Emerald Engineering, Construction and Architectural Management

Integrating value management into sustainable construction projects in Hong Kong

Journal:	*Engineering, Construction and Architectural Management*
Manuscript ID	ECAM-03-2017-0049.R3
Manuscript Type:	Original Article
Keywords:	Value Management, Construction, Integrated Practice, Questionaire survey
Abstract:	

Integrating value management into sustainable construction projects in Hong Kong

Abstract

Purpose

Integrating sustainability into the value management (VM) process can provide a strategic platform for promoting and incorporating sustainable design and development during the lifespans of construction projects. The aim of this study was to investigate the strengths, weaknesses, opportunities and threats (SWOT) for integrating sustainability into the VM process in Hong Kong.

Design/methodology/approach

Following an extensive literature review, 45 attributes were identified and grouped into Strength, Weakness, Opportunity and Threat elements. A questionnaire survey based on these groupings was supported by a semi-structured interviews with public sector clients, value managers and VM facilitators. They shared their experience and views on how to integrate sustainability into the VM exercises.

Findings

The triangulated results of the survey and interviews are presented in this paper. The ranking of the SWOT analysis results indicate that VM does provide opportunities for multidisciplinary professionals and stakeholders to focus on issues relating to society and the environment, which is considered a main strength. The major weakness of integration is the lack of well-trained staff and low levels of VM participant expertise in relation to the

sustainable construction issue.

Practical implications

There are immense opportunities for integrating sustainability into the VM process, including encouragement of the reduction, reuse and recycling of construction and demolition waste. However, threats presented by integration include the additional time and costs required for achieving sustainability targets.

Originality/value

Findings and recommendations provided in this paper should be helpful to decision makers including clients and VM facilitators for the successful integration of the sustainability concept into the VM process.

Introduction

Buildings have a massive effect on society, the economy and the environment over their entire life cycles. According to a report released by the United Nations Environmental Programme (UNEP) (2009), buildings consume more than 40% of global energy and contribute up to one-third of global GHG emissions in both developed and developing countries. Around 40% of the total energy consumed by the U.S. and Europe is consumed in residential and commercial buildings (U.S. Department of Energy 2008; Buildings Performance Institute Europe 2011). Buildings consume about 90% of the electricity in Hong Kong, and alone generate around 60% of Hong Kong's GHG emissions (Council for Sustainable Development 2011; Yip and Ho 2013). These have led to the development of 'sustainable buildings' that are environmentally responsible and resource-efficient over their development processes.

Brundtland (1987) defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." Kibert (1994) defined sustainable construction as "creating a healthy built environment using resource-efficient, ecologically-based principles." Sustainable construction has generally been described as a process that starts before construction *per se* (in the planning and design stages) and continues after the construction team has left the site (Hill and Bowen 1997). Wolstenholme (2009) emphasised that the construction industry must be modernised by adopting efficient, integrated, innovative and sustainable construction practices. Raising sustainability awareness at the early onset of a project is highly encouraged, to optimise the potential to determine the course of the project. Value management (VM) has the capability to encompass the adoption of the sustainability concept at the conceptual and design stages of a project process (Abidin and Pasquire 2003; 2007).

Value Management is an organised function-oriented systematic team approach directed at analysing the functions and costs of a system, supply, equipment, service or facility, for the purpose of enhancing its value, through achieving the required functions specified by the clients at the lowest possible overall cost, consistent with requirements for performance (Shen, 1993). The process may be applied to management decision making at any level of an organisation and specifically may be applied to projects, products, systems, services, [and] processes" (AS/NZS 4183, 1994). VM is a proactive, creative, structured, systematic, analytical and multidisciplinary approach to examining project functionality and a wide range of stakeholder requirements to optimise value for money at the lowest overall cost during the project life cycle, from concept to use (Al-Saleh and Taleb 2010; Kelly et al. 2004). It does so by reviewing the costs, quality and functions involved in the project (Myers 2013). VM

studies are usually conducted during the early stages of a project to achieve the maximum benefits and resource savings (Norton and McElligott 1995; HM Treasury 1996; Thiry 1997). Although costs and benefits are the primary considerations of VM studies, VM is considered not only a cost-cutting exercise, but rightfully a value-enhancing tool (Al-Saleh and Taleb 2010). The project cost should not be reduced at the expense of its functionality and sustainability objectives, which would then diminish its value (Male et al. 1998; Parker 1998).

However, very few studies have investigated how to effectively integrate sustainability issues into the VM process (Schneider 1999; Abidin and Pasquire 2003; Fong 2003; Abidin 2005; Abidin and Pasquire 2005; Abidin and Said 2006; Abidin and Pasquire 2007; Al-Saleh, Taleb 2010). The strengths, weaknesses, opportunities and threats of integrating sustainability issues into the VM process should be investigated in practice. This research project seeks to fill this gap. The aim of this paper is to investigate the potential value of integrating sustainability issues into the VM processes in Hong Kong by undertaking a SWOT analysis. The major objectives are to investigate the potential for integrating sustainability considerations into the VM processes by identifying integration strengths and major weaknesses and by developing effective ways of creating opportunities and mitigating any threats to the integration process. Effectively SWOT analysis was used to analyse the current practice with respect to the integration of sustainability considerations into the VM processes and to formulate strategies to make more likely the inclusion of sustainability issues at the project inception stage.

Literature Review

Value management and its application in Hong Kong

"The VM process is based on a facilitated participatory workshop involving a multidisciplinary and representative group of people who work together and follow a prescribed job plan to achieve best value or, where appropriate, best value for money for projects, products, systems, services, and processes" (Standards Australia 2007, p. iv). An essential element of the process is that it enables multidisciplinary stakeholders, including clients, consultants, government representatives, end users and the general public, to participate in briefing and design, clarify their needs, attain a better understanding of the project and interests of other stakeholders, build a consensus, and create a sense of ownership and commitment to the solutions that emerge from the VM workshops (Lam 1995; Kelly and Duerk 2002; Yu 2007; Yu et al. 2005a,b; Yu et al. 2006a,b; Yu et al. 2007; 2008). The VM process clarifies project objectives, various stakeholder perspectives and how project objectives may be achieved effectively (Kirk and Spreckelmeyer 1988; Shen 1993). Although its approaches may vary depending on the procurement route chosen, VM is a technique that can be applied to any construction project, and take into account its functional and services requirements over the entire life cycle.

Value management was first introduced in Hong Kong in 1988 (Shen and Yu 2012). The Environment, Transport and Works Bureau of Hong Kong issued a technical circular demanding that VM studies be carried out in the Public Works Programme (PWP) for major projects with an estimated cost of more than HK$200 million (equivalent to USD$15.6 million) (Works Bureau 2002). As the works agent for the construction of new government buildings, the Architectural Services Department (ArchSD) of Hong Kong arranged a number of VM studies and still takes a leading role in promoting the integration of sustainability into the VM processes. The ArchSD has been taking proactive measures to uphold the environmental performance of government buildings via comprehensive site planning,

sustainable architectural design, the use of green and recycled materials, greenery provisions, waste management, water conservation, the application of energy-efficient measures, the adoption of renewable energy technologies, indoor environmental control, visual effects, low running costs, user comfort and holistic green construction measures at different project stages (Ho and Au 2010). At present moment, ten mega infrastructure projects announced in a 2007-08 policy address are being carried out in Hong Kong at a total value of HK$49.6 billion (USD$6.39 billion), and sustainability issues are being given priority. For example, greening and urban connectivity are being emphasised in the Kai Tak redevelopment project (Architectural Services Department 2011). Although the public sector is encouraged to adopt VM in their projects, there is lack of record for the application of VM in the private sector.

Application of sustainability in VM

Topics of sustainability have been addressed by countless studies (Oke et al, 2015). Transforming strategic sustainability objectives into specific actions for projects is a complicated process (Aarseth et al., 2016; Marcelino-Sádaba et al., 2015). A balance needs to be created between the environmental, economic and social sustainability dimensions (Martens and Carvalho, 2016; Oke et al, 2015). These are considered the “three pillars” of sustainable construction. Integrating sustainability at a very early stage of the construction processes and throughout the project life cycle is essential to the decision making process of project development and project success (Carvalho and Rabechini, 2017). The desire for sustainable development and the new corporate social responsibility ethic adopted by companies are drivers that may also encourage the wider use of VM at the earlier strategic stages (Fewing 2005). The extent to which each of the three pillars applies to a particular construction project and the decision over where to give priority depend on the value judgments of the client, VM facilitator and participants. Although a trade-off is sometimes

required between the different sustainability pillars, this trade-off should neither hinder innovative ideas nor compromise the project cost, quality and time objectives (Hill and Bowen 1997). During the workshop stage, brainstorming and group dynamics are key ingredients in the successful delivery of project value for money (Langston and Ding 2001). VM studies must account for different stakeholder needs and expectations. These stakeholders may include senior representatives of client's managerial team, design and project management team, contractor's team and end users. Economic sustainability should not be separated from environmental and social sustainability in proposing alternatives and solutions. In the post-workshop stage, the proposals can be accepted or rejected by senior management. If the proposals are accepted, plans and strategies are formulated to implement them. A conceptual framework for integration of sustainability into value management process is depicted in Figure 1.

[Insert Figure 1 here]

Scholars have proposed the notion of integrating sustainability into the VM process at different international conferences organised by the Institute of Value Management (Barton et al. 1999; Alexandre et al. 2006; Yeomans 2002). Abidin's (2005) studies pioneered work in the field. VM enables sustainability to be integrated into the design process of a construction project (Abidin and Pasquire 2003; 2007). A systematic VM job plan can effectively guide the inclusion of sustainability issues during the building life cycle. Although the term "sustainability" may not be used frequently in VM workshops, sustainability aspects such as energy efficiency, waste minimisation, healthy indoor environment, air and water quality, aesthetic effects, low life-cycle costs and user comfort are commonly discussed (Abidin and Pasquire 2005; 2007; Shen and Yu 2012). Sustainability considerations may differ from one

VM workshop to another due to the client's unique requirements, commitment to construction aspects, knowledge of the VM participants and time constraints involved (Abidin and Pasquire 2005). For example, sustainability issues have been considered on various U.K. projects such as a sustainable housing project in Crianlarich, Startfilan, where VM was used to benefit the community (BRE Scotland 2001); sustainable homes and facilities in Stirlingshire; and the Katrine Water Project at Loch Katrine, Scotland (Stephenson 2003). The main concerns of the participants when conducting a VM workshop are identifying and achieving the project objectives. Sustainability issues must be integrated into VM workshops to achieve sustainability objectives (Abidin and Pasquire 2007).

