

Impact of Value Engineering on Construction Project Management and Achievement of Sustainable Development

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Abstract - In the realm of a modern building, sustainability and value enhancement are crucial factors. As a result, a construction project's value may increase as a result of the integration of sustainability and Value Engineering (VE). Therefore, the goal of this research was to create a framework that combines VE and sustainability ideas in Egypt's construction industry to increase project values. It's well known that Value engineering is an effective strategy for reducing costs and raising quality, particularly given the importance of the building sector to the global economy. Value engineering has been shown to have positive effects on the environment and the global trend of green construction, in addition to project prices and quality. Value engineering takes into account both the up-front and ongoing costs. Sustainable development is an approach that satisfies present needs without jeopardizing the ability of future generations to satiate their own needs. The sustainability approach takes into account all available resources, including water, energy, and the entire lifecycle of material, from its inception as raw materials to its eventual recycling.

Keywords: value engineering, cost, construction management, sustainable development.

I. INTRODUCTION

Quality, dependability, longevity, and better performance throughout a project's life are regarded as critical deliverables in the construction industry. Combining the ideas of "sustainable" and "Value Engineering (VE)" (Mahadik 2015). Furthermore, both sustainable and VE solutions are becoming increasingly popular in the modern building sector due to economic uncertainties and urbanization (Andelin et al. 2015). Value enhancement is the underlying justification for creating the two concepts in order to accomplish their complementary goals. Wao (2015) asserts that VE may be utilized as a tool to effectively attain improved quality and performance standards

in building projects while Sustainable Construction (SC) can be used to do the same.

SC would assist the construction sector in moving toward sustainable development while taking into account socio-cultural, economic, and environmental concerns (Berardi 2013; Goel 2019). Therefore, a large value can be acquired by taking sustainable principles into account and concentrating primarily on the built environment (Andelin et al. 2015). However, the construction industry has been slow to adopt sustainable practices, mostly because green applications are expensive and there aren't enough customer demands (Zhang et al. 2011; Wao et al. 2016; De Paula et al. 2017). Morris, however, has stated that sustainability objectives may result in a 30% increase in a building's overall cost (as cited in Wao et al. 2016).

The Society of American Value Engineers (SAVE) defines value engineering (VE) as the systematic use of known approaches to determine the function of a good or service by determining its worth and delivering it for the least amount of money possible (Wao 2015). In addition, VE is a subset of value management, together with value planning and value analysis (Karunasena et al. 2016). Tom and Gowrisankar (2015) claim that it concentrates on the needed function's performance, maintainability, safety, and aesthetics at the lowest possible life cycle cost.

Therefore, Mahadik (2015) considered the integration of VE and SC as a technique that may be used to overcome the hurdles of SC since she believed that VE could maximize the value provided through SC.

Furthermore, the combination of SC and VE won't have a negative effect on construction projects, claim Abidin and Pasquire (2005). Therefore, VE is frequently applied at the beginning of a project as a motivator for reaching sustainable goals (Vorakulpipat et al. 2010).

Despite the fact that the construction industry is acknowledged as one of the major contributors to a country's economy, it is also recognized as a leading emitter of greenhouse gases, with 33 percent of greenhouse-gas emissions attributable to construction operations (Chau et al. 2015). Additionally, buildings use around 40 percent of the energy produced worldwide (Lu et al. 2020). Therefore, it is crucial to reduce such harmful effects on the environment and resources with a new environmental approach. But one of SC's hesitations is due to the expense. In this perspective, VE is frequently seen as a cost-cutting tool with similar goals to SC. As a result, numerous researchers have conducted investigations on the merging of VE and SC.

There have also been numerous research conducted in Egypt. For instance, a framework for SC that is appropriate for Egypt has been established by Athapaththu and Karunasena (2018). Karunasena et al. (2016) and Senarathne et al. (2014) established an integrated framework that focuses on value planning and sustainability, each of which focuses on a distinct component of value management (value management comprises value planning, VE, and value analysis) (Potts and Ankras 2013). The integration of VE and SC, however, has not been the subject of many investigations. Consequently, in contrast to Karunasena et al. (2016) and Senarathne et al., this study focuses exclusively on VE in-depth (2014).

