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Barriers of value management implementation for building projects in Egyptian construction industry

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ABSTRACT

This research aims to address barriers and obstacles to the adoption of value management (VM) in the Egyptian building projects. Furthermore, the primary contribution of this research paper is to establish the current level of the VM implementation in the Egyptian construction industry which is the first research that appears this level. The research was limited to the regions of Cairo and Giza, and clients, consultants, and contractors with sufficient experience in building construction management are the key participants. With a view to find answers from those who work actively as part of the construction industry, a quantitative questionnaire survey was used. The analysis of the collected data was based on descriptive statistical tools. Research shows that the critical barriers in the construction industry are inadequate facilitation of skills and training, and difficulty in the involvement of decision-makers and other key partners in the VM workshop. The results constitute barriers to VM implementation in the country and its guidelines will significantly promote VM adoption, both in the country and in other developing nations, where the same projects are carried out. On the other hand, this study concluded that implementation and usage of the VM technology concept within the organization has a significant impact on professionals and management skills.

1. Introduction

Value Management (VM) is a powerful tool for the management of planning, design, and performance in various building project components. (VM) was produced in the industry sector in the United States by Miles at General Electric in the late 1940s due to a lack of parts for products after the Second World War and was used in the building industry at the beginning of 1960 [1]. At that time, alternative materials were common, but often because of the war, they were unlikely. This led to a quest not for other components, but rather for an alternative way of accomplishing the features of the component. This method resulted in cheap products without any noticeable lack of efficiency. The approach was taken at the end of the war, in both the removal and production of unnecessary costs of goods and, thus, the birth of value engineering process based on functional analysis [2]. VM is also known as the US Value Engineers Association (SAVE) or Value Assessment (VA) [3]. While some think tanks vary from VM and VA, generally, the VM can be used more commonly to reflect another approach for meaning [4]. The term VM is synonymous with VE and VA is used for convenience throughout the study.

Jaapar et al. [5] define (VM) as a multidisciplinary, team-oriented, organized, analytical and systemic method of analysis explicitly designed to give the most value through design and construction to consumer awareness. It promotes a method that begins at the planning stage and extends until the project is finished. This is why effective and productive construction practices during the life of building projects are critical. VM is capable of stimulating and reducing unnecessary costs while incorporating sustainable development in programs and budgetary conservation [4]. The call to raise the efficiency of the construction industry is driving public policies and seeking to reduce building costs since the government

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is a significant consumer in building projects [6]. This proposal was endorsed by Tanko et al. [7], who argued that VM unmistakably aims to optimize efficiency and achievement without losing value. A strategy for value for money and increased productivity seems to be internationally agreed in the VM industry [8]. Ellis et al. [9]confirmed that, if the VM is correctly applied at an initial phase of the project, the capital costs of the construction projects could be reduced by 10–25 percent. Past evidence suggests that the technique has reduced the cost of building projects by 5–10% [10].

VM is currently widely practiced in many countries around the world. Nevertheless, VM principles and implementations in the construction industry have proven to have not been well implemented in most developing countries [11]. For instance, VM is still in its infancy in Malaysia and China and is not widely accepted [5]. Therefore, the VM is seldom used in South-East Asia in the construction industry [12], and even less common in South Africa [13]. Malla [14] concluded that the VM concept had only been introduced in Nepal, although adoption of VM in the field of construction professionals in Myanmar and Nigeria is extremely slow [15]. Abdelghany et al. [16] stated that no systematic studies had yet been conducted in Egypt to examine Egyptian VM parties' understanding and implementation. However, in light of the author's experience in the field, it can be concluded that most of the Egyptian stakeholders do not have enough VM information, which is significantly ineffective in designs, and that the implementation of the SAVE International VM methodology is not accessible in Egypt because of a lack of understanding of the methodology. For reasons of cost reduction, practitioners are compromising the performance and even some of the elementary functions. Also, due to the formulation of uncoordinated teams, they do not appear to provide creative alternatives, although team formulation determines the success or failure of a VM study.