The general view of the construction industry in Hong Kong is that any application of environmentally friendly methods involves extra costs and effort (Shen and Tam 2002). Earlier researchers have identified practical barriers, including time limitations, the absence of sustainability standard guidance and behavioural barriers such as lack of knowledge and awareness of sustainability among VM participants, and conflicting perceptions among VM practitioners of how sustainability should be integrated into the VM process (Abidin and Pasquire 2005; 2007). Previous studies have focused on investigating the integration of risk management with VM (Hiley and Paliokostas 2001; Daddow and Skitmore 2004; Othman 2005; Dallas 2006; Hwang et al. 2014). Lin and Shen (2007); Lin et al. (2011) investigated the strengths and weaknesses of the existing measurement frameworks in the context of VM studies and identified 18 Key Performance Indicators for measuring VM performance. Similarly, Ramly et al. (2015) identified 10 critical success factors for VM workshops implementation in the Malaysian construction industry. However, the intrinsic capabilities of VM to assist in the incorporation of sustainability aspects early in the briefing and design stages of the project process have not been fully explored in Hong Kong practice.

Research Methodology

Both qualitative and quantitative approaches were adopted, including a questionnaire survey and three semi-structured interviews conducted with a public sector client, a VM participant and a VM facilitator, respectively. The use of qualitative and quantitative approaches together to study a research topic – triangulation – is a powerful to gain insights and results, to assist in making inferences and in drawing conclusions (Fellow and Liu, 2015).

Questionnaire survey

The questionnaire was developed by comprehensive literature, discussion between the research team and a pilot study with three professionals in early of 2015. The operationalisation of constructs is shown in Table 1. A cluster sampling approach was used in the questionnaire survey and target survey respondents were selected based on two criteria: they (i) had had working experience of sustainable construction development and VM, and (ii) had attended VM workshop(s) either in the role as a facilitator, participant or client. To solicit the opinions of practitioners, 323 respondents were targeted in Hong Kong. The list of clients, value managers and VM participants was obtained from different sources including the Institute of Value Management of Hong Kong. 73 completed survey responses were received in mid of 2015, representing a response rate of 23%. Over half of the respondents have been VM participants in VM workshops. 66% of the respondents had participated in one VM workshop, and that one quarter have been involved in more than five VM workshops. Around 19% of the respondents were involved with school and education projects, and 12% were involved with offices, followed by commercial estates, hospital and transportation projects. Some respondents had experienced more than one type of project and therefore

chose more than one type of project for their answers. Around 97% of the respondents had attended VM workshops, and 90% reported that sustainability had been considered in the VM workshops in which they were involved. However, 60% thought that sustainability was not considered as a separate agenda i.e. singled out for special consideration in its own right in the VM workshops, echoing interviewee responses.

Insert Table 1 here

The questionnaire included two sections (a sample of the questionnaire is attached in Appendix A). Section I collected information related to respondent backgrounds, including their involvement in VM studies, their professions, the roles they played in VM studies and the types of projects they were involved in. Section II solicited respondent perceptions of SWOT as a means of analysing the potential for integrating sustainability into VM. SWOT analysis is a strategic planning tool used to evaluate strengths, weaknesses, opportunities and threats related to a project or a business. It involves specifying the objectives and identifying the internal and external factors that may affect the achievement of those objectives (Arslan and Er 2008). The respondents rated their degrees of agreement against each SWOT analysis factor according to a 5-point Likert scale (1= "Strongly disagree" to 5= "Strongly agree"). An additional option of "Do not know" was provided to allow the respondents to express a lack of understanding of the SWOT analysis factors.

Semi-structured interviews

Previous researchers have also conducted semi-structured interviews; for example Daddow and Skitmore (2004); Abidin and Pasquire (2007); Al-Saleh and Taleb (2010), used the semi-structured interview technique with experts in the field of VM and sustainability. Their target survey respondents included construction industry practitioners (clients, project managers,

contractors, consultants, property/facilities managers, end users, engineers, academics, architects and quantity surveyors) working in senior-level positions. Semi-structured interviews provided an interactive dialogue with a representative of each of these key respondents to tap into their front-line experience using a common questionnaire.

The three interview participants in this study are key decision makers in VM workshop (British Standard 2000; Kelly et al. 2003). The interviewees were selected based on their vast amount of front-line experience with VM and sustainability issues and their influential roles within their organizations so as to obtain a balanced picture about the integration of sustainability with the VM process. All three interviewees represent "organisational elites" and "key informants" and work in key and responsible positions. Interviewing "elite" personnel is a common qualitative research method, which uniquely yields valuable and insightful information (Marshall and Rossman 2011).

Interviewee A was the past president of the Hong Kong Institute of Value Management as well as the director of a consultancy firm, having first-hand experience of organising more than 50 VM workshops worldwide. Interviewee B was the client of a public sector project which won the first environmental award for greenest building in Hong Kong. Interviewee C was a senior manager of a public sector organization (a fore-runner in promoting sustainable development), who has participated in different VM workshops.

Data analysis

Data collected by questionnaire survey was analyzed using an SPSS statistical package. Cronbach's alpha reliability test, Kendall's coefficient of concordance *W* test, the descriptive statistic were used to analyze the data collected; and the Mann-Whitney *U* and Kruskal-

Wallis non-parametric tests were used to check for statistically significant differences between the different groups of respondents (i.e., the clients, VM facilitators and VM participants). Data collected by interviews was analysed by coding and content analysis. The following section presents a detailed analysis of the results.

Test of survey reliability

First, Cronbach's alpha was determined to measure the reliability of the data obtained (Nunnally 1978; Nunnally and Bernstein 1994). Table 2 tabulates the coefficient values of Cronbach's alpha for Section B' questions 8-11 (refer to attached sample survey questionnaire). The coefficients range from 0.862 (Q.11) to 0.923 (Q.9). Because all of the coefficients are above 0.70, the collected data are considered to be "reliable" (Nunnally 1978; Nunnally and Bernstein 1994; Geroge and Mallery 2003).

[Insert Table 2 here]

Test of response consistency

Kendall's coefficient of concordance *W* was used to determine the degree of association and consistency of responses within the groups of questions. *W* has possible values between 0 and +1. If complete agreement between the different respondents is achieved, a significant *W* value near to +1 among all of the rank sets emerges. However, if there is no association, the value of *W* is equal to 0 (Sheskin 2011; Siegel and Castellan 1988). Hypothesis testing will determine whether to *accept* or *reject* the null hypothesis.

H_0: *there is no association between the rankings given by the respondents.*

H_A: *there is an association between the rankings given by the respondents.*

At the 95% confidence interval, the null hypothesis (H_0) can be rejected if the value of W is at a low level of significance ($p < 0.001$). This rejection of the null hypothesis means that some degree of consensus existed amongst the respondents when answering a particular group of questions. Kendall's W test is suitable when the number of elements (N) in each group of questions is at or below seven. If the number of elements in one question is more than seven, the Chi-square (χ^2) test should be used as the best option (Siegel and Castellan 1988). Table 3 shows the results of applying the Chi-square test to questions 8-11, for which the respondents gave rankings. The final right-hand column in Table 3 shows a rejection of the null hypothesis for questions 8 and 9 (but not questions 10 and 11), indicating that there was some degree of consensus among the respondents. Questions 8 and 9 were rejected because values obtained using Chi-square tests were higher than the critical value of Chi-square and questions 10 and 11 were accepted because the critical values were higher than the Chi-square values obtained using SPSS.

[Insert Table 3 here]

Relative importance index

Sambasivan and Soon (2007) and Gündüz et al. (2013) used the relative importance index (RII method) to determine the relative importance of the various variables. The same method was adopted in this study. RIIs are calculated for each factor as in the following equation:

$$\text{RII} = \frac{\sum W}{(A * N)}$$

where RII = relative importance index; W = weighting given to each factor by respondents (ranging from 1 to 5); A = highest weight (i.e., 5 in this case); and N = total number of respondents. The RII value had a range of 0 to 1 (0 not inclusive); the higher the RII, the

more important was the factors. The RIIs were then ranked, and the results are shown in Table 4.

[Insert Table 4 here]

The Mann-Whitney U and Kruskal-Wallis tests

A non-parametric Mann-Whitney U Test was conducted to test the hypothesis and study the association of the ordinal (rank order) data with two independent sample groups (drawn from the clients, VM facilitators and VM participants) that did not necessarily have equal sizes or any assumed distributions (Siegel and Castellan 1988; Sheskin 2011). In a Mann-Whitney U test, if the *p-value* is equal to or smaller than a predetermined significance level of 5%, then the two samples are considered to exhibit a statistically significant difference. However, if *p* is larger than ($\alpha = 0.05$), then the two samples are considered to exhibit no difference. H_0 was rejected when the significance levels for the SWOT analysis attributes were found to be equal to or smaller than 0.05. Otherwise, H_A was accepted for the SWOT analysis attributes.

