong et al. (2001) on benchmarking, Thiry (2001) on sense making, Green and Liu (2005) on theory and practice, Shen et al. (2006) on measuring outcome of VM process as well as Shen and Liu (2003) on critical success factors, have all influence the final outcomes of this research. The application of VM in construction projects viewed through the lenses of the aforementioned references leads to the conclusion that a more strategic thinking approach for VM organisers and stakeholders is crucial in conducting more effective VM studies. VM cannot entirely rely on a stereotypical hard thinking notion that is directed purely at assuring economic benefit alone, therefore as set out as a major finding of this research, by ensuring a comprehensive application of the system thinking approach, that views a project and the VM process as a whole system, it is possible to achieve better planning of construction development projects.

The contribution to the body of knowledge by the outcomes from this research can be summarised by reference to the framework generated as a major deliverable from the study, that functions as a guide for future VM organisers. The framework provides the VM organiser with key attributes that govern VM workshop management so that the focus can be entirely around the effective design planning of a construction project. The framework s of ten attributes that need to be incorporated for ensuring that decisions made during VM workshops and studies produces result that have a high probability of more smoothly bridging between design and construction phase activities.

The identification and analysis of the visualisation, control mechanism, system thinking and constructability attributes are the contribution made by this research to the extant body of knowledge in VM. The visualisation attribute focuses on the need to implement visualisation tools or techniques that encourage workshop participants to be more engaged during the workshop process and actually communicate their valuable ideas in real-time. Findings made on the characteristics of this attribute contribute significantly to the team dynamic and participation literature, as both influences the interaction between individuals during the workshop process. The control mechanism attribute contributes in term of structuring the VM process to be as flexible as possible, but at the same time still retaining its methodological rigour in controlling the workshop conduct either through its system or human aspects. This accord well with the current VM methodology literature where acknowledgement of the benefits of flexibility in VM to tailor to specific projects needs has been already suggested. The system thinking attribute contributes to the expansion of the soft systems methodology introduced by Green (1997) and sense making perspective of Thiry (2001). It works together with other attributes found in this research and establishes a paradigm for the VM organiser to think strategically on the direction and perspective of VM workshops. Finally, the constructability attribute contributes significantly in introducing a new approach to the use of VM tools and techniques within the overall workshop process. It creates an extension to the creative problem solving process and decision-making techniques by way of structuring thinking patterns to include buildability considerations during a VM design planning workshop. Such a consideration is expected to extend the perspective of VM workshop participants by ensuring that they are looking at VM study issues and seeking much broader practical solutions instead of just economic outcomes alone.

8.2.2 Contribution to practical application of the framework

The case study approach that was designed to collect information from an on-going airport construction project has provided opportunities for research results to be validated against a significant and relevant real-life project. It provides a firm basis from which to compare theories and practical applications of VM. The framework generated as a result of this research provides an important guideline for current or future VM organisers on the full range of matters that need to be considered when planning and organising VM workshops and studies.

The practical application of this framework is expected to affect future VM workshops by way of utilising the ten attributes generated from this research. Out of these ten attributes, there are two major attributes that could contribute significantly in terms of improving existing workshop process. These attributes are the new findings made for the VM body of knowledge and methodology, where inclusion of constructability and visualisation tools during workshop processes is expected to enhance interaction between participants as well as the overall participant workshop experience.

The infusion of the constructability attribute within any VM workshop process could add to the structured approach allowing workshop participants to better perform the creative problem solving and decision-making processes. One of the new features in this attribute is the application of a constructability checklist consisting of a list of design parameters that can assist workshop participants to compare and contrast their various suggestions against existing design. It also allows for setting up of clear boundaries within which to conduct workshop discussions.

Visualisation attribute could assist future VM organiser in investing on computerised visualisation software as tools to communicate design information and workshop issue. It is useful in depicting various dimensional information about the design, walk-through, costing, facilities management, construction methods and programming. This attribute was found to be essential for project that involve complex design information that integrate various system components and stakeholders. The application of visualisation software also assists in communicating design information into more comprehensible form to the non-technical workshop participants. Software such as Building Information Modelling [BIM], AutoCAD and Autodesk Revit are among the potential to be infuse within workshop environment.

8.3 RESEARCH LIMITATION

Throughout the research process, there are several issues that were faced which affect the way research is being conducted and affect its expected outcomes. The limitations that were faced indirectly limit the level of exploration of the VM workshop process in this case study. Comparison and in-depth analysis could have been done more comprehensively should these limitations are minimised.

Timing of the study

The major risk that this research faced is the planned timing of the study that coincides during construction phase of the selected case study. This affect the study timing in term of difficulty in getting respondents to spent their time for this research. The timing has slightly affect survey, document analysis and interviews appointment scheduling. Numerous interviews and survey needs to be re-schedule to suit respondent’s changing schedule and working time on-site. Since majority of respondents are currently working on-site, they have little time to be spent corresponding to this research needs due to higher priority. Risk of time limitation among respondents interviewed on-site is one of the risks that were not incorporated during the design of the case study. However, this risk is being minimised by offering to respondents multiple method of responding to this research needs.

Interviews are not necessarily to be conducted on-site, however they have the option to conduct interview through Skype or Facetime at their convenient time. This approach has proven to ease those re-scheduling of interview appointments during early stage of data collection. In the end, respondents are more focus in contributing to this research without any distractions.

Access of information

Access of information in this research is limited within the office of case study provider's main office. The organisation has a strict policy that restricts photocopying, reproducing and removing VM workshop reference documents from their office. This measure is taken to ensure confidential information is not exposed to public while the construction project is still ongoing. Information taken from the reference need to be validated by the officer to ensure only relevant information is use for the research. This limitation indirectly affects timing of the document analysis process where researcher needs to analyse all reference documents before deciding relevant information to be used. Despite this limitation, researcher is given a workstation in the Planning and Development [P&D] department with 8.00am to 5.00pm access daily throughout the data collection period. This opportunity has in turn given better access and time to spend in reviewing all documentations.

Limit of issue exploration

The exploration of VM workshop organisation in this research is limited to certain aspect imposed by the case study provider. One of the aspects in the study of VM outcome is to measure the cost impact and percentage of saving generated as a result from VM process. Numerous researchers have put emphasis on this attribute as one of VM success criteria. However, the issue of costing and savings generated from VM studies were not allowed to be revealed or use as part of analysis and reporting structure of this research or any publications. This information is treated as confidential as the project is currently on-going in which the case provider prefer not to disclose such information to public at this moment in time. Therefore, research need to address this limitation through designing appropriate interview and survey question that attempt to depict economic impact of VM outcome of this case study without revealing any figures.

8.4 RECOMMENDATION FOR FUTURE RESEARCH

There are several recommendations for future research can be made based on findings from this research in term of framework, attributes generated and replication of study.

Framework and attributes

The framework itself is a working guideline that subject to future expansion and research. Each attribute found can be further research and developed from various perspectives such as workshop critical success factors, benchmarking on VM workshop studying issues other than design planning. Further development of this framework also can be tested and expanded within sustainable construction paradigm due to its emphasis on system thinking approach that can be linked with Whole System Design [WSD].

Computerised visualisation software as introduced in this research could be expanded in studying its impact on workshop organisation [investment cost, return of investment, training, user friendly etc] and outcome made as an effect of its application. Building Information Modelling [BIM] application can further research on possibility to be fully integrated within workshop environment that can be used at VM point of intervention during construction development lifecycle.

Replicability

The methodology of this research setting in term of case study protocol and procedures can be replicated in testing others' organisation conduct of VM study. Findings made from this research are based on Government Linked Company [GLC] approach to Value Management and adhering to their own set of procedures. Application of this research setting can be tailored and expanded in studying public and private sector practices of Value Management. The results from these replications are expected to further enhance and strengthen the position of Value Management within the Malaysian construction industry.

Bibliography

Afila, D., & Smith, N. J. (2007). Risk management and value management in project appraisal. *Proceedings of the Institution of Civil Engineers: Management, Procurement and Law, 160*(2), 63-67.