This finding that appeared from the Egyptian construction industry supported by, Oke and Ogunsemi [17] that in most developing countries the use of VM in the 1970s was widespread in many developed building industry sectors, for example, the USA, the UK, Hong Kong, and China and Australia [11,13,18] It has been often mandatory for general service management contracts in the United States and significant advances have been made in their implementation. A weak project supply industry that has contributed to the majority of client's dissatisfaction. VM would be one of the best ways to realize that achievement because it means achieving cost value by keeping costs down and searching for and deleting unnecessary resources, processes and manufacturing times [19,20]. [21] noted that construction companies in developing countries faced different types of problems because of their weak projects. For example, the project does not meet the project deadlines and the project ends with the projected budget and project results [22]. However, a variety of construction projects have been suspended or abandoned in the face of investment shortfall [11].

Nevertheless, the practice of VM remains a non-starter for the industry, despite recommendations to embrace VM, greater awareness among construction specialists and even the possibility that VM may be accomplished by being introduced. Oke and Ogunsemi [23]found that small VM workshops continue to be conducted and that the workshops were well concluded. However, there are still studies in progress in developing and globalized countries about VM barriers [11,22,24,25]. In order to encourage VM implementation, factors that have hindered VM implementation should be investigated to allow practitioners to identify barriers to sending, adopting and implementing VM strategies.

2. Research objective and contribution

The objectives of this study are:

a) To state the current practice, awareness and perception of VM in building projects in the Egyptian construction industry.
b) To identify the significant factors by ranking the impeding factors that affect the adoption of VM in building projects in the Egyptian construction industry based on the Relative Importance Index (RII).

The contributions of this study are:

a) Construction organizations would be interested to assess their VM practice and to identify which areas to enhance so that they can achieve improvement not only in cost but also in customer satisfaction, productivity, and quality.
b) The findings of this study will be useful to managers, engineers, researchers and top management as it will provide insights into specific areas that require adequate attention to ensure effective VM implementation.

3. Review of related literature

Most experts, researchers and practitioners in the construction sector have been interested in applying VM. Value management (VM) has become an approved method in the past decade, using tools and techniques that have been ordinarily understood [26]. Male et al. [27] define VM as a way to maximize project efficiency with the management of its framework for development and to use a proprietary, advanced, problematic or problematized program. In conjunction with this definition, Alan Short et al. [28] identified a structural or organized approach as a core concept for VM; a multidisciplinary analysis; functional analysis; start-up to complete; SAVE [29] more specifically defined VM as a cross-disciplinary systemic effort to study projects in order to provide the most significant benefit at the lowest overall cost. Kelly et al. [30] founded that VM was a practical development approach that could reduce capital and life cycle unnecessary costs. Abidin and Pasquire [31] noted that while customers tend to exert pressure to reduce cost, VM continued to see the capital improvements, the quality, profitability and excellent images of the market improve. Dallas [24] said that VM is entirely focused on the design of conducting organized workshops.

The first example is technically oriented and involves putting together the viewpoints of several people so as to ensure that the effort to satisfy business requirements is the right one. For this workshop SAVE [32] organized information, function analysis, innovation, assessment and development phases. This workshop encourages select team members to refine the project and build a cost-effective model [33]. Nevertheless, Aigbavboa et al. [20] pointed out that VM does not reduce costs but is primarily concerned with a project or component exercise. This means that a different cost management strategy can be accomplished without jeopardizing project performance and intent by implementing it at the lowest possible cost.