Table 5 shows significant differences at the 95% confidence level ($\alpha < 0.05$) for the SWOT attributes, including statistical differences between 8(d) "The strategic timing of the VM process enables the sustainability agenda to be highlighted at a critical decision making stage" (between the client and VM facilitator and also between the VM facilitator and participants); 8(f) "An effective VM process allows sustainability measures to be integrated during the conceptual and early design stages" (between the client and VM participants and between the VM facilitator and participants); 8(g) "During VM studies, solutions are proposed that promote a safe and healthy environment for the occupants (between the VM facilitator and

participants); and 8(h) "Long-term proposal criteria, such as adaptability for future changes, whole-life costs and select renewable resources, are considered during VM exercises (between the VM facilitator and participants). Statistical differences were also found between weakness attribute 9(i) "The lack of technological support for achieving sustainability objectives (between the client and VM participants); opportunity attributes 10(d) "VM is a mechanism proved capable of delivering better sustainable value" and 10(g) "The VM process encourages participants to apply environmentally friendly technologies on site (between the VM facilitator and participants); and threat attributes 11(d) "The perceived additional time required for sustainable measures," 11(e) "The negative perception of green buildings in terms of the additional cost involved" (between the client and VM participants and between the VM facilitator and participants) and 11(i) "Ignoring the VM facilitator's recommendations for achieving sustainability objectives due to the clients' limited budgets or other prior commitments" (between the VM facilitator and participants). Furthermore, Kruskal-Wallis (K-W) tests were conducted to determine whether other differences between the respondents affected their perceptions of the relative significance of the SWOT analysis attributes in integrating sustainability into the VM process (Laerd Statistics 2013). The results of the K-W tests are shown in Table 6, which depicts only statistically significant different items at the 95% confidence level ($p < 0.05$) for these attributes 8(d); 8(f); 10(d) and 11(e). The K-W test is an extension of the t-test and used to compare the means of more than two samples.

[Insert Tables 5 and 6 here]

Coding and content analysis

Interview data was transcribed into field notes to prepare for analysis. Coding is the process of segmenting and labeling text to form descriptions and broad themes in the data. The objective of the coding process is to make sense out of text data, divide it into text segments, label the segments with codes, examine codes for overlap and redundancy, and collapse these codes into broad themes. The themes consist of no more than two to four words. In this study, the basic steps of conducting content analysis followed the methodology introduced by Fellows and Liu (2015). A qualitative content analysis was adopted. In this method, emphasis is on determining the meaning of the data. Data are given coded allocations to categories and groups of respondents from whom the data were obtained, so that a matrix of categorised data against groups is constructed. Statements can be selected from each cell of the matrix to illustrate the contents of each of the cells. As in any allocation mechanism, the categories should be exclusive (i.e., data assigned to one category only) and exhaustive (i.e., categories cover the research topic comprehensively).

Results and discussions

SWOT analysis is a tool commonly used to scan the internal strengths and weaknesses of a product or service industry and highlight opportunities and threats presented by the external environment (Kurttila et al. 2000; Pasonen et al. 2000; Rauch 2007). It comprises a general, brief and subjective list of attributes or statements that describe the present and future trends of both internal and external environments (Wickramasinghe and Takano 2009). It is also considered a convenient technique for conducting situational assessments. Although SWOT analysis has been conducted in various fields, only a few studies have focused on sustainability and/or VM for infrastructure projects. Lu (2010) conducted a SWOT analysis of construction industry strategic planning. Milosevic (2010) did also from both the investor and contractor viewpoints during the planning, contracting and construction phases of a

project. Other researchers have tried to quantify SWOT factors using hybrid methods. For example, Kurttila et al. (2000) and Yuan (et al. 2012) used a combined SWOT-analytic hierarchy process (AHP) for public housing projects. In this case, the AHP, a multi-criteria decision making method for determining the relative importance of attributes within a group, was used to evaluate the factors identified via SWOT analysis (Saaty 1980). However, the SWOT-AHP approach is beyond the scope of this research.

In this study, strengths are represented by attributes 8(a)-(j), weaknesses by attributes 9(a)-(l), opportunities by attributes 10(a)-(k) and threats by attributes 11(a)-(l). Table 7 shows the overall mean values and RII of the SWOT attributes according to the clients, VM facilitators and VM participants. Contrary to the overall mean values for weaknesses and threats, the mean values for strengths and opportunities are over 3.50. The respondents might have believed that integrating sustainability into the VM process presented more strengths and opportunities than weaknesses and threats. A detailed discussion of the SWOT analysis of integrating sustainability into the VM process is as follows:

[Insert Table 7 here]

Strengths

Strengths are the variables associated with an organization's strengths, variables that should be taken advantage of to promote growth and development of the organization (Kangas et al. 2001; Yuan et al. 2012). Table 4 shows the minimum, maximum and mean scores and relative ranks of various strengths. The RIIs of all of the attributes related to the strengths of integrating sustainability into the VM process were above 0.6. It shows the ranking of attributes from 1 to 5 (i.e., "Strongly disagree," "Disagree," "Neither agree nor disagree,"

"Agree" and "Strongly agree"). An additional choice of 0 representing "Do not know" was provided to allow the respondents to express a lack of understanding of the SWOT attributes. However, none of the respondents chose the "Do not know" option. The RII of attribute 8(c) "VM provides opportunities for multidisciplinary professionals and stakeholders to become involved and focus on issues relating to society and the environment" was ranked highest by all respondents echoing the findings of Shen and Yu (2012). One of the interviewees stated: "The Kai Tak government offices would be the first government green buildings in Hong Kong. One section of the VM workshop for these government offices was allocated for the brainstorming of green ideas. The Kai Tak government offices are being constructed at the time of writing. Sometimes sustainability is made a key factor of the VM workshops. In one education institution (the Hong Kong Polytechnic University) master plan campus expansion project, a VM workshop was carried out on November 28, 2013. Many ideas were discussed in this workshop, such as the recycling of food waste, whether to retain old buildings and whether it was necessary to build new zero-energy buildings and minimise lifts or escalators (to encourage people to use stairs and walk more to increase their health, and to save electricity)."

It was noted in the interviews that sustainability was sometimes considered as a separate agenda and integrated into other value drivers such as time, cost and quality. "Sustainability issues are integral to the project functions and objectives, which should be dealt with accordingly during the VM process and should not be treated as a separate agenda" (Abidin and Pasquire 2005, p 178). One of the interviewees (a VM facilitator) noted the following: "In a recent VM workshop focusing on accessibility for the disabled on pedestrian footbridges, we evaluated the energy effectiveness of the air conditioning systems installed in the footbridges. During our 'option analysis,' we evaluated how to take out the air

conditioning system while also improving the indoor air quality and lift ventilation. We looked at the options of installing solar panels on the lifts. The aim of this workshop was to make the pedestrian lifts more energy efficient (reducing energy consumption) and make them comfortable for pedestrians. That whole VM workshop was focused purely on energy reduction itself, so sustainability considerations were clearly a separate agenda in this case but VM workshops or can alternatively be integrated into other value-enhancing objectives."

The attribute 8(i) "Stakeholders are strongly encouraged to propose sustainable solutions at an early stage" and 8(f) "An effective VM process allows sustainability measures to be integrated during the conceptual and early design stage" were ranked second and third. VM ensures that sustainability issues should be brought to the attention of all stakeholders before critical decisions are made (Abidin and Pasquire 2005). The VM facilitator interviewed noted that the VM process should start as early as the feasibility or inception stages: "In a recent (education institution) project related to master planning, the VM workshop was conducted at a very early stage. In the information phase, many green ideas were incorporated into the early design stage. In terms of a functional diagram, the key building functions received by the client were included in this phase. Sustainability of the building could itself be a key function. The functional analysis, brainstorming (creativity), evaluation and implementation phases are the most common phases adopted in most VM workshops. The ideas generated at this point become part of the project brief. Recently sustainability has become included in the design and development stage of most projects. The first question to be asked is whether the existing facilities should be redeveloped or rebuilt. If the services can be provided without rebuilding or demolishing the facilities, how the sustainability objectives can be attained should be looked at. He further elaborated that during the decision making process, the client can determine whether a new building is necessary or whether the refurbishment or extension

of any existing facility can fulfill the client's requirements. In addition, during the VM workshop, the participants were asked to write down the functions of the buildings for the next 50 years. One participant left a blank sheet because during the next 50 years, he felt, no more education institutions would be needed because education may be provided in virtual environments. Management later shortened the planning horizon to 10 years to make it more practical.

Shen and Yu (2012) suggested that VM workshops provide diverse knowledge sources for sustainable development. They further pointed out that a sustainability vision should be discussed as early as possible in the design and briefing stages of a project. Sustainability should be integrated into all of the activities involved in the project design and development processes, with close interactions between the clients and key stakeholders. Attribute 8(g) "During the VM studies, solutions are proposed that promote a safe and healthy environment for the occupants" was ranked last.

Weaknesses

The weaknesses are the variables that may impede or question the need for growth and development of an organisation (Kangas et al. 2001; Yuan et al. 2012). Table 4 shows the minimum, maximum and mean scores and relative ranks of the weaknesses. The RIIs of weaknesses of integrating sustainability into the VM process range from 0.548 to 0.674. Attribute 9(c) "The lack of well-trained staff and expertise of the VM participants in relation to sustainable development" was ranked first, a finding echoed by the interviewees' remarks that Hong Kong lacked well-trained staff and that VM participants may be unaware of sustainability issues. Attribute 9(d) "The lack of client supports in achieving sustainable construction during the VM exercise" was ranked second. However, one interviewee asserted

that clients were "willing to achieve sustainability objectives. In some instances, it's the users who may not be interested in or willing to achieve sustainability objectives. There are many user groups in the Kai Tak government offices. The designer suggested sensor lighting instead of traditional lighting to save energy, but the user groups objected to the idea. There was an option for a bicycle park instead of a car park. The user groups were not happy with this idea and deleted this sustainability option." The Hong Kong property market also, is not mature in terms of sustainability and lacks awareness and understanding of the basic principles of sustainability (Chen 2013), as well as passive and negative perceptions about integration (Abidin and Pasquire 2005). Attributes 9(i) "The lack of technological support for achieving sustainability objectives" was ranked last among the weaknesses.

In Hong Kong, some private sector interests invest in sustainable buildings as part of their corporate social responsibility. According to one of the interviewees, "currently there is social pressure on the private sector that stimulates clients to consider sustainable buildings. Private-sector organizations such as the Hong Kong Jockey Club wants to be seen as good members of society, so they want to establish themselves as socially responsible organisations. In the short run, all of these sustainability considerations cost more. They are not cost-reduction measures, and tend to cost more at the initial design and development stages." He further continued, "in the long run, taking account of life-cycle costs, will benefit the occupants and future generations. Most of these organisations are targeting LEED and BEAM platinum or gold certification. The Hong Kong Jockey Club's Sha Tin Communications and Technology Centre will be a very environmentally friendly building. This Jockey Club project is targeting gold LEED or BEAM assessment certificates." However, some of the Hong Kong developers who maximise profit from every square foot rarely care about investing in sustainable buildings. The private-sector developers merely try to meet the

minimum environmental requirements. According to one associate dean of architecture, passive design that takes account of factors such as the orientation of a building in relation to sun and wind patterns and to window-to-wall ratios is crucial. If the design maximises natural lighting and ventilation, considerable energy savings may result without spending a cent on advanced technologies. However, the dean also stressed that the buildings on Hong Kong Island face north to secure harbor views at the expense of natural light (Chen 2013).