Alshawi, M., & Underwood, J. (1999). *The Application of information Technology in the management of Construction*. London.

Andi, & Minato, T. (2003). Design documents quality in the Japanese construction industry: factors influencing and impacts on construction process. *International Journal of Project Management, 21*, 537-546.

Anumba, C. J., & Evbuomwan, N. F. O. (1997). Concurrent engineering in design-build projects. *Construction Management & Economics, 15*(3), 271-281.

Ashworth, A. (2004). *Cost studies of buildings* (4 ed.). Edinburgh: Pearson Education Limited.

Ashworth, A., & Hogg, K. (2007). *Willis's Practice and procedure for the Quantity Surveyor* (12 ed.): Blackwell Publishings.

Belbin, M. (1993). Team roles at work, Butterworth-Heinamann, p.23

Barton, R. (1991). Value management. A vehicle for innovation in building design and construction. In (pp. 138-143): Publ by IE Aust.

Barton, R. (2001). Historical overview of Value Management. Retrieved December 12, 2009, from Institute of Value Management Australia http://www.ivma.com.au/education/papers-by-ivma-members

Barton, R., & Knott, J. (1996a). The role of VM in the strategic development and management of infrastructure in Australasia & South East Asia. *The Value Manager, 2*(2).

Barton, R., & Knott, J. (1996b). The role of VM in the strategic development and management of infrasturcture in Australasia & South East Asia.

Bernauer, J. A., Lichtman, M., Jacobs, C., & Robertson, S. (2013). Blending the old and the new: Qualitative data analysis as critical thinking and using NVivo with a generic approach. *The Qualitative Report, 18*, 1-10.

Best, R., & Valence, G. D. (Eds.). (1999). *Building in value : Pre-design issue*: Arnold.

Borza, J. (2011). FAST Diagrams: The Foundation for Creating Effective Function Models. Retrieved March 23, 2013 http://www.aitriz.org/documents/TRIZCON/Proceedings/2011-06_FAST-Diagrams-The-Foundation-for-Creating-Effective-Function-Models.pdf

Bowen, P., Edwards, P., Cattell, K., & Jay, I. (2010). The awareness and practice of value management by South African consulting engineers: Preliminary research survey findings. *International Journal of Project Management, 28*, 285-295.

Bowen, P. A., Edwards, P. J., & Catell, K. (2009). Value management practice in South Africa : The built environment professions compared. *Construction Management & Economics, 27*, 1039-1057.

Bowen, P. A., Edwards, P. J., Catell, K., & Jay, I. (2009). Value management practice by South African quantity surveyors. Retrieved February 10, 2010, from http://www.emeraldinsight.com/0263-2772.htm

Bryman, A. (2012). *Social reseach methods* (4th ed.). Oxford: Oxford University Press.

British Standard Institution. (2000). *Value management BS EN 12973:2000*. British Standard.

Burke. R., (2007). *Project management techniques*. College Ed. United Kingdom: Burke Publishings.

Bytheway, C. W. (1965). Basic function determination technique. In *Fifth National Meeting of the Society of American Value Engineer*.

Canadian Society of Value Analysis. (2013). Function analysis system technique: Fact sheets. Retrieved July 2, 2013 http://www.scav-csva.org/upload/about%20va/How_to_Read_a_FAST_Diagram.pdf

Champion, D. J. (2006). Data collection strategies 3: Interviews. In *Research methods for criminal justice and criminology* (3rd ed.). New Jersey: Pearson Prentice Hall.

Charmaz, K., & Belgrave, L. (2002). Qualitative interviewing and grounded theory analysis. *The SAGE handbook of interview research: The complexity of the craft, 2*.

Che'Mat, M. (1999). The challenges and potential of value management in local construction industry. *Jurnal Alam Bina*, *2*(1).

Che'Mat, M. & Shah, Z. M.(2006). *Value management as an effective and efficient tool for space management*. Paper presented at Value Management National Seminar 2006, Malaysia.

Che'Mat, M. (2006a). *Value management as an effective tool for organizations in making strategic decisions*. Paper presented at International Conference on Construction Industry 2006 (ICCI 2006), Malaysia.

Che'Mat, M. (2010). *Value management - the way forward*. Paper presented at Seminar on Achieving Better Value in Construction Industry Through Value Management & Life Cycle Costing, Kuala Lumpur.

Che'Mat, M. M. (2002). *Value management : Principles and applications*. Selangor, Malaysia: Prentice Hall.

Che'Mat, M. M. (2006b). *Perceptions and implementation of value management in Malaysian construction industry* PhD(PhD thesis). Universiti Teknoogi MARA, Kuala Lumpur.

Che'Mat, M. M., & Malaysia Airports Holdings Berhad. (2008). *Value Management Manual*. Sepang: Malaysia Airports Holdings Berhad.

Chen, W. T., Chang, P.-Y., & Huang, Y.-H. (2010). Assessing the overall performance of value engineering workshops for construction projects. *International Journal of Project Management*, *28*, 514-527.

Clark, R.S. (2009). Integrated architectural design. In L. Griffis, T. Helwig & M. Waggoner (Eds), *Structures Congress 2009: Don't mess with structural engineer.* Austin, Texas, United States.

Connaughton, J. N., & Green, S. D. (1996). *Value management in construction : A client's guide* Construction Industry Research and Information Association.

Constructing Excellence. (2004). Effective teamwork: A best practice guide for construction industry. United Kingdom.

Construction Industry Development Board (CIDB) Malaysia. (2013). *Tinjauan Ekonomi Binaan 2011*. Retrieved from https://www.cidb.gov.my/cidbv3/index.php?option=com_content&view=category&id=45&Itemid=387&lang=ms

Creswell, J.W. (2009). *Research design: Quantitative, qualitative and mixed method approaches*. Los Angeles: Sage.

Crosthwaite, J., MacLeod, N., & Malcolm, B. (1997). 14 Case studies: theory and practice in natural resource management. *Sustainability and Social Research*, 201.

Cyon Research. (2003). Architectural automation : Facing the challenges of work-culture. *Cyon Research White Paper*. Retrieved from

Daddow, T., & Skitmore, R. M. (2005). Value management in practice : An interview survey. *The Australian Journal of Construction Economics and Building, 4*(2), 11-18. Retrieved from http://eprints.qut.edu.au.

Dallas, M. F. (2006a). Maximising project value through integrated risk and value management. Retrieved October 15, 2009, from SAVE International http://www.value-eng.org/knowledge_bank/attachments/200606.pdf

Dallas, M. F. (2006b). *Value & risk management : A guide to best practice*: Blackwell Publishing.

Dell'Isola, A. J. (1982). *Value engineering in the construction industry* (3 ed.): Van Norstrand Reinhold Company.

Diehl, M., & Stroebe, W. (1987). Productivity loss in brainstorming groups: Towards the solution of a riddle. *American Psychological Association*, *53*(3), 497-509.

Dimitrijevic, B. (2004). Translating the brief into a design. In M. Murray & D. Langford (Eds.), *Architect's handbook of construction project management*. London: RIBA Enterprise.

Economic Planning Unit Malaysia. (2009). *Garis Panduan Perlaksanaan Pengurusan Nilai (Value Management).* Retrieved from www.epu.gov.my.

Economic Planning Unit Malaysia. (2011). *Panduan Pelaksanaan Pengurusan Nilai dalam Program/Projeck Kerajaan.* Putrajaya: Economic Planning Unit.

Edwards, W., & Newman, J. R. (1982). *Multiattribute evaluations*. Beverly Hills CA: Sage.

Egan, J. (1998). *The report of the construction task force: Rethinking Construction*. Retrieved from

Eisenhardt, K. M. (1989). Building theories from case study research. *The Academy Management Review, 14*(4).

Eliot, S. (2010). Taking notes vs recording interviews. Retrieved February 7, 2013, from http://www.qualitative-researcher.com/interviews/taking-notes-instead-of-recording-the-interview/

Ellis, R., Wood, G., & Keel, D. (2005). Value management practices of leading UK cost consultants. *Construction Management & Economics, 23*(5), 483-493.