The VM is accessible in many developed countries throughout the world and has attracted a lot of attention in emerging countries [34]. This interest in developing countries may be due to the massive gains seen in developed countries with this entirely accepted theory. While past research in VM focuses on awareness, readiness for discipline and their advancement in developing countries, recent studies on the challenges of their implementation have been carried out. Al-Yami [35] described many significant problems that impeded the adoption of the VM in the public sector of Saudi Arabia: e.g. lack of information on VM requirements, standards, historical data, lack of time for the introduction of the VM, an inadequate understanding of VM and customer commitments, and other problems. The critical factors in the Malaysian construction industry

were the absence of knowledge of VM, the absence of support from the parties with authorities such as officials from government and owners and a lack of local guidelines on the implementation of VM [36]. In research into the effect of VM implementation in the same country, Jaapar et al. [5] have also confirmed this. This demonstrates that lack of knowledge, resistance to change among the parties and conflicting project goals between those parties are the major issues facing the VM workshop. It is not surprising that VM's lack of knowledge was another significant issue, although the time spent for implementing VM in Malaysia did not cause significant barriers. Also, Kim et al. [11] analysed the challenges of VM application in the Vietnamese building sector and identified four core components, including the absence of qualified VM staff, inherent VM workshop difficulties, lack of VM awareness and VM application records.

Coetzee [37] argued that stakeholders have not yet understood the functional advantages of the South African construction industry. A recent state study founded that lack of awareness of the training and public knowledge of stakeholders are the significant challenges faced by VM adoption [20]. In public projects in Ghana, 22 VM issues were examined by Kissi et al. [22] and five key components were identified. The following components provide obstacles to the VM team's implementation challenges, technical concerns and impediments in developing economies. Luvara and Mwemezi [25] also assessed the most significant obstacles to VM adoption for public buildings in Tanzania: lack of knowledge, wrong paths of procurement, and a lack of qualified skills.

Aduze [38] noted that the possibilities and challenges of VM implementation in Nigerian building projects. The study founded that lack of government legislation and policy, poor reception of clients, and lack of knowledge about VM in Nigeria are factors that hamper the implementation of the VM. In recent years, Ezezue [39] has found that the effectiveness of the VM program is prevented by inadequate focus and orientation towards VM values. Hayatu [40] also submitted the lack of government funding, lack of VM professionals, lack of commitment to implementing VMs. several issues that could impact the VM implementation of the construction industry are insufficient preparation and management support, and difficulties involved in the project processes of all main actors. Shen [41] also analysed VM knowledge and implementation in the building industry in Hong Kong and found three key reasons why VM was not used in its work environment, namely, lack of knowledge as to how VM should be implemented, lack of confidence in the introduction of VM to its customers and lack of time to implement VM. This study noted that the absence of awareness and knowledge of VM in client institutions is the reason that only, so few organizations have adopted VM as a strategy.

In the case of China, Cheah and Ting [12] concluded that the implementation of the VM is not difficult and that the main obstacles to VM are lack of expertise and the technical standards. The application of VM to the construction industry in Sri Lanka is relatively new and little is shown on the VM implementation in the construction industry [42]. The absence of standard procedures for the VM process, the inability of the construction industry to promote, advance and guide to integrating VM and the lack of information and advice regarding the benefits of VM were all reasons why the VM in Sri Lanka was insignificant. Fard et al. [43] have investigated 5 factors in the context of Iran, including outdated standards and specifications, traditional thinking, and negative attitudes, lack of local guidance, lack of knowledge, the practices in the construction industry, and changes to ownership requirement, that impede VM implementation in the building sector. Malla [14] has provided guidelines to assist in the application of VM in the building sector in Nepal, not recognizing the causes of obstacles. Malla's [14] guidelines included in the contractual agreement a possibilities clause for a re-proposal VM, a commitment by senior VM support management, VM-skilled teambuilding and time for VM implementation.

In the Indonesian construction industry, Latief and Vincentius Untoro [44] studied the VM of Infrastructure Services in the Department of Public Works. The 31 factors that influence VM's readiness for deployment from different sources were included, defining five significant factors: the number of VM qualified staff, the VM implementation strategy, the workforce composition, VM technology and management awareness, and the level of training offered to employees. In another study, Whyte and Cammarano [45] looked at infrastructure projects for implementing VM in western Australia's engineering sector, this study used a semi-structuring interview method. The study founded that time constraints, lack of understanding and participation of each team member have negative consequences on the success of the VM workshop. Based on the findings of this research work, each study reached various conclusions regarding impeding factors in respect of the elements that could hinder the use of VM in developing countries. It is also apparent that some triggers exist. Mostly, the participants are not adequately informed and comfortable with VM, lack of government and management support, as well as an unwillingness on the part of consumers to bear any additional costs.