According to Kosala and Karunasena (2015), the Egyptian building industry does not support VE suggestions or other sustainable alternatives. This is primarily due to ignorance and a lack of understanding of the principles. Additionally, the study is needed to determine the best real-world applications for the Egyptian building sector. Therefore, the goal of this research was to provide a framework for integrating VE and SC in construction and raising the value of projects in Egypt's construction industry.

1.1 Research Objectives

The objectives that were formulated to achieve this aim were (1) to review the existing knowledge of VE and sustainability in the construction industry, (2) to explore the potential of integrating VE and sustainability in the construction industry, (3) to review the existing state of the application of VE and sustainability concepts in the Egyptian construction industry, and (4) to develop a framework to integrate VE and sustainability to improve project value in the Egyptian construction industry.

Sustainability in the built environment is a goal of sustainable construction (SC):

The idea of sustainability first appeared in early human civilization as the Bushmen of South Africa (Hill and Bowen

1997). Environmental degradation, the depletion of natural resources, and related socioeconomic issues have raised concerns about sustainability around the globe (Chen et al. 2010).

Many industries have now adopted sustainability, and today's society is urged to do the same in order to improve the globe (Zhang et al. 2011).

Due to a paradigm shift brought about by sustainability, the construction industry dominates in this regard (Schropfer et al., 2017). In order to reduce the overall environmental impact of built assets throughout the course of their lives, sustainability concepts are now being incorporated into the construction process (Ahn et al. 2010, Opoku and Ahmed 2014, Chamikara et al. 2020). Therefore, sustainability can be applied in building projects to strike a balance between value and risk (Rahman and Esa 2014).

If the building sector wants to accomplish the 17 sustainable development goals set forth by the United Nations under its Agenda 2030, sustainability will be essential (Goel 2019). The

The two objectives "sustainability and resilience in infrastructure" and "cities" are tied to the construction industry directly, and the sector indirectly affects objectives relating to poverty, hunger, health, education, gender equality, energy, and climate change (Casier 2015).

These sustainable development objectives can be accomplished through SC because it is a method for enhancing human well-being so that people can coexist with their surroundings without hurting the ecosystems (Brandon and Lombardi 2010; Spindler 2013; Wao 2017).

Therefore, energy usage reduction in the built environment and natural resource protection, which will benefit future generations, have emerged as the primary factors for sustainable performance (Airaksinen and Matilainen 2011; Samari et al. 2013; Enshassi et al. 2016).

SC adoption involves a cradle-to-grave strategy. Beginning with the abstraction of raw materials, it culminates in the destruction of a thing after it has undergone design and construction (Tan et al. 2011; Chamikara et al. 2020). Therefore, SC must satisfy organizational criteria, such as work practices in design, construction, and facilities management, as well as technological needs (e.g., technologies to increase energy performance).

While several researchers have categorized SC under different themes, as shown in Table 1, Hakkinen and Belloni (2011) have broadly categorized sustainability impacts into

three categories: environmental, economic, and social. As shown in Table 1, different researchers have classified SC under various themes. However, Hakkinen and Belloni (2011) have broadly categorized sustainability impacts into three categories: environmental, economic, and social.

Despite the benefits of SC, the prevailing consensus is that green building takes more time and money to complete (Wao 2017; Yu et al. 2018). Additionally, there is a financial risk associated with implementing SC because project costs may be higher than anticipated (Onsarigo et al. 2014). Additionally, inadequate policy enactments and the client's lack of comprehension and knowledge serve as barriers to the implementation of SC (Hakkinen and Belloni 2011; Zhang et al. 2011). Additionally, investigations have found that while practitioners are aware of SC, its implementation has been limited thus far (Abidin 2010; Son et al. 2011; Annunziata et al. 2016). It has been determined that integrating sustainability and VE is a workable strategy for overcoming the difficulties associated with implementing SC because it will increase the

long-term worth of construction while increasing its financial profitability (Al-Saleh and Taleb 2010). Despite this situation, Athapaththu and Karunasena (2018) discovered that Egypt's construction sector is still unprepared for SC.