Ellis, R. C. T., Woods, G. D., & Keel, D. A. (2003). *An investigation into the value management services offerred by UK cost consultants*. Paper presented at The Construction and Building Research Conference of the Royal Institution of Chartered Surveyors (COBRA 20063), Wolverhampton.

Fan, S., & Shen, Q. (2011). The effect of using group decision support systems in value management studies : An experimental study in Hong Kong. *International Journal of Project Management*, 29, 13-25.

Fan, S., Shen, Q., & Kelly, J. (2008). Using group decision support system to support value management workshop. *Journal of Computing in Civil Engineering, 22*(2), 100-113.

Fan, S., Shen, Q., & Lin, G. (2007). Comparative study of idea generation between traditional value management workshops and GDSS-supported workshops. *Journal of Construction Engineering and Management, 133*(10), 816-825.

Fellows, R., & Liu, A. (2008). *Research methods for construction* (3 ed.). Oxford: Wiley-Blackwell.

Ferry, D. J., Brandon, P. S., & Ferry, J. D. (2003). *Cost planning of buildings* (7th ed.). Oxford: Blackwell Publishing.

Foley, J. & Macmillan. S., (2005). Patterns of interaction in construction team meetings. *CoDesign,* Vol. 1, No. I, March 2005, 19-37

Fong, P. S.-w., Shen, Q., & Cheng, E. W. L. (2001). A framework for benchmarking the value management process. *Benchmarking: An International Journal, 8*(4), 306-316.

Fong, S. W., & Shen, Q. P. (2000). Is the Hong Kong construction industry ready for value management. *International Journal of Project Management, 18*, 317-326.

Gambatese, J. A., & McManus, J. F. (1999). The constructability review process: A constructor's perspective. *Journal of Management in Engineering, 13*(3), 93-94.

Ghani, A. M. A. (2004). *Value management practice in Malaysia : The Principles and method* MSc.(MSc. diss.). International Islamic University Malaysia, Kuala Lumpur.

Glaser, R., & Strauss, R. (1965). *The discovery of grounded theory*. Chicago: Aldine.

Gray, C., & Hughes, W. (2001). *Building design management*. Oxford: Butterworth-Heinamann.

Green, S. D. (1990). The essentials of value engineering. *Chartered Builder, 2*(5), 2-4.

Green, S. D. (1994). Beyond value engineering : SMART value management for building projects. *International Journal of Project Management, 12*(1), 49-56.

Green, S. D. (1997a). *New directions in value management*. Paper presented at Hong Kong Institute of Value Management International Conference: Effective Change through Value Management, Hong Kong.

Green, S. D. (1997b). A participative research strategy for propagating Soft methodologies in value management practice. *International Journal of Project Management, 17*, 329-320.

Green, S. D., & Liu, A. (2007). Theory and practice in value management: a reply to Ellis et al. (2005). *Construction Management & Economics, 25*(649-659).

Grove, R. W. (1988). An analysis of the constant comparative method. *International Journal of Qualitative Studies in Education, 1*(3), 273-279.

H.M. Treasury. (1996). *Value management, CUP Guidance No.54.* London: Central Unit of Procurement,.

Haahr, M. (2011). Random.Org. Retrieved September 12, 2011, from http://www.random.org/

Hammersley, M. (1981). Ideology in the staffroom. *A critique of false consciousness, in: L. BARTON & S. WALKER (Eds) Schools, Teachers and Teaching*.

Heidgerken, L. E. (1953). The interview method. *Nursing Research, 2*(2), 94.

Hogg, K. (1999). *Value management : A failing opportunity?* Paper presented at Construction, Building and Real Estate Reseacrh Conference (COBRA 1999).

Hollowman, C., & Hendrick, H. (1971). Problem solving in different size groups. *Personal Psychology, 24*, 489-500.

Hunter, K., & Kelly, J. (1998). Value management assistance in design-build. *The Value Manager Journal, 4*(3).

Hunter, K., & Kelly, J. (2006). The supporting factors that make VM an attractive option in meeting the best value requirements of the UK public service sector. Retrieved October 19, 2009, from SAVE International http://www.value-eng.org/knowledge_bank/dbsearch.php?c=view&id=197&ref=dbsearch.php%3Fc%3Dquery%26category%3D%26keywords%3D%26match%3D%26pg%3D14

Hunter, K., & Kelly, J. (2007a). Efficiency in vm/ve studies and the pressure for shorter workshops. Retrieved March 10, 2010, from SAVE International http://www.value-eng.org/knowledge_bank

Hunter, K., & Kelly, J. (2007b). An Integrated framework to support best value in the UK public sector. *The Value Manager, 13*(1), 3-11.

Hussein, A. (2009). The use of Triangulation in Social Sciences Research: Can qualitative and quantitative methods be combined? *Journal of Comparative Social Work, 1*.

Jaapar, A. (2006). *The application of value management in the Malaysian construction industry and development of prototype value management guidelines* (PhD thesis). Universiti Teknologi MARA, Kuala Lumpur.

Jaapar, A. (2008). *Value management study to the malaysian construction industry*. Paper presented at BEAN 2008 Conference, BEST Research Centre(Built Environment and Sustainable Technologies), Liverpool, John Moores University, UK.

Jaapar, A., Endut, I. R., Bahri, N. A. A., & RoshanaTakim. (2009). The impact of value management implementation in Malaysia. *Journal of Sustainable Development, 2*(2).

Jaapar, A., & Torrence, J. V. (2006). *Contribution of value management to the Malaysian construction industry : A new insight*. Paper presented at International Conference on Construction Industry 2006 (ICCI 2006), Universitas Bung Hatta, Indonesia.

Jones, C., & Lyons, C. (2004). Case study: design? Method? Or comprehensive strategy?. *Nurse researcher*, *11*(3), 70-76.

Kaufman, J. J. (1990). *Value engineering for the practitioner*. Chapel Hill,NC: North Carolina State University.

Kelly, J. (2007). Making client values explicit in value management workshops. *Construction Management & Economics, 25*(4), 435-442.

Kelly, J., & Male, S. (1991). *The practice of value management : enhancing value or cutting cost?* London: Royal Institution of Chartered Surveyors.

Kelly, J., & Male, S. (1993). *Value management in design and construction : The economic management of projects*: Taylor & Francis.

Kelly, J., & Male, S. (1999). *The implementation of value management in the public sector : A value for money approach?* Paper presented at Construction, Building and Real Estate Reseacrh Conference (COBRA 1999).

Kelly, J., & Male, S. (2002). Value management. In J. Kelly, R. Morledge & S. Wilkinson (Eds.), *Best Value in Construction*. Oxford: Blackwell Publishing Ltd.

Kelly, J., Male, S., & Graham, D. (2004). *Value management of construction projects*: Blackwell Science Publishing.

Kelly, J., Morledge, R., & Wilkinson, S. (Eds.). (2002). *Best Value in Construction* (1 ed.): Blackwell Publishing.

Kirk, S. J., & Leung, M. Y. (2005). Value management 'module I' 40-hour training workshop - Hong Kong and Beijing. *Value Society, 8*(7).

Kirk, S. J., Turk, R., & Hobbs, R. (2002). Value based team design decision-making. from SAVE International http://www.value-eng.org/knowledge_bank

Koskalan, M., Wallerius, J., & Zionts, S. (2011). *Multiple criteria decision making : From early history to the 21st century*. Singapore: World Scientific.

Kvale, S. (1996). *InterViews: An introduction to Qualitative Research Interviewing*. Thousand Oaks,CA: Sage.

Lam, A. (2000). Tacit knowledge, organisational learning and societal institutions: An integrated framework. *Organization Studies, 21*(3).

Land, R. R. (1997). Applications of value engineering and life cycle cost in project management. *The Value Manager, 3*(2).

Latham, M. (1994). *Constructing the team*. Retrieved from

Lawson, B. (2006). *How designers think* (4 ed.). Oxford: Architectural Press.