Besides, lack of knowledge and lack of existing guidance on VM tends to discourage the adoption of the VM system. On the other hand, the lack of time has not been taken for VM to become one of the most significant challenges of the studies. Consequently, it is possible to say that the obstacles to VM adoption are likely to be similar in the way these developing countries execute projects.

4. Research methodology

This research would recognize the barriers and challenges in developing countries to implementing VM in order to improve the method's use in the construction industry by offering potential preventative measures. The research used the methodology of the questionnaire and examined building professionals who are involved directly in construction projects. It was designed to describe the characteristics of a population or phenomena. Since this study aims to identify and classify the factors affecting VM implementation; a descriptive survey could help the researcher to properly understand the construction industry and providing corrective measures or remedial systems from low-quality products.

The professionals were chosen based on the assumptions that they would have to be involved in project execution, especially by contractors, consultants and clients, while building projects were constructed. These include architects, electrical and quantity inspectors, structural engineers and mechanical engineers. Reports have been collected from their respective organizations, which help to assess them. Fig. 1 illustrates the research procedures.

4.1. Pilot survey (Questionnaire I)

The pilot study was conducted before evaluating the main survey. This was done after discussing all factors which were obtained from the literature review with fifteen experts by sending the first draft survey to 200 randomly selected construction workers. Based on a pilot test and experts' opinions, the final draft was modified. The validity and reliability of a research tool must be assessed, and accurate results obtained [46]. The validity of a test is the study of phenomena [47]. Two specific tests to assess the degree to which the elements of a research tool adhere and reflect the targeted research framework are the validity of form and content [48]. Further validity verification of the instrument was conducted

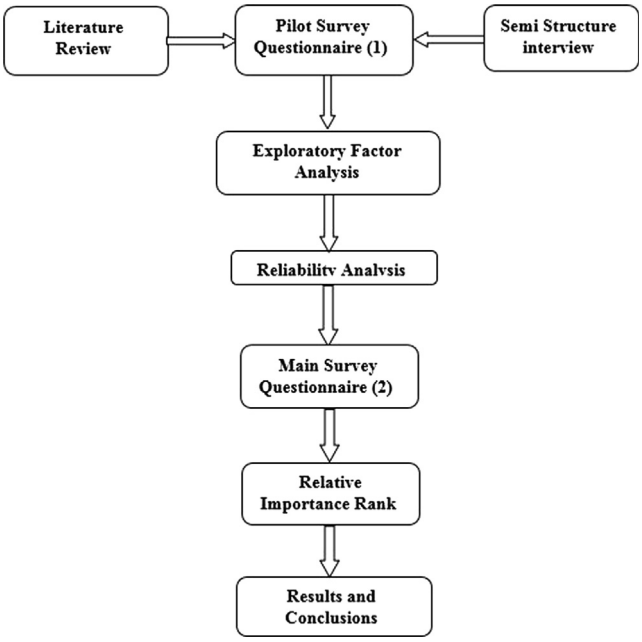

Fig. 1. Research flowchart.

via exploratory factor analysis (EFA). In this analysis, the sample number is 200, which is well within the range suggested by [52]. To study the dimensionality of these variables and improve the interpretation of factor loads, it was considered necessary to reduce these barriers to smaller numbers of coherent sub-scales. The Cronbach α test was also used to determine the reliability of the research tool. This method measures the reliability of the questionnaire between each field and the average of the whole questionnaire area.

4.2. Main survey (Questionnaire II)

As the objective of this research is to identify the major barriers that affect VM adoption in developing countries, the questionnaire survey was further used after pilot study to achieve this objective. Fellows and Liu [49] suggested that the initial use of the research tool (questionnaire), is to decide whether the questions are straightforward, easy to answer and accurate, as well as to develop the questionnaire and evaluate how much time the exercise will take to complete.