Opportunities

Opportunities are those variables an organisation can take advantage of to ensure its future growth and development (Kangas et al. 2001; Yuan et al. 2012). Table 4 shows the minimum, maximum and mean scores and relative ranks of opportunities of integrating sustainability into the VM process. The RIIs of opportunities for integrating sustainability into the VM process were 0.7. Attributes 10(f) "Encouraging the reduction, reuse and recycling of construction and demolition waste" and 10(g) "The VM process encourages participants to apply environmentally friendly technologies on site" were top ranked opportunities of integrating sustainability into the VM process. SAVE International (2007) suggests that VM is a mechanism proved capable of delivering better sustainable value to a project. Similarly, Abidin and Pasquire (2005) recommend producing tools, guidelines, improving knowledge for sustainable integration into the VM process. Promoting the integration of sustainability into the VM process will enhance the reputation of VM as a value enhancing technique and enable it to remain competitive in delivering its services. Furthermore, Shen and Tam (2002) suggest that including sustainability into the VM process will highlight the financial and non-financial incentives of sustainable development to clients and contractors during VM studies. It is necessary that by including sustainability issues the clients and contractors will benefit in monetary and non-monetary terms. Attribute 10(e) "The legal enforcement of environmental

protection and the implementation of sustainable practices" was ranked the last opportunity attribute.

Threats

Threats are the variables that may affect or prevent the growth of an organisation (Kangas et al. 2001; Yuan et al. 2012). Table 4 shows the minimum, maximum and mean scores and relative ranks of threats. The RIIs of threats to the process of integrating sustainability into the VM process range from 0.586 to 0.718. The majority of the RIIs are greater than 0.6. Attributes 11(d) "The perceived additional time required for sustainable measures"; 11(b) "The client and service provider react passively in fulfilling environmental and social needs", and 11(e) "The negative perception of green buildings in terms of the additional cost involved" ranked first (RII=0.718), second (RII=0.715) and third (RII=0.677) respectively as major threats to the integration of sustainability issues into the VM process. Abidin and Pasquire (2005; 2007) identified the time limitation as a practical barrier to the integration of sustainability into the VM process. Hence, it is impractical and difficult to address all sustainability issues within a VM workshop. There could also be other potential barriers including perceived extra costs of the integration of sustainability into the VM process. Since, the initial cost of a sustainable building may be 2 to 7 percent higher than the cost of an ordinary building and with a long payback period. As revealed in the interview, Sing Yin Secondary School project has more than double the normal payback period. Furthermore, Williams and Dair (2007); Pitt et al. (2009) and Häkkinen and Belloni (2011) identified different barriers including lack of client demand, awareness and the affordability of sustainable buildings. Meryman and Silman (2004) point out that cost as an important barrier to the implementation of green specifications. The study by Ofori and Kien (2004) in Singapore also found that the perception of extra cost is a fundamental obstacle to the design

team in persuading the clients and other relevant stakeholders to include environmental considerations into the design and construction processes. Extra costs also relate to time, and any delay in workflow caused by green practice would have economic implications. Similarly, Sayce et al. (2007); Sodagar and Fieldson (2008) and Lam et al. (2009) identified "perceived additional cost" as one of the main obstacles to the implementation of sustainable building design in construction projects. Attribute 11(h) "The VM facilitator's fear of the extra responsibilities involved in highlighting the importance of sustainable development" ranked the lowest potential threat to inclusion in VM workshops.

Implications

This research study has highlighted some important practical implications for clients, contractors and VM practitioners. The study demonstrated that the current practices are generally neglecting integration of sustainability into the VM process due to cost and time constraints. There are ample strengths and opportunities recommended by this study for integrating sustainability into the VM process which are beneficial for the clients and contractors for achieving value for money and meeting sustainability targets.

Limitations and future studies

The major limitation of this study is that the completed survey and interviewees were held in only the one location, i.e., Hong Kong. The results may not able be generalisable to other well-developed countries but only to other locations with similar sustainability and VM practicing environments. Therefore, further research should be conducted at other locations and compared with the findings of this SWOT analysis. Moreover, in future research a hybrid SWOT-AHP decision-making method could be applied to a larger sample to make pair-wise comparison between the identified SWOT attributes.

Conclusions

This research study is presented as a contribution to understanding the factors affecting the integration of sustainability into the VM process. The study has identified areas of strengths, which support the notion of integrating sustainability into the VM process, and weaknesses, which could be converted into opportunities and threats to be avoided. The results indicate that the strongest factors (strengths and opportunities) relate to the potential for VM exercises to provide for multidisciplinary professionals and stakeholders involvement, and a focus on issues relating to society and a sustainable built environment at the conceptual and design stages of a project to encourage the reduction, reuse and recycling of construction and demolition waste. However, it is recognised that the client needs to strike a balance between economic, social and environmental objectives. The strongest factors (weaknesses and threats) hindering the potential for sustainability integration into the VM process are the lack of well-trained staff and low levels of VM participant expertise in relation to sustainable development and the additional time and resources required to achieve sustainability targets. The perception of extra time and cost was seen as the main obstacle to the implementation of sustainability initiatives. All interviewees observed that sustainability has recently been considered an important issue for both public and private sector projects in Hong Kong, but especially the former. All interviewees agreed that design teams should incorporate sustainability objectives early in the project design and development stages, and that design solutions should not conflict with sustainability and environmental objectives. Both public and private sector clients understand the concept of sustainability and are willing to implement them through the VM process. Along with other value drivers, sustainability should be given priority and should be integrated in the early stages of the VM process for successful project delivery.

Under the conceptual framework outlines earlier, VM practitioners should incorporate sustainability consideration into VM workshops. The existing target of value creation and enhancement should be expanded to cover environmental improvement and more specifically climate mitigation. Thus, managers may instil better value of money for their projects. On the research front, suitable tools need to be developed to evaluate managers to achieve the above integration with competence and objectivity. SWOT analysis is one such tool.

References

Aarseth, W., Ahola, T., Aaltonen, K., Økland, A. and Andersen, B. (2016), "Project sustainability strategies: A systematic literature review," *International Journal of Project Management,* available online on 23 December 2016.

Abidin, N.Z. and Pasquire, C.L. (2003), "Moving towards sustainability through value management," *Proceedings of the Joint International Symposium of CIB Working Commissions W55 and W107*, (2) 258-268, Singapore.

Abidin, N.Z. (2005), *Using value management to improve the consideration of sustainability within construction*, Doctor of Philosophy, Loughborough University, UK.

Abidin, N.Z. and Pasquire, C.L. (2005), "Delivering sustainability through value management: concepts and performance overview," *Construction and Architectural Management*, 12(2) 168-180.

Abidin, N.Z. and Said, I. (2006), "Involvement of sustainability issues in value management: requisite factors," *International Conference of Construction Industry*, Padang, Indonesia, 12-24 June 2006.

Abidin, N.Z. and Pasquire, C.L. (2007), "Revolutionize value management: a mode towards sustainability," *International Journal of Project Management*, 25(3) 275-282.

Al-Saleh, Y.M. and Taleb, H.M. (2010), "The integration of sustainability within value management practices: a study of experienced value managers in the GCC countries," *Project Management Journal,* 41(2) 50-59.

Alexandre, J., Henbriques, J., Catarino, J., Nogueira, A., Rodrigues, F. and Camocho, D. (2006), "How to measure value from a sustainable point of view," *International Conference of the Institute of Value Management*, Brighton, UK.

Architectural Services Department (2011), *Task Force on Kai Tak Harbour Front Development: Kwun Tong Promenade Stage 2*. (http://goo.gl/7u2XC1) (October 10, 2014).

Arslan, O. and Er, I.D. (2008), "A SWOT analysis for successful bridge team organization and safer marine operations," *Process Safety Progress,* 27(1) 21-28.

AS/NZS 4183 (1994), *Australian/New Zealand Standard, Value Management*, Joint Technical Committee, OB/6, April.

Barton, R., Jones, D. and Anderson, H. (1999), "Incorporating the values of ecologically sustainable development into project definitions using soft value management," *International Conference of the Institute of Value Management*, Hong Kong.

Better Buildings Summit (2003), "Better Buildings Summit Issues Paper," Department of Trade and Industry, HMSO, London, https://goo.gl/TvRa9D (Nov. 04, 2017).

BRE Scotland (2001), *Report on Value Management Workshops for Community Self Build Scotland*, BRE Scotland. (http://goo.gl/rHv5WB) (Dec. 10, 2013).

British Standard (2000), BS EN 12973 Value Management, https://bsonline.techindex.co.uk. (May 03, 2014)

Brundtland, G.H. (1987), *Our Common Future: The World Commission on Environment and Development*, Oxford University Press, Oxford.

Buildings Performance Institute Europe (2011), *Final Draft: Principles for Nearly Zero-Energy Buildings - Paving the Way for Effective Implementation of Policy Requirements*, Buildings Performance Institute Europe, Brussels.

Carvalho, M.M. and Rabechini, R. (2017), "Can Project sustainability management impact project success? An empirical study applying a contingent approach," International Journal of Project Management, available online on 14 March 2017.

Chen, A. (2013), *Take a Look Inside Sing Yin Secondary School, One of the World's Greenest*, Thursday, 14 November 2013, South China Morning Post. (http://goo.gl/yFNL5v) (Aug. 06, 2014).

Council for Sustainable Development (2011), *Combat Climate Change: Energy Saving and Carbon Emission Reduction in Buildings,* Hong Kong SAR, China. (http://goo.gl/ZjpGw8) (Aug. 06, 2014).

Daddow, T. and Skitmore, M. (2004), "Value management in practice: an interview survey," *Australasian Journal of Construction Economics and Building,* 4(2) 11-18 (http://goo.gl/KR7vjp).