Leen, C. L. (2010). Saving on Cost of projects, *The Star*.

Lenzer, B. (2001). *21st Century corporate strategies to apply new value tools and techniques : An introduction to Multi-dimensional decision analysis hybrid fast modelling*. Paper presented at SAVE International Conference, Fort Lauderdale, Florida.

Leung, M.Y. & Wong, M.S. (2000) *A survey study on the major characteristics of value management*, Proceeding of COBRA 2000 Conference, RICS, U.K.

Leung, M.-y., Chu, H.-Y., & Lu, X. (2003). *Participation in value management*. Report for RICS Education Trust Funded Project, Surveyor Publication, London.

Lin, G., & Shen, Q. (2007). Measuring the performance of value management studies in construction: Critical review. *Journal of Management in Engineering, 23*(1).

Liu, A.M.M. and Leung, M.Y. (2002) Developing a soft value management model, *International Journal of Practice Management, 20*, 341-349.

Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry*. New York: Sage.

Lopez, R., Love, P. E. D., Edwards, D. J., & Davis, P. R. (2010). Design error classification , causation and prevention in construction engineering. *Journal of Performance of Constructed Facilities*.

Love, P. E. D., Skitmore, M., & Earl, G. (1998). Selecting a suitable procurement method for a building project. *Construction Management & Economics, 16*(2), 221-233.

Lovins, A., & Browning, W. (1992). Green architecture: vaulting the barriers. *Architectural Record*(December).

Maitlis, S., & Lawrence, T. B. (2007). Triggers and enablers of sensegiving in organizations. *Academy of Management Journal, 50*, 57-84.

Malaysia Airport Holdings Berhad. (2011). Site selection of KLIA2. Retrieved February 16, 2012, from Malaysia Airport Holdings Berhad, http://www.malaysiaairports.com.my/index.php?qt=KLIA2&submit.x=0&submit.y=0&nh=20&tl=64

Male, S., & Kelly, J. (1989). Organisational responses of public sector clients in Canada to the implementation of value management: lessons from the UK construction industry. *Construction Management & Economics, 7*(3), 203-216.

Male, S., & Kelly, J. (2004). A re-appraisial of value methodologies in construction. Retrieved March 30, 2010, from SAVE International http://www.value-eng.org/knowledge_bank

Male, S., Kelly, J., Fernie, S., Gronqvist, M., & Bowles, G. (1998). *The value management benchmark: Research results of an international benchmarking study*. Edinburgh: Thomas Telford.

Mandelbaum, J., & Reed, D. L. (2007). *Value engineering handbook*. Virginia: Institute for Defense Analyses.

Manzoor, F., Pheng, L. S., & Assaf, S. A. (2006). Contractor's views of the potential causes on inconsistencies between design and construction in Saudi Arabia. *Journal of Performance of Constructed Facilities, 20*(1), 74-83.

Mao, W., Zhu, Y., & Irtishad, A. (2007). Applying metadata models to unstructured content of construction documents: A view-based approach. *Automation in Construction, 16*, 242-252.

Mao, X., Zhang, Z., & AbouRizk, S. M. (2009). Enhancing value engineering process by incorporating inventive problem-solving techniques. *Journal of Construction Engineering and Management, 135*(5), 416-424.

McGeorge, D., & Palmer, A. (2000). *Construction management new directions*. London: Blackwell Science.

McGeorge, J. F. (1988). Design Productivity : a quality problem. *Journal of Management in Engineering, 4*(4), 350-362.

McGill. (2011). History of value engineering. Retrieved September 12, 2012, from Department of Mechanical Engineering, McGill University http://www.mcgill.ca/ve/history

Miles, L. D. (1989). *Techniques of value analysis and engineering* (3rd ed.): Eleanor Miles Walker.

Minichiello, V., Aroni, R., Timewell, E., & Alexander, L. (1990). *In-Depth Interviewing: Researching People*. Hong Kong: Longman Cheshire.

Mosey, D. (2009). *Early contractor involvement in building procurement : Contracts, partnering and project management*. United Kingdom: Wiley-Blackwell.

Moyle, W. (2002). Unstructured interviews: challenges when participants have a major depressive illness. *Journal of Advanced Nursing, 39*(3).

New South Wales Treasury. (2004). *Total Asset Management : Value management guideline.*

Nolan, M., & Behi, R. (1995). Triangulation: the best of all worlds. *British Journal of Nursing*, *4*(14), 829-832.

Norton, B. R., & McElligott, W. C. (1995). *Value management in construction: a practical guide*. Basingtoke: Macmillan.

NSW Treasury. (2004). *Total asset management : Value management guideline.* Sydney.

Office of Fixed and Asset Management. (1997). *Value management: It's not a good idea, it's the law.*

Value management in construction : Case Study, HM Treasury UK (2007).

Office of the Deputy Assistant Secretary of Defense for Systems Engineering. (2013). Value Engineering. from Department of Defence United States of America

Osborn, A. F. (1957). *Applied imagination* (Revised ed.). New York: Scribner.

Palmer, A., Kelly, J., & Male, S. (1996). Holistic appraisal of value engineering in construction in United States. *Journal of Construction Engineering Management, 122*(4), 324-328.

Panciuk, S. (2008). Design-build problems : Design growth. Retrieved December 1, 2009, from Canadian Design-Build Institute, www.cdbi.org/risk/pdf/ArticleEnconApril2008.pdf

Patton, M. Q. (1990). *Qualitative Evaluation and Research Methods* (2nd ed.). Newbury Park, CA: Sage Publications, Inc.

Parker, D. E. (1998). *Value engineering theory*. Washington Parker.

Pasquire, C., & Maruo, K. (2001). A comparison of value management methodology in the UK, USA and Japan. *Journal of Financial Management of Property and Construction, 6*(1), 19-29.

Pickles, L. (1999). Value management workshops - The VEAMAC debate. *The Value Manager, 5*(2).

Potts, K. (2008). *Construction cost management : Learning from case studies*: Taylor & Francis.

Pulaski, M. H., & Horman, M. J. (2005). Organizing Constructability Knowledge for Design. *Journal of Construction Engineering and Management, 131*(8), 911-919.

QSR International Pty Ltd. (2007). QSR International Pty Ltd. Retrieved November 1, 2009, from http://www.qsrinternational.com/

Robson, C. (2002) Real world research: a resource for social scientists and practitioner-researchers. 2nd ed. Oxford: Blackwell

Royal Institution of Chartered Surveyor (RICS). (1996). *The Procurement guide: A guide to the development of an appropriate building procurement strategy*. London: RICS.

Rubin, H. J., & Rubin, I. S. (2005). *Qualitative interviewing: The art of hearing data*. California: Sage Publications.

Ruddock, L., & Knight, A. (2008). Advanced Research Methods in the Built Environment.

Saaty, T. L. (1999). *Decision making for leaders*. Pittsburgh: RWS Publcations.

Sankey, J. B. (1995). The use of design charettes to enhance pratice of value engineering. In *SAVE International Conference* (pp. 48-54).

SAVE International. (1998). *Value methodology standard*: The Value Society.

SAVE International. (2001). *Value methodology standard*.

SAVE International. (2007). *Value standard and body of knowledge*: The Value Society.

Shen, Q., & Chung, J. K. H. (2002). A group decision support system for value management studies in the construction industry. *International Journal of Project Management, 20*, 247-252.

Shen, Q., Chung, J. K. H., Li, H., & Shen, L. (2004). A Group Support System for improving value management studies in construction. *Automation in Construction, 13*, 209-224.

Shen, Q., Guo, J., Zhang, J., & Liu, G. (2008). Using Data Mining Techniques to Support Value Management Workshops in Construction. *Tsinghua Science & Technology, 13*(2), 191-201. Retrieved from http://www.sciencedirect.com/science/article/B7RKT-4S56Y4V-F/2/affe93424b489354aa6ea9f97241085d.

Shen, Q., Lin, G., Kelly, J., & Sun, M. (2006). Measuring the processes and outcomes of value management studies in construction. *The Value Manager, 12*(2).