The study listed the RII-based variables in light of the mean ratings. According to Salleh [50], a statistical method used to define the rankings of different causes is the Relative Importance Index (RII). Taiwo et al. [51] and Mohd Rahim et al. [52] have linked the RII with the application of relativity used to assess the classification of desires, variables, and choices. The event of frequency and intensity of the responses are evaluated on a 5-point Likert scale, and RII is estimated using Eq. (1). The mean and standard variance of each factor, according to Chan and Kumaraswamy [53] was not statistically appropriate for determining global rankings, as they did not reflect any relationship, and thus the use of significance indexes was advocated. The statistical means, standard deviations and RII ranks for these factors are presented in Table 5 and Fig. 3.

$$\begin{aligned} &RII = \sum \tfrac{ni.pi}{Rv.N} (0 \leqslant \text{index} \leqslant 1) \\ &\text{Where, ni} = \text{number of respondents that chose pi} \\ &\text{pi} = 1 \text{ to } 5 \text{ on a Likert scale} \\ &\text{N} = \text{total number of questionnaire returned} \\ &\text{Rv} = \text{highest value in Likert scale} \end{aligned} \quad (1)$$

Subsequently, the ranking for the variables is used to cross-compare the relative importance of the factors as perceived by the 3 selected groups of respondents (clients, consultants and contractors). Based on this ranking, the study will be able to identify the most important factors which contribute to impeding the VM implementation in the construction industry.

5. Data collection

The study was carried out in the Egyptian construction sector with respondents from the two regional areas of the country, which are Giza and Cairo. The details of the data collection for the main survey will be illustrated as follows:

5.1. Pilot survey (Questionnaire I)

Following the semi-structured interview with experts, through EFA analysis a pilot study was conducted to explore the new VM barriers subscales, which obtained from the interview sessions. According to Tabachnick et al. [54] the samples of pilot study through EFA should be between 150 and 300 for factor analysis. For this analysis, the sample number is 200, and the returned and valid are 150 which with a percentage around 75% which is well within the scope suggested by Tabachnick et al. [54].

5.2. Main survey (Questionnaire II)

The study methodology used was systematic questionnaires based on information from literature review and interviews with 15 experts in both construction projects and VM as this number is appropriate as and used in many qualitative research [55]. The experts were to rule out insignificant factors and add obstacles they considered to be significant. The research took place in Egypt's construction sector was limited to VM adoption in residential building projects in Egypt and this was due to the level of availability of needed and required information from these types of projects. The professionals were brought together from both regions of the country in Giza and Cairo. The questionnaire has been structured in the first segment to gather information on the background and level of knowledge of VM activities of the respondent as well as their perception of the level of VM adoption in the building industry.

5.2.1. Questionnaire design

This questionnaire was designed in 3 major parts which are the demographic profile of the respondents, impeding factors that affect VM implementation and open-ended questions to add any factors that the respondents perceive worth to be listed. Respondents received VM barriers based on the level of knowledge and experience using a Likert 5-point scale, where: 5 very high, 4 high, 3 average, 2 low and no or very low, as this scale is was widely used in various past VM studies in developing countries [5,15,17,23,35,36].

5.2.2. Questionnaire distribution

This study is based on three main building sectors in Egypt in Giza and Cairo (client, consultant, and contractor). Because VM is relatively new in Egypt, stratified sampling was considered to reach the specific subpopulation [56]. This approach was intended to help the authors obtain the most reliable and accurate results, since this survey is related to a particular topic regarding VM. Sharma [57] agreed that the advantaged of stratified sampling are as follows: (1) Reducing the biases in the selection of the sample cases, which means that the sample will have highly representative representation to the population under investigation; (2)

allow generalization of samples to the population. Stratification takes into account the differences in population across the three sectors (client, consultant, and contractor) [58]. Therefore, a prequalification assessment with the several institutes was implemented via telephone calls. More than 280 organizations were produced in the screening study, but only 215 organizations have approved to contribute. The selected building organizations with 9–250 employees, the self-employed, and non-global sectors of the multinational companies were founded in 1994–2010 to remove any influence from the parent group's international policy [59–61].