Dallas, M. (2006), Value and risk management: A guide to best practice, Blackwell Publishing, Oxford.

Fellows, R. and Liu, A. (2015), Research Methods for Construction, 4th edn., Wiley Blackwell, Oxford.

Fewing, P. (2005), *Construction Project Management: An Integrated Approach,* Taylor & Francis, Oxon.

Fong, S.W. (2003), "Value management – going all out for knowledge creation," *The Value Manager,* 9(1) available at (http://goo.gl/IEXlQo) (Aug 20, 2015).

Geroge, D. and Mallery, P. (2003), *SPSS for Windows Step by Step: A Simple Guide and Reference. 11.0 Update,* 4th edn., Allyn and Bacon, Boston.

Gündüz, M., Nielsen, Y. and Özdemir, M. (2013), "Quantification of Delay Factors Using the Relative Importance Index Method for Construction Projects in Turkey," *Journal of Management in Engineering,* 29(2), 133-139.

Häkkinen, T. and Belloni, K. (2011), "Barriers and drivers for sustainable building," *Building Research & Information*, 39(3), 239-255.

Hill, R.C. and Bowen, P.A. (1997), "Sustainable construction: principles and a framework for attainment," *Construction Management and Economics*, 15(3) 223-239.

Hiley, A. and Paliokostas, P.P. (2001), "Value management and risk management: An examination of the potential for their integration and acceptance as a combined management tool in the U.K construction," Construction Industry Proceedings of COBRA 2001, Royal Institution of Chartered Surveyors, London, U.K. (https://goo.gl/Reb2oT) (Jan 9, 2015).

HM Treasury (1996), *Central Unit on Procurement Guidance No. 54 Value Management*, The Stationary Office. (http://goo.gl/TKpc5L) (July 04, 2014).

Ho, S.K. and Au, W.Y.V. (2010), "Optimizing the environmental performance of government buildings and facilities," *The Sixteenth Annual International Sustainable Development Research Conference, 30 May-1 June*, 2010 The Kadoorie Institute, Hong Kong. (http://goo.gl/Bt8dPT) (Jan. 09, 2014).

Hwang, B., Zhao, X. and Ong, S. (2014), "Value management in Singaporean building projects: implementation status, critical success factors, and risk factors," J*ournal of Management in Engineering*, 04014094.

Kangas, J., Pesonen, M., Kurttila, M. and Kajanus, M. (2001), "Integrating AHP with SWOT analysis," *Proceedings of the Sixth Int. Symposium on the Analytic Hierarchy Process, Institute for Accounting and Controlling*, p. 189-198, University of Berne, Berne, Switzerland.

Kelly, J. and Duerk, D. (2002), "Construction Project Briefing/Architectural Programming," *Best Value in Construction*, eds. J. Kelly, R. Morledge and S. Wilkinson,) 38-58, Blackwell Science Ltd.

Kelly, J., Hunter, K. and Male, S. (2003), "The client's value system explored: case studies from the UK public sector," In Proceedings of the joint International Symposium of CIB Working Commissions W55, W65 and W107, Knowledge in Construction **1**, Singapore, October 22-24, 2003, 423-433.

Kelly, J., Male, S. and Graham, D. (2004), *Value Management of Construction Projects*, Wiley-Blackwell Science Ltd., Oxford.

Kibert, C.J. (1994), "Final Session," *First International Conference of CIB TG 16 on Sustainable Construction, 6-9 November 1994.* Tampa, FL.

Kirk, S.J. and Spreckelmeyer, K.F. (1988), *Creative Design Decisions*, Van Nostrand Reinhold Company, New York.

Kurttila, M., Pesonen, J., Kangas, M. and Kajanus, M. (2000), "Utilizing the analytic hierarchy process (AHP) in SWOT analysis: a hybrid method and its application to a forest-certification case," *Forest Policy and Economics*, (1) 41-52.

Laerd Statistics (2013), *Kruskal-Wallis H Test using SPSS Statistics*. (http://goo.gl/TTdjC9) (on September 29, 2014. Lund Research Ltd.

Lam, P.T.I. (1995), "Applications of value engineering in the construction industry," *The Asia Pacific Building and Construction Management Journal*, (1) 18-24.

Lam, P.T.I., Chan, E.H.W., Chau, C.K., Poon, C.S. and Chun, K.P. (2009), "Integrating Green Specifications in Construction and Overcoming Barriers in their Use," *Journal of Professional Issues in Engineering Education and Practice*, 135(4), 142-152.

Langston, C.A. and Ding, G.K. (2001), *Sustainable Practices in the Built Environment,* 2nd edn., Butterworth-Heinemann, Oxford.

Lin, G., Shen, G., Sun, M. and Kelly, J. (2011), "Identification of key performance indicators for measuring the performance of value management studies in construction," *Journal of Construction Engineering and Management*, 137(9), 698-706.

Lin, G. and Shen, Q. (2007), "Measuring the performance of value management studies in construction: Critical Review," *Journal of Management in Engineering*, 23(1), 2-9.

Lu, W. (2010), "Improved SWOT Approach for conducting strategic planning in the construction industry," *Journal of Construction Engineering and Management*, 136(12) 1317-1328.

Male, S., Kelly, J., Fernie, S., Grönqvist, M. and Bowles, G. (1998), *The Value Management Benchmark: A Good Practice Framework for Clients and Practitioners*, Thomas Telford Publishing, London.

Marcelino-Sádaba, S., González-Jaen, L.F. and Pérez-Ezcurdia, A. (2015), "Using project management as a way to sustainability. From a comprehensive review to a framework definition," *Journal of Cleaner Production,* 99, 1-16.

Marshall, C. and Rossman, G.B. (2011), Designing qualitative research, 4th edn, SAGE Publications, Inc., California.

Martens, M.L. and Carvalho, M.M. (2016), "Key factors of sustainability in project management context: A survey exploring the project managers' perspective," *International Journal of Project Management,* available online on 14 May 2016.

Meryman, H. and Silman, R. (2004), "Sustainable engineering—Using specifications to make it happen," *Structural Engineering International (IABSE, Zurich, Switzerland)*, 14(3), 216-219.

Milosevic, I. (2010), "Practical application of SWOT analysis in the management of a construction project," *Leadership and Management in Engineering*, 10(2) 78-86.

Myers, D. (2013), *Construction Economics: A New Approach*, 3rd edn., Routledge, Oxon.

Norton, B.R. and McElligott, W.C. (1995), *Value Management in Construction*, Macmillan Press, London.

Nunnally, J.C. (1978), *Psychometric Theory*, 2nd edn., McGraw-Hill, New York.

Nunnally, J.C. and Bernstein, I.H. (1994), *Psychometric Theory*, McGraw-Hill, Sydney.

Ofori, G. and Kien, H.L. (2004), "Translating Singapore architects' environmental awareness into decision making," *Building Research & Information*, 32, (1), 27-37.

Oke, A. E., and Aigbavboa, C. O. (2017), "Sustainable Value Management for Construction Projects," Springer.

Oke, A.E., Aghimen, D.O. and Olatunji, S.O. (2015), "Implementation of Value Management as an economic sustainability tool for building construction in Nigeria," *International Journal of Managing Value and Supply Chains,* 6(4), December, 55-64.

Organisation for Economic Co-operation and Development (2010), "Regulatory Policy and the Road to Sustainable Growth," https://goo.gl/UWQvPH (Nov. 30, 2017).

Othman, A.A. (2005), "Value and risk management protocol for dynamic brief development in construction," *Emirates Journal Engineering Research,* 10(2), 23-26.

Parker, D.E. (1998), *Value Engineering Theory*, The Lawrence D. Miles Value Foundation, Washington, DC.

Pasonen, M., Kurttila, M., Kangas, J., Kajanus, M. and Heinonen, P. (2000), "Assessing the priorities using A'WOT among resource management strategies at the Finnish forest and park service," *Forest Science,* 47(4) 534-541.

Pitt, M., Tucker, M., Riley, M. and Longden, J. (2009), "Towards sustainable construction: promotion and best practices," *Construction Innovation*, 9, 201–224.

Ramly, M.Z., Shen, G. and Yu, A. (2015), "Critical success factors for value management workshops in Malaysia," *Journal of Management in Engineering*, 31(2), 05014015-7.

Rauch, P. (2007), "SWOT analyses and SWOT strategy formulation for forest owner cooperations in Austria," *European Journal for Forest Research,* 126(3) 413-420.

Saaty, T.L. (1980), *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*, McGraw-Hill, New York.

Sambasivan, M., and Soon, Y. W. (2007). "Causes and effects of delays in Malaysian construction industry," *International Journal of Project Management,* 25(5),517–526.

SAVE International (2007), *Value Standard and Body of Knowledge*. (http://goo.gl/ob9C8r) (July 23, 2014).

Sayce, S., Ellison, L. and Parnell, P. (2007), "Understanding investment drivers for UK sustainable property," *Building Research & Information*, 35, 629–643.

Schneider, M. (1999), "Value management and sustainability: an opportunity to revolutionize the construction industry," Managing Sustainable Values, Proceedings of the International Conference of the Institute of Value Management Hong Kong, 6-7 May, 1999.

Shen, G. Q., Yu, A. T., and Chung, J. K. (2015), "6 VM Applications," *Value Management in Construction and Real Estate: Methodology and Applications*, 66.

Shen, G.Q. and Yu, A.T.W. (2012), "Value management: recent developments and way forward," *Construction Innovation: Information, Process, Management*, 12(3) 264-271.

Shen, L.Y. and Tam, V.W.Y. (2002), "Implementation of environmental management in the Hong Kong construction industry," *International Journal of Project Management*, 20(7) 535-543.

Shen, Q.P. (1993), *A Knowledge-Based Structure for Implementing Value Management in the Design of Office Buildings*, PhD thesis, University of Selford, British Library, Document Supply Centre, UK.

Shen, Q.P., Brandon, P. and Baldwin, A. (2009), *Collaborative Construction Information Management*, Spon Press, Oxon.

Sheskin, D.J. (2011), *Handbook of Parametric and Nonparametric Statistical Procedures*, 5th edn., Chapman and Hall/CRC.