Shen, Q., & Liu, G. (2003). Critical Success Factors for Value Management Studies in Construction. *Journal of Construction Engineering and Management, 129*(5), 485-491.

Shen, Q. P., & Chung, K. H. (2000). *Overcome difficulties in VM workshop: The use of information technology*. Paper presented at 4th International Value Management Conference, Hong Kong.

Shen, Q. P., Chung, K. H., & Shen, L. Y. (2004). A group system for improving value management studies in construction. *Automation in Construction, 13*(2), 209-224.

Singh, A., & Jannadi, O. (2006). *Comparison of evaluation techniques in value engineering*. Paper presented at International Conference in the Built Environment (ICiBE), Universiti Teknologi MARA,Malaysia.

Smart, W. (1931). *The introduction to the theory of value*. London: Macmillan and Co Limited.

Song, L., Mohamed, Y., & Rizk, S. M. A. (2009). Early contractor involvement in design and its impact on construction schedule performance. *Journal of Management in Engineering, 25*(1), 12-20.

Spatz, D. (2000). Team-building in construction. *Practice Periodical on Structural Design and Construction*, Vol. 5, No. 3, August, 2000.

Spaulding, W. M., Bridge, A., & Skitmore, M. (2005). The use of function analysis as basis for value management in the Australian construction industry. *Construction Management and Economics, 23*(7), 723-732.

Sprokkereef, A., Lakin, E., Pole, C. J. and Burgess, R. G. (1995) The data, the team, and the Ethnograph, in R. G. Burgess (ed.)*Studies in Qualitative Methodology: Computing and Qualitative Research*, pp. 81–104.

Standards Australia. (2007). Value Management Standard AS4183-2007. On. Australia: Standards Australia.

Steven, D. (2004). *Strategic thinking: Success secrets of big business projects*. Kuala Lumpur Malaysia: Advantage Quest Publications.

Stevens, D. R. (1999). Value management: expanding the methodology through futures techniques. *The Value Manager, 5*(3).

Stukhart, G. (1987). Construction management responsibilities during design. *Journal of Construction Engineering and Management, 113*(1).

Tanenbaum, R. J. (2004). Value management :The objective forensic analysis tool. Retrieved October 30, 2009, from SAVE International http://www.value-eng.org/knowledge_bank/attachments/200446.pdf

Teijlingen, E. v., & Hudley, V. (2002). The importance of pilot studies. *Nursing Standard, 16*(40), 33-36.

The Institute of Value Management. (2013). Value management techniques. Retrieved July 13, 2013 http://ivm.org.uk/techniques

Thiry, M. (2001). Sensemaking in value management practice. *International Journal of Project Management, 19*, 71-77.

Thomas, D. R. (2006a). A general inductive approach for qualitative data analysis. *American Evaluation Association, 27*(2).

Thomas, D. R. (2006b). A general inductive approach for qualitative evaluation data. *American Journal of Evaluation*, *27*(2), 237-246.

Thompson, A. (1999). *Architectural Design Procedures*. Oxford: Architectural Press.

Thurmond, V. A. (2001). The point of triangulation. *Journal of Nursing Scholarship, 33*(3), 253-258.

Tilley, P. A., Wyatt, A., & Mohamed, S. (1997, July). Indicators of design and documentation deficiency. In *Proceedings of the Fifth Annual Conference of the International Group for Lean Construction* (pp. 137-148).

Triantaphyllou, E., & Mann, S. H. (1995). Using the analytic hierarcy process during decision making in engineering applications: Some challenges. *International Journal of Industrial Engineering: Applications and Practice, 2*(1).

Trochim, W. (1989). Outcome of pattern matching and program theory. *Evaluation and Program Planning*, *12*, 355-366.

Tunstall, G. (2007). *Managing the building design process*. UK: Butterworth-Heinemann.

US General Service Administration. (2013). Value Engineering. http://www.gsa.gov/portal/category/21589

Wright, S. (2004). User involvement in school building design. *Forum, 46*(1).

Yee, J., Walker, A., & Menzfield, L. (2012). *The use of design visualization methods to support decision making*. Paper presented at International Design Conference - Design 2012, Dubrovnik Croatia.

Yeomans, P. (1997). Facilitating with spirit. Retrieved October 19, 2009, from SAVE International http://www.value-eng.org/catalog_conference1997.php

Yin, R. K. (1993). *Application of case study research*. Newbury Park California: Sage Publications.

Yin, R. K. (2009). *Case study research: Design and methods* (4 ed. Vol. 5): SAGE.

Yu, A. T. W., Shen, Q., Kelly, J., & Hunter, K. (2005). Application of value management in project briefing. *Facilities, 23*(7/8), 330-342.

Zainul Abidin, N., & Pasquire, C. L. (2007). Revolutionize value management : A mode towards sustainability *International Journal of Project Management, 25*, 275-282.

Zhang, P. & Ng. F.F. (2012). Attitude towards knowledge sharing in construction teams. *Industrial Management and Data Systems*, Vol. 112 No. 9, 2012 pp. 1326-1347.

Zimmerman, L. W., & Hart, G. D. (1982). *Value engineering : A practical approach for owners,designers and contractors*. New York: Van Nostrand Reinhold.

[*Extra page inserted to ensure correct even-page footer for this section*]

Appendices

Appendix A

Inconsistencies between design and construction findings

Design Phase	Construction Phase
Involvement of Contractor in the design development phase	Lack of designer's knowledge of available materials and equipment
Lack of information	Insufficient working drawing details
Delay in preparing construction documents	Communication gap between designer and contractor
Time limitation in the design phase	Complexity of design and construction technology
Lack of Human resources in design firm	Ambiguous design details
	Shortage of construction materials
	Design errors
	Lack of coordination between parties
	Construction errors at job site
	Designers' lack of awareness about ongoing construction processes.
	Contractor's lack if comprehension of drawing details
	Contractor's lack of knowledge about new technology
	Lack of professional experience and judgment

Appendix B

Recording of information

SAMPLE

School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology
Brisbane, Australia

Case ID	
Package No:	

PROJECT	**Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang Selangor**		
VM Subject			
Client	Malaysia Airports Holdings Berhad [MAHB]	**Consultant**	

PROJECT COST			
Initial Cost	**RM**	**Revise VM**	**RM**
Savings		**Savings (%)**	

Summary

Notes

VM Obj Theme	Cost optimisation	Design improvement

Results

Project Criteria		

Design Assumptions	

Project Constraints		

Generated Ideas		
Remarks:	The soil treatment for circular portion is done by EW01 contractor	Delay the completion of perimeter road next to runaway 3 by 6 months

Action Plan	To review the groun improvement design - earthwork and pavement	**Nominee**	JP GEA (C&S)

Participants		**Division**	

Study Duration		**Location**	

VM Methodology

Information Phase		*hr*	Function Analysis	YES /NO
Creativity Phase		*hr*		
Judgment Phase		*hr*		
Development Phase		*hr*		
Recommendation		*hr*		

Study Date	

Documentation		

Design Related
Architectural

Design Related
Structural

VM Recommendation

Original Design	*Proposed Design*

Observation

Appendix C

Questionnaire Design

QUT/MAHB/Q FINAL VERSION

School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology
Brisbane, Australia

Department of Quantity Surveying,
Faculty of Architecture and Environmental Design
International Islamic university Malaysia

Malaysia Airports Holding Berhad

Survey PhD Research

DESIGN-VALUE MANAGEMENT (DVM) IN THE DESIGN PROCESS: A FRAMEWORK FOR OPTIMIZING CONSTRUCTION PROCESS

MOHAMAD SAIFULNIZAM SUHAIMI
PhD Student
School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology
2 George St GPO Box 2434
Brisbane Qld
4001 Australia
Mobile: +61430618878
Email: saifulnizam.mohamad@student.qut.edu.au

DR VAUGHAN COFFEY
Principal Supervisor
School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology

Email: v.coffey@qut.edu.au

This research aim to study the impacts of multi-disciplinary team during VM study particularly in addressing issues related to the effects of design on construction process. The objective of this questionnaire will examine the VM workshop process in reviewing the design through multi-disciplinary team participation.