II. CONSTRUCTION INDUSTRY AND VALUE ENGINEERING (VE)

Techniques for value management focus on determining, maximizing, and achieving value for money, where the total value is targeted (Potts and Ankrah 2013). (Potts and Ankrah 2013). In other words, it is a general term used to refer to value techniques such as value planning (used during the project concept stage), value engineering (used during the design and construction phase), and value analysis (used at any point of the life cycle to measure the effectiveness) (Potts and Ankrah 2013; Kelly et al. 2014). A multidisciplinary team of professionals can work together using VE, a systematic, organized, and function-oriented strategic tool, to improve the quality and performance of their systems or services at the lowest possible cost (Wao et al. 2016; Yu et al. 2018).

Table 1. Sustainable construction themes.

Sustainable Construction Themes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	
Minimization of resource consumption			x	x	x	x			x				x	x	x		x	x	x			x	x		x	x	x	x	x	x	19	
Use of renewable resources	x	x	x	x					x	x			x	x							x					x	x	x	x	x	18	
Minimising energy in usage	x	x	x	x					x				x	x	x						x					x	x	x	x	x	18	
Use of recyclable resources	x		x	x				x	x	x	x	x	x													x	x	x	x	x	17	
Conserving water resources	x	x	x	x					x												x					x	x	x	x	x	16	
Waste management		x	x	x					x												x				x	x	x	x	x	x	15	
Creation of a healthy and non-toxic environment			x	x					x	x			x	x										x	x	x	x	x	x	x	14	
Avoiding pollution	x	x							x												x					x	x	x	x	x	14	
Enhancing the quality of life and offer customer satisfaction	x								x	x											x					x	x	x	x	x	13	
Minimising energy in construction	x			x	x				x																	x	x	x	x	x	12	
Respecting people and their local environment		x							x	x																	x	x	x	x	x	11
Site design and planning				x																							x	x	x	x	x	10
Life cycle cost reduction	x																														9	
Improvement of indoor air quality				x	x																										9	
Health and safety in construction				x	x	x																									8	
Promotion of socio-economic uplifting				x																											6	
Pursuance of quality in creating the built environment																															5	
Enhancement of serviceability, durability and reliability		x																													5	
Promotion of employment opportunities																															4	
Reduction in maintenance costs		x																													4	
Enhancement of the economy																															4	
Consideration of material costs																															3	
Preservation and enhancement of bio-diversity		x																													3	
Uplifting of innovation and design process																															3	
Optimisation of land use																															3	

(1) Horne as cited in (Al-Yami and Price 2005) (2) Pitt et al. 2009 (3) Adjarko et al. 2015 (4) Shafii et al. 2006 (5) Ensassi and Mayer 2005 (6) Farzanehrafat et al. 2015 (7) Akotia 2014 (8) Miyatake as cited in (Al-Yami and Price 2005) (9) DETR as cited in (Al-Yami and Price 2005) (10) GCCP as cited in (Al-Yami and Price 2005) (11) Mahadik 2015 (12) Kibert 1994 (13) Samari et al. 2013 (14) Dewick and Miozzo 2002 (15) Airaksinen and Matilainen 2011 (16) Aarseth et al. 2017 (17) Hill and Bowen 1997 (18) Chen et al. 2010 (19) Ahn et al. 2010 (20) Enshassi et al. 2016 (21) Tan et al. 2011 (22) Liu et al. 2015 (23) Hajek as cited in (Al-Yami and Price 2005) (24) Wijesooriya et al. 2015 (25) BREEAM as cited in (Fowler and Rauch 2006; Sebake 2009; Portalatin et al. 2015) (26) LEED as cited in (Fowler and Rauch 2006; Sebake 2009; Portalatin et al. 2015) (27) Green Star as cited in (Younker 2003; Portalatin et al. 2015) (28) CASBEE as cited in (Fowler and Rauch 2006) (29) GBTool as cited in (Fowler and Rauch 2006) (30) Green Globes as cited in (Younker 2003).

In order to improve the safety, functional performance, maintainability, and aesthetics of the functions, VE facilitates cost-effective solutions, time savings, quality improvements, and whole life cycle cost reductions (Atabay and Galipogullari 2013; Uddin 2013; Tom and Gowrisankar 2015; Bhokare et al. 2017). Consequently, VE is a tool for enhancing value as well as decreasing costs (Al-Saleh and Taleb 2010). Bhokare et al. (2017) noted that for a project to profit from VE, it must be either expensive or complex, highly transparent, with repetitive costs and condensed design programs.