Siegel, S. and Castellan, N.J. (1988), Nonparametric Statistics for the Behavioral Sciences, 2nd edn., McGraw-Hill, New York.

Sodagar, B. and Fieldson, R. (2008), "Towards a sustainable construction practice," *Construction Information Quarterly*,10, 101–108.

Standards Australia (2007), *Australian Standards: Value Management*, Standards Australia, Sydney.

Stephenson, M. (2003), *How Can Value Engineering be used to Enhance the Sustainability of Major Engineering Developments?* MSc Dissertation, University of Strathclyde, United Kingdom.

Tahir, M. Z., Nawi, M. N. M., and Ibrahim, A. (2016), "Value Management (VM): A Strategic Approach for Improving Energy Efficiency," *International Journal of Supply Chain Management*, 5(4).

Thiry, M. (1997), *Value Management Practice*, Project Management Institute, Newtown Square, PA.

U.S. Department of Energy (2008), *Energy Efficiency Trends in Residential and Commercial Buildings*, U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, U.S.A.

UNEP (2009), *Building and Climate Change: Summary for Decision-Makers*, United Nations Environment Programme, Paris.

Wickramasinghe, V. and Takano, S. (2009), "Application of combined SWOT and analytic hierarchy process (AHP) for tourism revival strategic marketing planning: a case of Sri

Lanka tourism," *Journal of the Eastern Asia Society for Transportation Studies*, (8) 954-969.

Williams, K. and Dair, C. (2007), "What is Stopping Sustainable Building in England? Barriers Experienced by Stakeholders in Delivering Sustainable Developments," *Sustainable Development*, 15, 135-147.

Wolstenholme, A. (2009), *Never Waste a Good Crisis: A Review of Progress since Rethinking Construction and Thoughts for Our Future*, Construction Excellence, London.

Works Bureau (2002), *Technical Circular No. 35/2002, Environment, Transport and Works Bureau Technical Circular, Implementation of Value Management in Public Works Projects*, Environment, Transport and Works Bureau, Hong Kong SAR, China.

Yao, R. (2013), *Design and Management of Sustainable Built Environments*, Springer, London.

Yates, A. (2003), "*Sustainable buildings: benefits for constructors*," Building Research Establishment London.

Yeomans, P. (2002), "Environmentally sustainable development plus value management equals results minus rhetoric," *International Conference of the Institute of Value Management* Hobart, Australia.

Yip, C.H. and Ho, W.Y. (2013), "Enhancing building energy efficiency - a concerted effort of the trade and the government," *Proceedings of 4th Greater Pearl River Delta Conference on Building Operation and Maintenance - Sustainable Operation and Maintenance for Green Buildings, 12 December 2013*. (http://goo.gl/cDhJ2d) 103-107, EMSD, Hong Kong SAR, China.

Yu, A.T.W. (2007), "*A Value Management Framework for Systematic Identification and Precise Representation of Client Requirements in the Briefing Process*," Doctor of Philosophy, The Hong Kong Polytechnic University, Hong Kong SAR, China.

Yu, A.T.W., Shen, Q.P. and Chan, E.H.W. (2005a), "An analytical review of the briefing practice in Hong Kong's construction industry," *The International Journal of Construction Management*, 5(1) 77-89.

Yu, A.T.W., Shen, Q.P., Kelly, J. and Hunter, K. (2005b), "Application of value management in project briefing," *Facilities*, 23(7/8) 331-342.

Yu, A.T.W., Shen, Q.P., Kelly, J. and Hunter, K. (2006a), "An investigation of the critical success factors in construction project briefing by way of content analysis," *Journal of Construction Engineering and Management*, *ASCE*, 132(11) 1178-1186.

Yu, A.T.W., Shen, Q.P., Kelly, J. and Hunter, K. (2007), "An empirical study of the variables affecting construction project briefing/architectural programming," *International Journal of Project Management*, 25(1) 198-212.

Yu, A.T.W., Shen, Q.P., Kelly, J. and Hunter, K. (2008), "A comparative study of the variables in construction project/architectural programming," *Journal of Construction Engineering and Management*, 134(2) 122-138.

Yu, A.T.W., Shen, Q.P., Kelly, J. and Lin, G.B. (2006b), "A value management approach to strategic briefing: an exploratory study," *International Journal of Architectural Engineering and Design Management*, 2(4) 245-259.

Yuan, J., Guang, M., Wang, X., Li, Q. and Skibniewski, M. (2012), "Quantitative SWOT analysis of public housing delivery by Public–Private Partnerships in China based on the perspective of the public sector," *Journal of Management in Engineering*, 28(4) 407-420.

Department of Building and Real Estate, The Hong Kong Polytechnic University
Project entitled " **SWOT analysis of integrating sustainability into the value management process for construction projects"**

I. About the Respondent *(Only overall statistical data will be compiled, i.e., individuals not identifiable)*

1. Have you ever been involved in value management (VM) workshop(s) (to-date)?
   ☐ Yes ☐ No (*Please pass a blank copy to someone whom you know with such experience)*

2. If yes, how many VM workshops have you ever been involved with?
   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ more than 5

3. Your general role:
   ☐ Client/Project Manager ☐ Contractor ☐ Sub-contractor ☐ Property/Facilities Manager
   ☐ End User ☐ Engineer ☐ Environmental Expert ☐ Academic ☐ Architect ☐ Quantity Surveyor
   ☐ Other pls. specify: _____

4. Your role in VM exercise(s)?
   ☐ Client ☐ VM Facilitator ☐ VM participants or team member

5. Is sustainability considered in VM workshops which you were involved with?
   ☐ Yes ☐ No

6. Is sustainability regarded as a separate agenda in VM workshop(s)?
   ☐ Yes ☐ No

7. Which of the following types of projects have you been involved with? (More than one box may be selected)
   ☐ Commercial Estate ☐ Offices ☐ Entertainment and Exhibition Centre
   ☐ Hospital ☐ Transportation ☐ Water Supply & Treatment ☐ Power & Energy
   ☐ ICT (Information & Communication Tech) ☐ Housing Estate ☐ Police & Prison
   ☐ School & Education ☐ Waste Management (Landfill) ☐ Others (please specify) _____

Please rate the following statements based on a scale from 0 – 5, where **"0" represents "Do not know", "1" "Strongly disagree", "3" "Neither agree nor disagree** "and **"5" represents "Strongly agree"**.

II. SWOT Analysis of Sustainability integration into Value Management

8. Please rate the following statements regarding the relative frequency of the following <u>strengths</u> of Sustainability integrating into VM	**0**	**1**	**2**	**3**	**4**	**5**
a) VM workshops recommend solutions for energy and resource efficient buildings	☐	☐	☐	☐	☐	☐
b) VM workshops provide diverse knowledge sources for sustainable development	☐	☐	☐	☐	☐	☐
c) VM provides opportunities for multi-disciplinary professionals and stakeholders' involvement to focus on issues relating to society and environment	☐	☐	☐	☐	☐	☐
d) Strategic timing of VM process enables sustainability agenda to be highlighted at a critical decision making stage	☐	☐	☐	☐	☐	☐
e) VM promotes sustainable design for a project	☐	☐	☐	☐	☐	☐
f) Effective VM process allows integration of sustainability measures during	☐	☐	☐	☐	☐	☐

the conceptual and early design stage						
g) During VM studies, solutions are proposed which promote safe and healthy environment for occupants	☐	☐	☐	☐	☐	☐
h) Consider long-term criteria in proposals i.e. adaptability for future changes, whole-life costs, select renewable resources etc. during VM exercises	☐	☐	☐	☐	☐	☐
i) Encourage strong participation of stakeholders for proposing sustainable solutions at a very early stage	☐	☐	☐	☐	☐	☐
j) Recommend optimum utilisation of natural resources	☐	☐	☐	☐	☐	☐
k) Others, pls. specify:_____	☐	☐	☐	☐	☐	☐

9. Please rate the relative frequency of the following <u>weaknesses</u> of Sustainability integrating into VM	**0**	**1**	**2**	**3**	**4**	**5**
a) Lack of government legal enforcement of sustainability policies	☐	☐	☐	☐	☐	☐
b) Additional management and operational cost of project for sustainability measures	☐	☐	☐	☐	☐	☐
c) Lack of well trained staff and expertise of VM participants about sustainable development	☐	☐	☐	☐	☐	☐
d) Lack of client's support in achieving sustainable construction during VM exercise	☐	☐	☐	☐	☐	☐
e) Lack of contractors, sub-contractors and suppliers' cooperation for achieving sustainability goals	☐	☐	☐	☐	☐	☐
f) Lack of incentives for clients/contractors for achieving sustainable development goals	☐	☐	☐	☐	☐	☐
g) Unclear project brief, poor specifications or inadequate business cases for achieving sustainable development	☐	☐	☐	☐	☐	☐
h) Difficult to enforce environmental performance	☐	☐	☐	☐	☐	☐
i) Lack of technological support for achieving sustainability objectives	☐	☐	☐	☐	☐	☐
j) Lack of integration of sustainability into VM studies	☐	☐	☐	☐	☐	☐
k) Lack of sustainable construction guidance	☐	☐	☐	☐	☐	☐
l) Not highlighting corporate social responsibility for achieving environmental and sustainable needs of society during VM process	☐	☐	☐	☐	☐	☐
m) Others, pls. specify:_____	☐	☐	☐	☐	☐	☐

10. Please rate the relative frequency of the following <u>opportunities</u> of Sustainability integrating into VM	**0**	**1**	**2**	**3**	**4**	**5**
a) Inclusion of sustainability issues early in the VM practices	☐	☐	☐	☐	☐	☐
b) Introduce sustainability guidance for VM practitioners	☐	☐	☐	☐	☐	☐
c) Promote client's interest on sustainability as a primary value driver	☐	☐	☐	☐	☐	☐
d) Prove VM capability as a mechanism to deliver better sustainable value	☐	☐	☐	☐	☐	☐
e) Legal enforcement on environmental protection and implementation of sustainable practices	☐	☐	☐	☐	☐	☐
f) Encourage reduction, reuse and recycling of construction and demolition waste	☐	☐	☐	☐	☐	☐
g) Encourage to apply environmentally friendly technologies on site	☐	☐	☐	☐	☐	☐
h) Provide in-house training on environmental management	☐	☐	☐	☐	☐	☐
i) Establish waste management plan during VM exercise	☐	☐	☐	☐	☐	☐
j) Inclusion of environmental scoring in tender process	☐	☐	☐	☐	☐	☐
k) Highlight financial and non-financial incentives of sustainable development for clients and contractors during VM studies	☐	☐	☐	☐	☐	☐
l) Others, pls. specify:_____	☐	☐	☐	☐	☐	☐