This questionnaire represents part of the case study data collection. It is aimed at collecting relevant data pertaining to the conduct of VM workshop organization which includes problem solving, team composition and techniques used. All data will be treated as strictly confidential (no individual or companies will be named or identified in the research) and will be used solely for the purposes of the research studies.

Section A – Respondent's Background

A1. What is your professional background?

- ☐ Architect
- ☐ Construction Engineer
- ☐ Building Service Engineer
- ☐ System Engineer
- ☐ Civil Engineer
- ☐ Structural Engineer
- ☐ Electrical Engineer
- ☐ Mechanical Engineer
- ☐ Quantity Surveyor
- ☐ Project Manager
- ☐ Transport Engineer
- ☐ Value Engineer
- ☐ Others, please specify ____________

A2. What is your highest academic qualification?

- ☐ Diploma
- ☐ Degree
- ☐ Master
- ☐ PhD
- ☐ Others, please specify ____________

A3. What is your current position in your organization?

- ☐ Executive
- ☐ Senior Executive
- ☐ Manager
- ☐ Senior Manager
- ☐ Director

A4. How long have you been serving your current position?

- ☐ Less than 5 years
- ☐ 6 to 10 years
- ☐ 11 to 19 years
- ☐ More than 20 years

A5. Do you possess any professional certification?

- ☐ Yes [Go to question A6]
- ☐ No [Go to question A7]

A6. What is your professional certification?

- ☐ Registered Architect (Ar)
- ☐ Registered Quantity Surveyor (Sr)
- ☐ Project Management Professional (PMP)
- ☐ Registered Engineer (Ir)
- ☐ Certified Value Engineer (CVM)
- ☐ Others, please specify ____________

A7. Which type of organization that you are currently working?

- ☐ Government
- ☐ Consultancy
- ☐ Developers
- ☐ Contracting
- ☐ Multi-disciplinary
- ☐ Project Management
- ☐ Government-Link Company (GLC)
- ☐ Others, please specify ____________

A8. How long have you been working in the construction industry?

- ☐ Less than 5 years
- ☐ 6 to 10 years
- ☐ 11 to 15 years
- ☐ 16 to 20 years
- ☐ More than 20 years

A9. Have you ever participated in any Value Management (VM) study prior to this project?

- ☐ Yes [Go to question A10]
- ☐ No [Go to Section B]

Page 2 of 5

A10. Which categories of project did you participate in your previous VM study? [You may tick more than 1]

- ☐ Building [Residential and Commercial]
- ☐ Civil Engineering [Infrastructure and Highways]
- ☐ Transportation
- ☐ Aviation
- ☐ Mechanical
- ☐ Electrical
- ☐ Others, please specify ____________

Section B – Value Management Workshop Organization

In answering Section B, please refer to the **VM workshop conducted for the KLIA2 project package** as a basis for your answers.

B1. Value Management in this workshop is

- ☐ a service which maximises the functional value of a project
- ☐ an organised approach in providing necessary functions at the lowest cost
- ☐ an organised approach to identify and eliminate unnecessary cost
- ☐ a systematic, multi-disciplinary effort directed towards analysing the functions of projects for the purpose of achieving the best value
- ☐ a technique for cost reduction
- ☐ a technique for cost cutting
- ☐ a technique to assist with decision making

The objective of this section is to capture respondents' perception on the objectives of Value Management (VM) workshop conducted for the **KLIA2 project packages**. Please select your preference on the statements given below against the scale provided by ticking in appropriate box.	*Scale 5 denotes "Strongly Agree" while scale of 1 denotes "Strongly Disagree".*				
	5	4	3	2	1
B2. Value Management assists with					
identifying and evaluating the need for construction works					
identifying and prioritising the key objectives construction projects					
identifying and evaluating the major constraints and risks					
identifying and evaluating the means of meeting needs and objectives of construction projects					
improving the quality of definition project brief					
developing a shared understanding of projects goals among key participants					
ensuring that all aspects of the design are the most effective for their purpose					
maintaining a strategic focus on the client's needs during design and construction					

providing a priority framework against which future potential design changes can be evaluated					
promoting design innovation					
B3. Reason for this workshop being initiated					
Standard operating procedures (SOP) by MAHB					
As part of project development process					
MAHB's initiative to add value to projects					
Project over-budget					
Project over-design					
Project behind schedule					
Others, please specify :					
B4. The objective of this VM workshop is					
to clarify client's project objectives					
to enhance project function					
to study the viability of the proposed project					
to find alternative solution for the proposed development scheme					
to find alternative solution for design					
to find alternative solution for construction methods					
to find alternative solution to save cost					
to find alternative solution to save time					
to complete the design					
to improve communication					
Others, please specify :					

Workshop Information

B5. Is there any information about the VM study being circulated among participants prior to the workshop?
☐ Yes ☐ No

B6. When did the information about the VM study being circulated to all participants?
☐ Before workshop ☐ During workshop

B7. Is sufficient time given to understand the circulated information for the workshop?
☐ Yes ☐ No

B8. Is adequate information provided for your preparation in this VM workshop?
☐ Yes ☐ No

B9. Is there any pre-briefing being held prior to the workshop to inform participants on the objectives of the workshop?
☐ Yes ☐ No

B10. What are the resources used as reference in this workshop? [*You may tick more than 1 option*]
☐ Feasibility Study Report
☐ Preliminary Estimates
☐ Bills of Quantities
☐ Drawings
☐ Specifications
☐ Method Statements
☐ Construction Programme
☐ Site Instruction
☐ Life-Cycle Costing (LCC)
☐ Statute and By-Laws
☐ Preliminary Detailed Abstract (PDA)
☐ Cost Benefit Analysis (CBA)
☐ Others, please specify ____________________

Workshop Participants

B11. Have you been involved in a pre-qualification exercise to select participant for this VM study?
☐ Yes ☐ No

B12. What are the key factors which contribute to your selection as participant in this workshop?
☐ Professional expertise
☐ Client's representative
☐ Decision making authority
☐ Consultants to the project
☐ End-users
☐ Others, please specify ____________________

B13. What is your membership role in this workshop?
☐ Decision making authority
☐ Client's representative
☐ Facilitator
☐ Consultants to the project
☐ External reviewer (Independent)

Workshop Problem Solving

B14. What are the techniques used to assess the problem of this design in this workshop? [*You may tick more than 1 option*]
☐ Presentation
☐ Brainstorming
☐ Issue Analysis
☐ Function Analysis
☐ Spatial Adjacency Analysis
☐ Functional Space Analysis
☐ User flow analysis
☐ SWOT Analysis
☐ Others, please specify ____________________

B15. Do you think the technique selected in Question B14 is sufficient to assess the issue?
☐ Yes ☐ No, please suggest any suitable technique ____________________

B16. What are the techniques used to generate solution to the issues in this workshop? [*You may tick more than 1 option*]
☐ Evaluation Comparison
☐ Brainstorming
☐ Issue Analysis
☐ Gordon Technique
☐ Idea hitchhiking
☐ SWOT Analysis
☐ Others, please specify ____________________

B17. Do you think the technique selected in Question B16 is sufficient to generate good solution to the issue?
☐ Yes ☐ No please suggest any suitable technique ____________________

B18. In your opinion, what are the main issue of the design under study? [*You may tick more than 1 option*]
☐ Architectural
☐ Structural
☐ Mechanical and Electrical
☐ Contract
☐ Statutory Approval
☐ Project Management
☐ Land Issue
☐ Others, please specify ____________________

B19. What is your function in solving the problem in this workshop?

(Tick ☒ on appropriate box)

☐ initiating new ideas
☐ seeking information
☐ giving information
☐ coordinating information
☐ evaluating information

B20. Which personality traits describe your behaviour in solving problem in this workshop?