Although VE may have significant advantages, professionals are hesitant to adopt it for a variety of reasons, including a lack of knowledge, decisions based on incorrect assumptions, bad habits, undesirable attitudes, a refusal to seek advice, a lack of time, technological advancements, and poor social relationships (Atabay and Galipogullari 2013; Karunasena and Kosala 2017). In order to overcome these challenges and adopt VE, scholars have identified the VE Job Plan, Functional Analysis Systems Technique (FAST), and Delphi Method (Cheah and Ting 2005). These methods take into account the various VE implementation needs (Chavan

2013). The six-stage job plan suggested by SAVE was applied in this study (Society of American Value Engineers).

These are the job plans:

The phase of information gathering: Background, purpose, and requirement information are gathered for the project's many components (Ilayaraja and Eqyaabal 2015; Mahadik 2015; Tanko et al. 2018).

The phase of function analysis: Identification and analysis of the function (Wao 2015). Each function is analyzed to see how important it is to the performance (Chung et al. 2009).

The phase of invention: Alternative strategies are created based on functional analysis (Chung et al. 2009). To produce a set of alternatives, brainstorming and accommodating new concepts are utilized as methods (Tom and Gowrisankar 2015; Tanko et al. 2018).

Evaluation phase: Unworkable or unworthy of further investigation alternatives are eliminated (Chung et al. 2009). Using idea comparison, feasibility rating, and analysis matrix, options are sorted and grouped to choose workable alternatives (Chavan 2013; Ilayaraja and Eqyaabal 2015).

The phase of development: To offer to the owners, the chosen solutions or concepts are developed into proposals (Tom and Gowrisankar 2015). Comprehensive technical and economic analysis is performed to provide the final recommendations on the likelihood that the plans will be implemented successfully (Sharma and Belokar 2012).

Presentation phase: The project owner is provided with a proposal for approval along with information on cost reductions and other supporting materials (Chung et al. 2009; Wao 2015).

It is clear that in order to achieve the optimum results, VE must be methodically implemented into the construction project in the job plan. As a result, a framework was created based on the task plan to incorporate sustainability and VE.

III. VALUE ENGINEERING'S USE OF THE SUSTAINABLE BUILDING (SC) (VE)

Both VE and SC are employed to uphold a project's quality, dependability, and durability as well as to boost its performance over the course of its life cycle (Mahadik 2015). According to Wao (2015), VE can be used as a tool to accomplish these goals. Sustainability concepts are developed to increase the value of construction projects. According to recent studies, VE makes it easier to choose the system that

would deliver the best sustainable solutions (Karunasena et al. 2016; Wao et al. 2016).

As a result, academics have frequently suggested combining VE with sustainability to produce sustainable projects and increase the value of the building (Al-Saleh and Taleb 2010; Wao 2018). During the lifespans of the construction projects, this integration will also make it easier to promote and include sustainable and economical designs and development (Shen and Yu 2012; Yu et al. 2018).

Therefore, it is clear that integrating environmental ideas with VE will make them more useful and effective. The anticipated benefits will give the client better value for their investment, and other stakeholders will also benefit in terms of the sustainability of the environment, economy, and society (Senarathne et al. 2014).

Time constraints, a lack of guidance on sustainability standards, a lack of understanding and awareness of sustainability, and contradictory sustainability perspectives have all been identified in previous research as challenges to integrating sustainability with VE (Abidin and Pasquire 2007). A structured VM Job Plan, on the other hand, can successfully direct the inclusion of sustainability issues during a building life cycle, as indicated by Yu et al. (2018).



Figure 1: Sustainable development

IV. RESEARCH METHODOLOGY

Because of the nature of the research, a hybrid strategy had to be used. A mixed strategy combines qualitative and quantitative methodologies, bridging the gaps between the corresponding elements of the two approaches (Johnson and Onwuegbuzie 2004; Harwell 2011), while also maximising the advantages of each approach and minimising its drawbacks (Creswell 2014).

Table 1 lists the 25 SC themes and 25 VE criteria that were found in the literature (Table 2). But in order to create the framework, it was required to pinpoint the most important VE criteria and SC themes among them. It was also required to determine the level of knowledge on the use of SC and VE in Egypt as well as the potential for merging the two ideas.