11. Please rate the relative frequency of the following threats of Sustainability integrating into VM	**0**	**1**	**2**	**3**	**4**	**5**
a) Client's strategic planning do not incorporating sustainability objectives	☐	☐	☐	☐	☐	☐
b) Passive reaction by the client and service provider for fulfilling environmental and social needs	☐	☐	☐	☐	☐	☐
c) Belief that trade-off requirements among the principles of sustainability	☐	☐	☐	☐	☐	☐
d) Perceived additional time required for sustainable measures	☐	☐	☐	☐	☐	☐
e) Negative perception of green buildings in terms of additional cost	☐	☐	☐	☐	☐	☐
f) Strong perception that integration of sustainability issues into VM studies may slow down the progress of the studies	☐	☐	☐	☐	☐	☐
g) Lack of knowledge, understanding and importance of sustainable development	☐	☐	☐	☐	☐	☐
h) VM facilitator's fear of extra responsibilities for highlighting importance of sustainable development	☐	☐	☐	☐	☐	☐
i) Ignoring VM facilitator recommendations for achieving sustainability objectives due to clients' limited budget or other prior commitments	☐	☐	☐	☐	☐	☐
j) No end users' involvement in sustainable design and development process	☐	☐	☐	☐	☐	☐
k) No compulsory regulations for implementing sustainable development measures, implementation is only an option	☐	☐	☐	☐	☐	☐
l) Corporate image could be damaged for not implementing sustainable practices	☐	☐	☐	☐	☐	☐
m) Others, pls. specify:_____	☐	☐	☐	☐	☐	☐

Further comments on Integration of Sustainability into VM

_____

_____

_____

_____

_____

_____

Please return the completed questionnaire to Dr. Ann Yu, Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, by post, email ann.yu@polyu.edu.hk, or fax: (852) 2764 5131.

If you are interested in receiving the overall results, please provide the following details:

Name: _____ **Position:** _____

Organization: _____

Address: _____

Telephone No.: _____**Fax No.:** _____ **Email address:** _____

****End of questionnaire****

Thank you for your cooperation!

Pls. return by email, fax or mail.

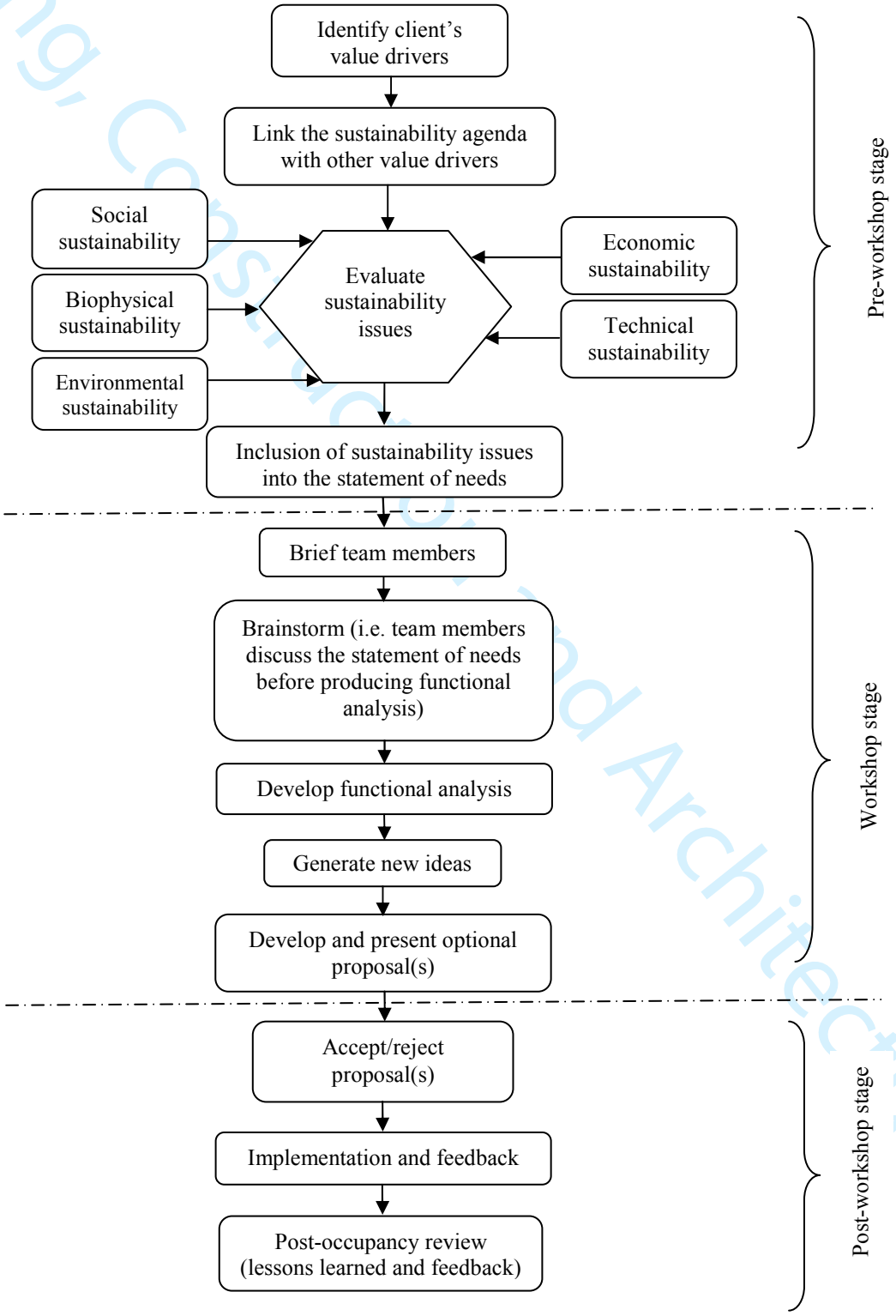

Figure 1: Stages of integration of sustainability into value management process (adapted from Abidin and Pasquire 2007)

Table 1. Operationalization of constructs

	VM Attributes	References
Strengths	VM provides opportunities for multidisciplinary professionals and stakeholders to become involved and focus on issues relating to society and the environment	(Shen and Yu 2012)
	Stakeholders are strongly encouraged to propose sustainable solutions at an early stage	
	An effective VM process allows sustainability measures to be integrated during the conceptual and early design stages	(Fewing 2005)
	The strategic timing of the VM process enables the sustainability agenda to be highlighted at a critical decision-making stage	(Ramly et al. 2015)
	The VM workshops provide diverse knowledge sources for sustainable development	(Shen and Yu 2012)
	The VM workshops recommend solutions for energy- and resource-efficient buildings	(Tahir et al. 2016)
	Long-term proposal criteria, such as adaptability for future changes, whole-life costs and select renewable resources, are considered during VM exercises	(Fewing 2005)
	VM promotes sustainable project design	(Yeomans 2002)
	The optimum use of natural resources is recommended	(Better Buildings Summit 2003)
	During VM studies, solutions are proposed that promote a safe and healthy environment for the occupants	(Yates 2003)
Weaknesses	The lack of well-trained staff and expertise of VM participants in relation to sustainable development	(Al-Saleh and Taleb 2010)
	The lack of client support in achieving sustainable construction during the VM exercise	
	Unclear project briefs, poor specifications or inadequate business cases for achieving sustainable development	(Oke and Aigbavboa 2017)
	The lack of incentives for clients/contractors to achieve sustainable development goals	
	The additional management and operational costs of sustainability measures for the project	(Al-Saleh and Taleb 2010)
	The lack of legal government enforcement of sustainability policies	(Organisation for Economic Co-operation and Development 2010)
	The difficulty of enforcing environmental performance	
	The lack of contractor, sub-contractor and supplier cooperation in achieving sustainability goals	(Al-Saleh and Taleb 2010)
	The VM facilitator and/or client does not highlight the role of corporate social responsibility in achieving the environmental and sustainable needs of society during the VM process	(Oke and Aigbavboa 2017)
	The lack of sustainability integration into VM studies	(Abidin and Pasquire 2005; Abidin and Pasquire 2007)
	The lack of sustainable construction guidance	
	The lack of technological support for achieving sustainability objectives	(Al-Saleh and Taleb 2010)
Opportunities	Encouraging the reduction, reuse and recycling of construction and demolition waste	(Abidin and Pasquire 2005)
	The VM process encourages the application of environmentally friendly technologies on site	
	Promoting the client's interest in sustainability as a primary value driver	(Abidin and Pasquire 2005; Fewing 2005)
	Including sustainability issues in the VM practices early on	(Abidin and Pasquire 2005)
	VM is a mechanism proved capable of delivering better sustainable value	
	Highlighting the financial and non-financial incentives of sustainable development for clients and contractors during VM studies	(Fewing 2005)
	Establishing a waste management plan during VM exercises	
	Introducing sustainability guidance for VM practitioners	(Abidin and Pasquire 2005)
	Including environmental scoring in the tender process	
	Providing in-house training for environmental management	
	The legal enforcement of environmental protection and the implementation of sustainable practices	
Threats	The perceived additional time required for sustainable measures	(Al-Saleh and Taleb 2010)
	The client and service provider react passively in fulfilling environmental and social needs	(Abidin 2005)
	The belief that the principles of sustainability should require trade-offs	(Shen and Yu 2012)
	The strong perception that integrating sustainability issues into VM studies may slow down their progress	(Shen et al. 2015)
	The negative perception of green buildings in terms of the additional cost involved	(Shen and Yu 2012)
	The client's strategic planning does not incorporate sustainability objectives	(Abidin and Pasquire 2005)

Ignoring the VM facilitator's recommendations for achieving sustainability objectives due to the client's limited budget or other prior commitments	(Oke and Aigbavboa 2017)
The organization's corporate image could be damaged due to its failure to implement sustainable practices	(Pitt et al. 2009)
The end users' lack of involvement in the sustainable design and development process	(Williams and Dair 2007)
The lack of knowledge and understanding of the importance of sustainable development	
The lack of compulsory regulations for implementing sustainable development measures, and the status of implementation as an option	(Shen and Yu 2012)
The VM facilitator's fear of the extra responsibilities involved in highlighting the importance of sustainable development	

Table 2. Test of Cronbach's alpha

Question number	*N*	Cronbach's alpha
8	10	0.920
9	12	0.923
10	11	0.891
11	12	0.862

Note: N=number of items in each survey question

Table 3. Test of concordance for sustainability and VM survey

Question number	*N*	Chi-square χ^2	df	Significance level from *SPSS* output	Critical value of Chi-square χ^2 at a = 0.001	Null hypothesis
8	10	63.805	9	<0.001	27.87	R
9	12	31.850	11	<0.001	31.26	R
10	11	20.898	10	<0.001	29.59	A
11	12	29.099	11	<0.001	31.26	A

Note: Total sample size = 73; *N* = number of items in each question; df = degree of freedom; A = accept; R = reject.