[*You may tick more than 1 option*]

☐ Cooperative
☐ Meticulous
☐ Creative
☐ Communicative
☐ Decisive
☐ Strategic
☐ Good tacit Knowledge
☐ Good explicit knowledge
☐ Ability to challenge ideas
☐ Ability to change ideas into action
☐ Others, please specify ________________________

B21. Is sufficient opportunity given to present your suggestion in solving the problem of design this workshop?

☐ Yes ☐ No

B22. Do you have enough opportunity to assess your suggestion in this workshop?

☐ Yes ☐ No

B23. Do you think you had the ability to enhance the quality of suggestion presented by others?

☐ Yes ☐ No

B24. Does your ability to improve your suggestion is limited due to certain factors?

☐ Yes [Go to question B25] ☐ No [Go to Section C]

B25. Which factors do you think contribute to your limitation in giving suggestion in this workshop? [*You may tick more than 1 option*]

☐ Insufficient information to generate solution
☐ Insufficient time to generate solution
☐ Limited knowledge of the issue
☐ Limited experience of the issue
☐ Limited opportunity to speak
☐ Limited decision making authority
☐ Confidence level on suggestion being accepted by others
☐ Dominant by other participants
☐ Others, please specify ________________________

B26. Which factors do you think will motivate your contribution in finding solution in this workshop? [*You may tick more than 1 option*]

☐ Sufficiency of information
☐ Sufficiency of time
☐ Knowledge of the issue
☐ Experience of the issue
☐ Opportunity to speak
☐ Leadership of the facilitator
☐ Others, please specify ________________________

B27. Do you think the current team composition is sufficient to yield good solution to the design issue of this workshop?

☐ Yes ☐ No

B28. If there is an opportunity, does this VM study requires a contribution by any other professionals?

☐ Yes, please state ________________________
☐ No

Section C – Value Management Recommendations

The objective of this section is to capture respondents' understanding on the recommendation made resulted from VM study. Please select your preference on the statements given below against the scale provided.	*Scale 5 denotes "Strongly Agree" while scale of 1 denotes "Strongly Disagree".*				
	5	4	3	2	1
C1. Key Areas of VM outcome for this workshop					
Recommendation improve understanding of the project objectives					
Recommendation enhance project function					
Recommendation improve value to the project					
Recommendation increase the viability of the project					
Recommendation provide alternative solution for the proposed development scheme					
Recommendation provide alternative solution for design					
Recommendation provide alternative solution for construction methods					
Recommendation provide alternative solution to save cost					
Recommendation with improved constructability of the design					
Recommendation with improved specification requirements					
Recommendation with improved life cycle costing					
Recommendation improved time performance of the project					
Recommendation minimise risk for the project					

Section D – Further Comments

Please state any other points which you think are important that could improved VM workshop looking into design process that have not been examined in this questionnaire

In the future, we might conduct interviews to capture deeper understanding of multi-disciplinary participation in design process through Value Management in construction projects.

I would like to take the opportunity to invite you to participate in the interview. The proposed appointment for further discussion will be structured in advance to minimize the discussion time and to maintain a standard format. Your time in sharing information about your organisation's experience is highly appreciated and will be treated in **strict confidentially**.

If you wish to participate in an interview, please provide the information below and I will contact you to arrange a time convenient to you.

Name	
Designation	
Email	
Phone	
Fax	

Thank you for your cooperation

Appendix D

Pilot Survey Checklist

School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology
Brisbane, Australia

Pilot Survey Checklist

This pilot survey intends to obtain feedback and comment on the devised questionnaire. The survey is part of data collection process on a research project involving Value Management workshop participant of a particular construction project. The aim of this research is to identify the management of activities of a value management workshop.

Your participation in this pilot survey as professional in the Value Management area is highly valueable in providing input for the improvement of this survey. The following checklist provides guideline in reviewing, assessing and completing this questionnaire. Please complete the questionnaire and provide your feedback or comment in the space allocated under each heading.

Ref	Criterias	Description
1	Language	Clarity of question. Free from grammatical errrors.
2	Terminology	Acceptable use of technical term in Value Management
3	Flow of questions	Appropriate flow of questions and questionnaire design
4	Ambiguity	Questions are free from any double-meaning/double-barrelled

5	**Leading questions**	Questions are from directing respondent to a particular direction or answer
6	**Sensitive / Negative questions**	Questions are free from any sensitive issue that may affect respondent's feeling, emotion, reputation and background.
7	**Time to complete**	Time to complete the questionnaire is reasonable
8	**Questions options**	Answers/options given for each questions are reasonable and within the knowledge of respondents.
9	**Further suggestion (s)**	

Thank you for your valueable review and feedback.

Appendix E

Interview Questions

School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology
Brisbane, Australia

Department of Quantity Surveying,
Faculty of Architecture and Environmental Design
International Islamic university Malaysia

Malaysia Airports Holding Berhad

PhD Research: Interview Questions

DESIGN-VALUE MANAGEMENT (DVM) IN THE DESIGN PROCESS: A FRAMEWORK FOR OPTIMIZING CONSTRUCTION PROCESS

MOHAMAD SAIFULNIZAM SUHAIMI
PhD Student
School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology
2 George St GPO Box 2434
Brisbane Qld
4001 Australia
Mobile: +61430618878
Email: saifulnizam.mohamad@student.qut.edu.au

DR VAUGHAN COFFEY
Principal Supervisor
School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology
Email: v.coffey@qut.edu.au

Interview Introduction

This project is being undertaken as part of PhD in Construction Management for Mohamad Saifulnizam Suhaimi. The purpose of this research is to study the effect of multi-disciplinary involvement in the design process through a Value Management (VM) workshop.

You have been invited to participate in this project because you have participated in one of the VM workshops organized by Malaysia Airport Holdings Berhad (MAHB). Your experience as a workshop participant and as a construction industry professional is considered very valuable in contributing towards this research.

Project Summary

Value management application in construction project has proven to assist construction team in making structured approach to decision making in the design of a project. The involvement of multi-disciplinary team participant in VM workshop allows for comprehensive review of the design with aim to improve construction process on-site. However, their degrees of involvement in the workshop process are influenced by the level of skills, knowledge, experience and other related factors. The aim of this interview is to explore these issues and finding practical solution to improve current practice and hence construction process on-site.

The following are the questions:

1. *Please tell me about your role in VM workshop in this project.*
2. *In reviewing the design for the current project, what is your perception on VM influence in improving construction process on-site?*
3. *In your opinion, do you think that VM focussing on design will assist in improving construction process on-site?*
4. *In what aspect does VM study can improve the design of the current project?*
5. *How does multi-disciplinary involvement in this VM workshop influence design outcome of this project?*
6. *Do you observe any limitation of multi-disciplinary participants in this workshop in term of their contribution?*
7. *What are the main attributes of a workshop participant that make VM workshop effective in reviewing the design of this project?*
8. *How do you view participant's level of knowledge/skills and experience in this workshop?*
9. *What are your suggestions to improve these attributes among future participants?*
10. *Considering maximising the outcome of the VM study for this project, what can be done in increasing contributions by participants looking into the design?*

Thank you for your cooperation

Appendix F

Interview Questions [Bahasa Malaysia Version]

School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology
Brisbane, Australia

Department of Quantity Surveying,
Faculty of Architecture and Environmental Design
International Islamic university Malaysia

Malaysia Airports Holding Berhad

Kajian Peringkat Sarjana Falsafah Kedoktoran (PhD): Kertas Soalan Temubual

APPLIKASI DESIGN-VALUE MANAGEMENT (DVM) DALAM PROSES REKABENTUK FASILITI: RANGKA KERJA UNTUK MENGOPTIMASIKAN PROSES PEMBINAAN

MOHAMAD SAIFULNIZAM SUHAIMI
PhD Student
School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology
2 George St GPO Box 2434
Brisbane Qld
4001 Australia
Mobile: +61430618878
Email: saifulnizam.mohamad@student.qut.edu.au

DR VAUGHAN COFFEY
Principal Supervisor
School of Urban Development
Faculty of Built Environment and Engineering
Queensland University of Technology
Email: v.coffey@qut.edu.au

Pengenalan Kajian

Kajian ini di jalankan bagi tujuan pengajian peringkat Sarjana Falsafah Kedoktoran untuk Mohamad Saifulnizam Suhaimi. Matlamat kajian ini adalah untuk mengkaji kesan penglibatan ahli pasukan projek dari pelbagai disiplin di dalam proses rekabentuk fasiliti melalui wokshop Pengurusan Nilai (Value Management).