V. PLATFORM FOR SC AND VE INTEGRATION

It is evident from the results of the literature research that the rationales for the concepts of SC and VE are comparable. But it's necessary to research the viability of their integration in Egypt.

Given that sustainability is based on three pillars—economic, social, and environmental—and that not all of its benefits can be realized at once, VE could also be used as a tool to determine the combination that offers the highest value for money. Thus, by combining the advantages of the two concepts, VE and sustainability in the Egyptian construction industry will increase value addition in the nation's construction projects. Therefore, the creation of a mechanism to combine the two notions was the next stage of the research.

Table 2. Fundamental aspects of VE.

VE Functions	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	
Cost optimization (Capital, operation & maintenance)	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16
Improve operational efficiencies	x				x	x	x	x	x	x	x	x			x	x				12
Construction time saving		x	x		x		x	x		x	x		x	x	x	x	x	x	x	13
Performance improvement					x		x	x	x	x	x		x		x				x	10
Quality improvement		x	x		x			x	x	x		x				x	x			10
Safety improvement			x	x			x	x					x			x			x	7
Healthy living environment				x		x	x	x	x					x	x				x	8
Client satisfaction				x			x	x				x	x			x			x	7
Reduce conflict and risks							x	x			x	x				x	x		x	7
Energy efficiency	x			x			x	x			x				x					6
Environment impact reduction			x	x		x		x				x		x						6
Reduce wastage of resources			x				x	x					x			x			x	6
Effective design	x						x	x	x											5
Aesthetics appearance										x	x	x				x	x			5
Water conservation			x										x	x						3
Manpower reduction						x		x						x					x	4
Attraction and retention of employees/occupants							x	x			x		x							4
Building weight reduction										x				x					x	3
Renewable resource usage				x				x		x										3
Minimisation of pollution				x				x											x	3
Land and material re-use				x	x			x												3
Reliability enhancement					x													x		2
Internal communication and common knowledge improvement								x			x		x							3
Creation of an environment with shared understanding	x																			1
Design deficiency isolation		x																		1

(1) Chavan 2013 (2) Atabay and Galipogullari 2013 (3) Wao 2015 (4) Abidin and Pasquire 2005 (5) Al-Yami and Price 2005 (6) Wao et al. 2016 (7) Dallas and Humphrey 2004 (8) Aghimien and Oke 2015 (9) Sharma and Belokar 2012 (10) Rane and Attarde 2016 (11) Coetzee 2009 (12) Green 1994 (13) Shen and Chung 2006 (14) Abdelghany et al. 2015 (15) Rangelova and Traykova 2014 (16) Kelly et al. 2014 (17) Rich and Holweg 2000 (18) Uddin 2013.

Analyzing the platform that may be utilized to combine the two notions was important in order to design the framework. The 'function analysis' stage was recognized as the stage during which the functions of a project might be identified based on the findings of the literature study. As a result, it was decided that this stage was the best one for integration.

While sustainability emphasizes minimizing consumption, which will also reduce wastage, VE places a strong emphasis on reducing waste. Similar to how efficiently energy can be used under VE, sustainability will result in minimal energy use. In the same way, water conservation and the development of a safe and non-toxic environment are addressed. Further evidence that both SC and VE care about customer happiness comes from the first layer analysis. Additionally, SC discusses environmental pollution prevention whereas VE focuses on minimizing environmental damage. As a result, the data made it feasible to pinpoint a connection

between sustainability and VE, proving that the two concepts may be combined.

On the other hand, it is discovered that the sustainable criterion "minimizing energy in usage" has the most associations with the VE functions. It has an indirect effect on cost optimization, resource waste reduction, environmental impact reduction, and performance improvement. Three VE functions are related to "reducing resource consumption," "reducing energy in construction," "enhancing indoor air quality," and "health and safety in construction." Both "respecting people and their local environment" and "conserving water resources" demonstrate a connection with "performance improvement." However, there are no indirect connections between "site design and planning" and "waste management."