Table 4. Descriptive statistics of the SWOT attributes of integrating sustainability into the VM process

			Five-point Likert scale					TOTAL	∑W	Mean	RII	Rank
	Code	VM Attributes	1	2	3	4	5					
Strengths	S3	VM provides opportunities for multidisciplinary professionals and stakeholders to become involved and focus on issues relating to society and the environment	1	2	11	33	26	73	300	4.1096	0.822	1
	S9	Stakeholders are strongly encouraged to propose sustainable solutions at an early stage	3	2	19	31	18	73	278	3.8082	0.762	2
	S6	An effective VM process allows sustainability measures to be integrated during the conceptual and early design stages	3	3	17	34	16	73	276	3.7808	0.756	3
	S4	The strategic timing of the VM process enables the sustainability agenda to be highlighted at a critical decision-making stage	1	4	20	35	12	72	269	3.7361	0.747	4
	S2	The VM workshops provide diverse knowledge sources for sustainable development	2	3	17	42	9	73	272	3.726	0.745	5
	S1	The VM workshops recommend solutions for energy- and resource-efficient buildings	2	5	16	42	8	73	268	3.6712	0.734	6
	S8	Long-term proposal criteria, such as adaptability for future changes, whole-life costs and select renewable resources, are considered during VM exercises	2	5	19	37	10	73	267	3.6575	0.732	7
	S5	VM promotes sustainable project design	3	5	21	34	10	73	262	3.589	0.718	8
	S10	The optimum use of natural resources is recommended	3	6	26	27	11	73	256	3.5068	0.701	9
	S7	During VM studies, solutions are proposed that promote a safe and healthy environment for the occupants	3	10	22	33	5	73	246	3.3699	0.674	10
Weaknesses	W3	The lack of well-trained staff and expertise of VM participants in relation to sustainable development	5	8	22	31	7	73	246	3.3699	0.674	1
	W4	The lack of client support in achieving sustainable construction during the VM exercise	4	13	21	26	9	73	242	3.3151	0.663	2
	W7	Unclear project briefs, poor specifications or inadequate business cases for achieving sustainable development	5	11	20	30	7	73	242	3.3151	0.663	3
	W6	The lack of incentives for clients/contractors to achieve sustainable development goals	5	13	19	23	11	71	235	3.3099	0.662	4
	W2	The additional management and operational costs of sustainability measures for the project	1	16	20	30	5	72	238	3.3056	0.661	5
	W1	The lack of legal government enforcement of sustainability policies	6	12	18	30	7	73	239	3.274	0.655	6
	W8	The difficulty of enforcing environmental performance	6	13	18	28	8	73	238	3.2603	0.652	7
	W5	The lack of contractor, sub-contractor and supplier cooperation in achieving sustainability goals	5	13	24	25	6	73	233	3.1918	0.638	8
	W12	The VM facilitator and/or client does not highlight the role of corporate social responsibility in achieving the environmental and sustainable needs of society during the VM process	8	12	23	23	7	73	228	3.1233	0.625	9
	W10	The lack of sustainability integration into VM	2	23	23	21	3	72	216	3	0.600	10

		studies										
	W11	The lack of sustainable construction guidance	6	17	23	23	3	72	216	3	0.600	11
	W9	The lack of technological support for achieving sustainability objectives	9	24	18	21	1	73	200	2.7397	0.548	12
Opportunities	O6	Encouraging the reduction, reuse and recycling of construction and demolition waste	1	3	12	45	12	73	283	3.8767	0.775	1
	O7	The VM process encourages the application of environmentally friendly technologies on site	1	1	17	41	13	73	283	3.8767	0.775	2
	O3	Promoting the client's interest in sustainability as a primary value driver	1	8	12	31	21	73	282	3.863	0.773	3
	O1	Including sustainability issues in the VM practices early on	1	3	18	36	15	73	280	3.8356	0.767	4
	O4	VM is a mechanism proved capable of delivering better sustainable value	2	1	18	43	9	73	275	3.7671	0.753	5
	O11	Highlighting the financial and non-financial incentives of sustainable development for clients and contractors during VM studies	2	3	18	39	11	73	273	3.7397	0.748	6
	O9	Establishing a waste management plan during VM exercises	0	2	30	30	11	73	269	3.6849	0.737	7
	O2	Introducing sustainability guidance for VM practitioners	1	6	21	32	13	73	269	3.6849	0.737	8
	O10	Including environmental scoring in the tender process	1	7	21	32	12	73	266	3.6438	0.729	9
	O8	Providing in-house training for environmental management	1	3	26	36	7	73	264	3.6164	0.723	10
	O5	The legal enforcement of environmental protection and the implementation of sustainable practices	2	5	25	32	9	73	260	3.5616	0.712	11
Threats	T4	The perceived additional time required for sustainable measures	1	12	13	37	10	73	262	3.589	0.718	1
	T2	The client and service provider react passively in fulfilling environmental and social needs	2	8	14	44	5	73	261	3.5753	0.715	2
	T3	The belief that the principles of sustainability should require trade-offs	3	11	22	29	8	73	247	3.3836	0.677	3
	T6	The strong perception that integrating sustainability issues into VM studies may slow down their progress	4	9	23	30	7	73	246	3.3699	0.674	4
	T5	The negative perception of green buildings in terms of the additional cost involved	3	8	21	32	9	73	255	3.4932	0.699	5
	T1	The client's strategic planning does not incorporate sustainability objectives	1	11	23	27	11	73	255	3.4932	0.699	6
	T9	Ignoring the VM facilitator's recommendations for achieving sustainability objectives due to the client's limited budget or other prior commitments	3	12	22	29	7	73	244	3.3425	0.668	7
	T12	The organization's corporate image could be damaged due to its failure to implement sustainable practices	2	9	29	29	4	73	243	3.3288	0.666	8
	T10	The end users' lack of involvement in the sustainable design and development process	3	13	22	28	7	73	242	3.3151	0.663	9
	T7	The lack of knowledge and understanding of the importance of sustainable development	4	15	17	29	8	73	241	3.3014	0.660	10
	T11	The lack of compulsory regulations for implementing sustainable development measures, and the status of implementation as an option	4	10	27	25	7	73	240	3.2877	0.658	11
	T8	The VM facilitator's fear of the extra responsibilities involved in highlighting the importance of sustainable development	7	21	22	16	7	73	214	2.9315	0.586	12

Table 5. Statistically significant Mann Whitney *U*-test results for integrating sustainability into the VM process

Question number	SWOT analysis attributes of integrating sustainability into the VM process	Client and VM facilitator	Client and VM participants	VM facilitator and participants
		p at α = 0.05	*p* at α = 0.05	*p* at α = 0.05
8(d)	The strategic timing of the VM process enables the sustainability agenda to be highlighted at a critical decision-making stage	.030*	-	.003*
8(f)	An effective VM process allows sustainability measures to be integrated during the conceptual and early design stages	-	.021*	.001*
8(g)	During VM studies, solutions are proposed that promote a safe and healthy environment for the occupants	-	-	.016*
8(h)	Long-term proposal criteria, such as adaptability for future changes, whole-life costs and select renewable resources, are considered during VM exercises	-	-	.027*
9(i)	The lack of technological support for achieving sustainability objectives	-	.031*	-
10(d)	VM is a mechanism proved capable of delivering better sustainable value	-	-	.017*
10(g)	The VM process encourages participants to apply environmentally friendly technologies on site	-	-	.048*
11(d)	The perceived additional time required for sustainable measures	-	.045*	-
11(e)	The negative perception of green buildings in terms of the additional cost involved	-	.014*	.018*
11(i)	Ignoring the VM facilitator's recommendations for achieving sustainability objectives due to the clients' limited budgets or other prior commitments	-	-	.038*

Notes: *Significant difference at the 95% confidence level. *Asymp. Sig. (2 tailed)* Total sample size=73 (clients=13, VM facilitators=19, VM participants/team members=41).

Table 6. Statistically significant Kruskal-Wallis test results

Question number	SWOT analysis attributes of integrating sustainability into the VM process	χ^2	*p*-value
8(d)	The strategic timing of the VM process enables the sustainability agenda to be highlighted at a critical decision-making stage	10.038	.007*
8(f)	An effective VM process allows sustainability measures to be integrated during the conceptual and early design stages	13.218	.001*
10(d)	VM is a mechanism proved capable of delivering better sustainable value	6.193	.045*
11(e)	The negative perception of green buildings in terms of the additional cost involved	9.507	.009*

Notes: *Significant difference at the 95% confidence level. *Asymp. Sig. (2 tailed)* Total sample size=73 (clients=13, VM facilitators=19, VM participants team members=41).

Table 7. Descriptive statistics of the SWOT attributes of integrating sustainability into the VM process (mean values)

SWOT attributes	Clients	VM facilitators	VM participants	Overall mean values	RII
Strengths	3.80	4.00	3.50	3.70	0.739
Weaknesses	3.39	3.12	3.13	3.17	0.637
Opportunities	3.88	3.84	3.63	3.73	0.748
Threats	3.61	3.23	3.34	3.36	0.674