Anda di jemput untuk menyertai kajian ini berdasarkan kepada penglibatan anda di dalam wokshop Pengurusan Nilai (Value Management) yang di kendalikan oleh Malaysia Airport Holdings Berhad (MAHB). Pengalaman anda sebagai peserta di dalam wokshop Pengurusan Nilai ini dan sebagai ahli professional di dalam industry pembinaan amat di hargai bagi menyumbang kepada pencapaian matlamat kajian ini.

Berikut adalah senarai soalan-soalan temubual:

1. *Sila jelaskan secara ringkas mengenai amalan Pengurusan Nilai (VM) yang dijalankan oleh pihak MAHB?*
2. *Apakah pendapat anda terhadap VM digunakan bagi tujuan mengkaji semula rekabentuk fasiliti bagi tujuan memudahkan proses pembinaan kelak?*
3. *Bagaimanakah sesuatu rekabentuk fasiliti di kaji semula di dalam wokshop Value Management?*
4. *Adakah anda berpendapat bahawa pengunaan VM yang menjurus kepada rekabentuk awal sesuatu fasiliti dapat membantu memudahkan proses pembinaan kelak?*
5. *Apakah aspek yang dapat di perbaiki terhadap sesuatu rekabentuk fasiliti melalui pengunaan Value Management?*
6. *Bagaimanakah anda melihat pembabitan ahli pasukan projek di dalam wokshop VM dapat mempengaruhi sesuatu hasil keputusan, terutuma sekali aspek rekabentuk fasiliti?*
7. *Adakah anda melihat pembabitan peserta VM dari pelbagai disiplin ini mempunyai had masing-masing dari sudut sumbangan yang diberikan?*
8. *Apakah permasalahan yang timbul apabila terdapat ramai peserta dari pelbagai disiplin mengkaji semula rekabentuk fasiliti?*
9. *Apakah cadangan anda untuk memperbaiki situasi tersebut sebagai panduan untuk peserta VM akan datang?*
10. *Melihat dari sudut memaksimakan hasil kajian di dalam wokshop VM, apakah cadangan anda untuk memperbaiki hasil kajian wokshop VM pada masa akan dating yang merujuk kepada rekabentuk fasiliti?*

Terima kasih di atas kerjasama anda

Appendix G

Case study 1 (CS1)

Project Title	Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor Malaysia.
Project Package	AF 06
VM Subject	LCCT Apron Control Tower Design
Client	Malaysia Airports Holdings Berhad (MAHB)
VM Consultant	MCM Value Sdn Bhd
VM Objectives	Cost optimization & Design Efficiency
Focus of the study	To study the design efficiency and cost optimization of DCA Operation Building and Control Tower.
Total Participants	30
Workshop Duration	Two days
Study Date	January 21 - 22, 2010
Study Location	Malaysia School of Engineering, Sepang (External Location to MAHB)
Recommendation Made	4

Participants Composition

Client	8	Project Managers (PMC)	3
Architects	1	Engineers	8
Quantity Surveyor	1	VM Consultant (External)	4
Airport Management Team	5	Specialist	4

Case study 2 (CS2)

Project Title	Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor Malaysia
Project Package	AF 08
VM Subject	AFRS Building Design (Air Field Fire and Rescue Services Station)
Client	Malaysia Airports Holdings Berhad (MAHB)
VM Consultant	MCM Value Sdn Bhd
VM Objectives	Cost optimization & Procurement Strategy
Focus of the study	To study the procurement strategy and cost optimization of AFRS station and Air Disaster Unit (ADU) which comprises of the main station, vehicle and garage, ADU and utility and hose tower.
Total Participants	25
Workshop Duration	Two days
Study Date	April 1 - 2, 2010
Study Location	Malaysia Airport Training Centre (MATC) (External Location to MAHB)
Recommendation Made	17
Note	Although the design was not part of the main objectives, the report highlighted all issues pertaining to the design process of the building rather than procurement strategy.

Participants Composition

Client	9	Project Managers (PMC)	4
Architects	1	Engineers	4
Quantity Surveyor	1	VM Consultant (External)	3
Specialist	2		

Case study 3 (CS3)

Project Title	Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor Malaysia
Project Package	LF 05 & LF 06
VM Subject	Approach Road & Central Terminal Road (LF05) and Security Road and Perimeter Road (LF06)
Client	Malaysia Airports Holdings Berhad (MAHB)
VM Consultant	MCM Value Sdn Bhd
VM Objectives	Cost optimization & Procurement Strategy
Focus of the study	To study the procurement strategy and cost optimization of proposed packages against design assumption set by the authority. The study also focuses on justification to be made on the proposed development cost which is considered high by the MAHB approving authority.
Total Participants	25
Workshop Duration	1 day
Study Date	December 1, 2009
Study Location	Malaysia Airport Training Centre (MATC) (External Location to MAHB)
Recommendation Made	10

Participants Composition

Client	5	Project Managers (PMC)	6
Architects	1	Engineers	3
Quantity Surveyor	3	VM Consultant (External)	4
Airport Management Team	1	Specialist	1

Case study 4 (CS4)

Project Title	Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor Malaysia
Project Package	LF 05A , LF 05B & LF 06
VM Subject	Terminal Approach Road (at Grade road & elevated structures and quick
Client	Malaysia Airports Holdings Berhad (MAHB)
VM Consultant	MCM Value Sdn Bhd
VM Objectives	Cost optimization & Procurement Strategy
Focus of the study	To study the procurement strategy and cost optimization of proposed Packages
Total Participants	30
Workshop Duration	1 day
Study Date	April 4, 2010
Study Location	MAHB School of Engineering (External Location to MAHB)
Recommendation Made	14
Note	Although the design was not part of the main objectives, the report highlighted all issues pertaining to the design process of the building.

Participants Composition

Client	9	Project Managers (PMC)	4
Architects	1	Engineers	6
Quantity Surveyor	4	VM Consultant (External)	4
Airport Management Team	-	Specialist	2

Case study 5 (CS5)

Project Title	Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor Malaysia
Project Package	TB 01
VM Subject	Terminal Building
Client	Malaysia Airports Holdings Berhad (MAHB)
VM Consultant	MCM Value Sdn Bhd
VM Objectives	Cost optimization & Design Efficiency
Focus of the study	To study the design efficiency and cost optimization of proposed packages Terminal building which is the core project packages of the KLIA2 project.
Total Participants	49
Workshop Duration	3 days
Study Date	Not mentioned
Study Location	MAHB School of Engineering (External Location to MAHB)
Recommendations	8

Participants Composition

Client	13	Project Managers (PMC)	7
Architects	8	Engineers	6
Quantity Surveyor	2	VM Consultant (External)	6
Airport Management Team	6	Specialist	2

Case study 6 (CS6)

Project Title	Proposed Development of New Low Cost Carrier Terminal (LCCT) and Associated Works at KL International Airport, Sepang, Selangor Malaysia
Project Package	UT 03
VM Subject	New Sewerage Line
Client	Malaysia Airports Holdings Berhad (MAHB)
VM Consultant	MCM Value Sdn Bhd
VM Objectives	Cost optimization & Design Efficiency
Focus of the study	To study the design efficiency and cost optimization of proposed new sewerage line.
Total Participants	12
Workshop Duration	Half day
Study Date	November 15, 2010
Study Location	Malaysia Airport Training Centre (MATC) (External Location to MAHB)
Recommendations	2

Participants Composition

Client	2	Project Managers (PMC)	4
Architects	1	Engineers	2
Quantity Surveyor	1	VM Consultant (External)	3
Airport Management Team	-	Specialist	2

***** *End of thesis******