Numerous researchers have been able to distinguish between VE functions and SC criteria individually. Even if

there were parallels between the two, they have neglected to acknowledge their connections. To fill this vacuum in the literature, this study was created. Furthermore, it is important to keep in mind that some elements or criteria allow for the identification of secondary links even in the absence of direct relationships. These links served as the foundation for the integration of the SC and VE principles. (Younker 2003; Al-Yami and Price 2005; Fowler and Rauch 2006; Shen and Chung 2006; Aghimien and Oke 2015; Sebake 2009; Uddin 2013; Kelly et al. 2014; Portalatin et al. 2015)

Creating the framework to combine VE and SC

According to Goel (2019), the built environment’s construction and sustainable considerations are not organized systematically. The VE Job Plan served as the foundation for the development of the framework (Figure 2) for integrating VE and SC after taking into account the systematic character of VE and the interaction between SC and VE. The experts were therefore asked to specify the phases at which the VE Job Plan can be coupled with sustainable concerns and how to do so.

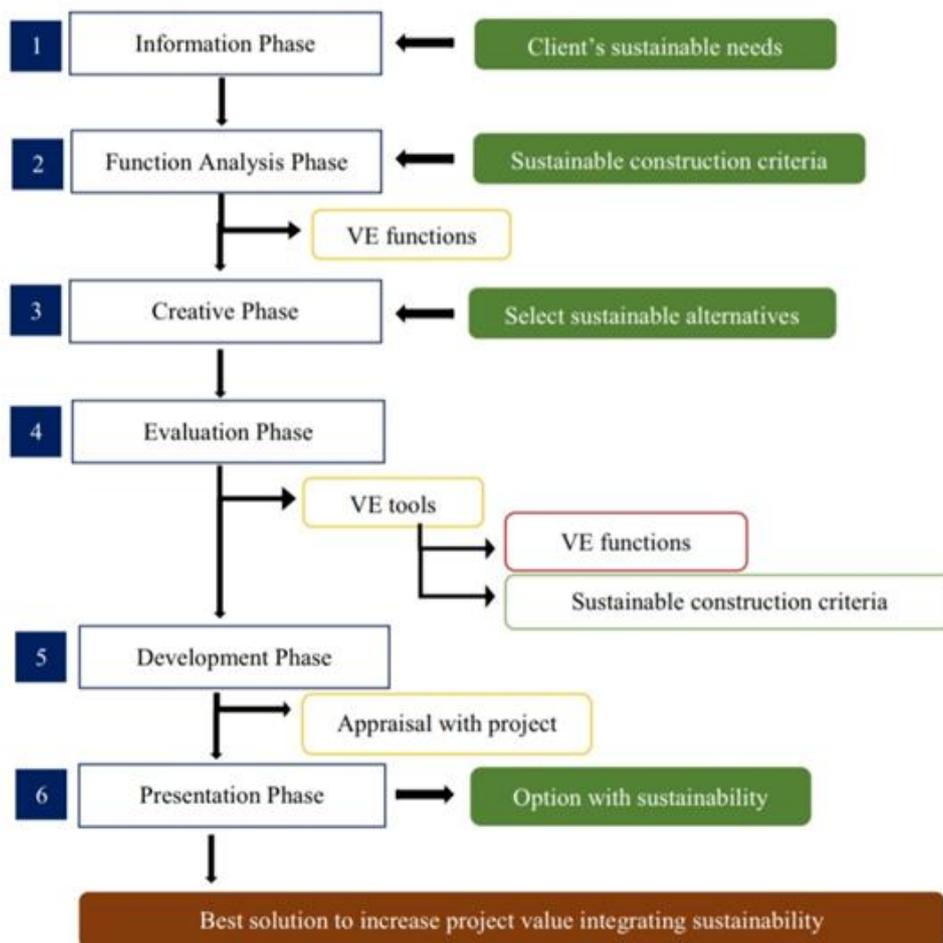


Figure 2: Integrated framework of VE and SC. (Gunarathne et. al., 2020)

The steps at which sustainability considerations can be included into the VE Job Plan are depicted in Figure 2. The information about the client and the needs for the project must be determined in the first step of the VE Job Plan (Mahadik 2015). Therefore, it is now necessary to determine the project’s potential for adopting sustainability-related demands, client requirements, and sustainability-related needs. In the “functional analysis” step, SC criteria must also be included in addition to the VE functions so that the functions of the elements can be assessed in relation to both VE and sustainability aspects.

In the “functional analysis” step, SC criteria must also be included in addition to the VE functions so that the functions of the elements can be assessed in relation to both VE and sustainability aspects. Strategies that increase the project’s value while ensuring its sustainability must be developed during the “creative” stage.

However, in order to develop the necessary strategy at this stage, brainstorming sessions must take into account both VE and sustainability issues (Tom and Gowrisankar 2015). Utilizing the right tools throughout the “assessment” phase will ensure that the chosen choice satisfies both sustainable

and VE standards. Accordingly, the roles and criteria must be ranked, and the best proposal must be chosen (Ilayaraja and Eqyaabal 2015). The best option must be chosen for implementation at the project's conclusion in order to maximise value for money and sustainability.

But it is clear that the framework for merging VE and SC will function well when put into practice during the "technical design," "development design," or "concept design" stages.

VI. RESEARCH IMPLICATIONS

Both SC and VE are intended to increase a construction project's value. The adoption of SC in the building sector will have a big impact on the nation's economy, environment, and social norms. On the other hand, VE is defined as the methodical use of well-known methodologies to perform the required functions at the lowest possible overall cost while increasing value. According to this perspective, academics have suggested combining SC and VE to economically gain from sustainable solutions.

Being a sector in a nation with several climatic and environmental issues, Egypt's building industry must carefully examine sustainable methods. However, due to a lack of a systematic strategy, sustainability issues have not yet been successfully incorporated into construction projects.

The integration of sustainability ideas and value planning in construction has been the subject of research by Senarathne et al. (2014) and Karunasena et al. (2016). But before integrating them, they must first seek to determine which stages are most appropriate for sustainable concerns.

Neither study has evaluated how the notions relate to one another. However, this study made an effort to thoroughly assess the relationship between the two ideas.

Only semi-structured expert interviews have been the emphasis of Senarathne et al. (2014) and Karunasena et al. (2016) for data collection. In order to create a framework that integrates VE and sustainability to increase project value in the Egyptian construction sector by analyzing the compatibility of the two ideas, this research used a hybrid approach, which benefits from both qualitative and quantitative approaches.

VII. RECOMMENDATIONS

To construction organizations:

Giving contractors' incentives when there is no design change, reducing contractor design responsibilities, increasing competitive advantages, and rewarding consultants for VE suggestions are just a few examples.

Contractors should: Recognize organizations and project teams using the VE technique; Approve green building certification for projects utilizing the technique; Request feedback from VE consultants or outside consultants; Request alternative proposals during the pre-construction stage; Allow consultants and contractors more time to review designs.

To improve communication on the job site and ensure that everyone has an equal opportunity to submit their ideas, allow consultants and contractors additional time to study designs. Establishing a good VE structure in organizations involved in the construction industry, introducing a point system for VE suggestions, adding a VE specialist to the design team, and encouraging project workers to submit proposals are all examples of mutual understanding among stakeholders.

For national-level construction authorities

Raise awareness of the VE technique among authorities and stakeholders (through lectures, seminars, and workshops, for example) Include the ICTAD VE clause in every construction contract that can be found include the VE clauses in client-consultant contracts Include the VE technique in the curriculum of contract-related courses in universities and institutes Reduce government spending Tax benefits for businesses using the VE approach Encourage the use of the VE methodology at the pre-contract stage, discourage overdesigns in favour of appropriate ones, improve benefit-sharing procedures, and have a government consultancy company review and approve designs.

VIII. CONCLUSION

In order to maximize value for money, the building sector uses SC and VE as independent methodologies. The merging of VE and SC will produce lasting results in a way that is both cost-effective and efficient because SC is regarded as a high-cost strategy and VE is perceived as a cost-reduction approach that enhances value.

As a result, by analyzing the SC themes and VE criteria, the study determined the connections between the two ideas and built a framework around them.

This study has shown that there is no set method for using the VE methodology in the construction business. Stakeholders immediately incorporate VE proposals into the project when they recognize the necessity for the VE technique. Although when evaluating a product's quality, consultants take into account both the original product's quality and the quality indicated in the specifications. It has been discovered that before applying the VE approach, stakeholders frequently do not take the project's life cycle

costs into account. The poor use of the VE approach in the building industry appears to be due to stakeholders' lack of awareness and a lack of government assistance.

As was noted in the literature review, the VE technique is considered to be extremely important to the building industry, according to industry professionals. The results of this study and other studies' findings in the literature showed how important it is for the construction industry to include the VE approach in projects.

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