A total of 335 questionnaires were distributed, and a total of 226 were found and considered suitable for analysis. This suggests a return rate of approximately 67.5%, which can be interpreted based on the viewpoints of [49,50]. The sample size which used in this study is higher than the same VM studies used for a similar analysis by Kim et al. [62] with a sample size of 100 respondents, and by Luvara and Mwemezi [25]with a sample size of 231 respondents, Oke and Aghimien [63]with a sample size of 330 respondents, Shen and Liu [4] with a sample size of 200 respondents, and Lin et al. [64] with a sample size of 285. The final questionnaire was accurate at 214 after the 12 incomplete questionnaires were ignored, and this final number is satisfied all the appropriate statistical tests. The reason for the high rate of response reported is because it took time for the analysis and how it was conducted. Four months and three weeks of data collection were used, and most questionnaires were self-administered by the researchers.

In the end, 23 possible obstacles and challenges of VM were identified for the construction industries of developing countries after reduction of two factors "Bar.WD1" (The procurement and contract strategies are inappropriate for implementing VM), and "Bar. ST5" (lack of readiness to adopt VM in the industry) from the pilot study stage through EFA analysis as shown in Table 1. Descriptive analysis and comparison tables for Relative Importance Index (RII) were used to rate the results.

6. Analyses and discussion

The outcomes of an analysis of the data collected were presented in this section and the findings are discussed, including EFA results, participant profiles, level of VM understanding, preliminary investigation, rating of obstacle factors, RII of obstacle factors, and Pearson correlation analysis.

6.1. Construct validity using exploratory factor analysis (pilot study questionnaire I)

Considering the number of barriers recognised in the previous studies and categorised by the 15 experts inbuilding industry, many of the underlying effects were likely to result. With the information which meets all the required criteria, factor analysis was conducted with principle component analysis (PCA) and varimax rotation to assess the factor structure between 25 VM Implementation barriers.

Many well-known criteria were used to determine the factorability of a correlation. KMO is a measure of factor homogeneity and is frequently used to assess whether the partial correlations between the variables are minimal [70]. For factor analysis, the KMO index ranges from 0 through 1, with a minimum value of 0.6 [54]. The sphericity test of Bartlett also demonstrates if the matrix for the correlation is an identity matrix. For the factor analysis to be considered appropriate, Pallant [71] suggested that the sphericity test by Bartlett [57] (po0.05) is significant. The results showed that Kaiser-Meyer-Olkin measure of sampling adequacy was 0.782, above the suggested value of 0.6, and Bartlett's test of sphericity was significant (χ^2 (300) = 1649.74, $p < 0.05$).

EFA's results for all 25 items extracted illustrated five variables that had values above 1 as shown in Table 2 with a total variance of 58.59%. last variable only included one item (Bar.WD1), which initially belonged to workshop dynamics, and Bar.ST5, which were excluded from the main study due to low loading factor. Fig. 2 shows the screen plot for extracted factors as recommended by Pallant [71].

After EFA analysis was achieved, the remaining factors' data was tested to assess the questionnaire's reliability based on the Cranach's alpha test, which measures the internal consistency of the construct's items [72]. The results of Cranach's alpha for VM barriers in the pilot study analysis ranged from 0.74 to 0.84, which is within the acceptable range [73].Cranach's alpha value within this range indicates that the items are suitable in terms of the number and is related to the construct they were designed to measure.

Table 1
Barriers to the adoption of VM in developing countries.

Subscale	Item	Item Name	Studies
Stakeholders & Knowledge	Bar.SK1	Lack of VM experts	[11,65]
	Bar.SK2	Poor collaboration and working relationship among stakeholders	[18]
	Bar.SK3	Inadequate facilitation skills and training	[20]
	Bar.SK4	Difficulty in the involvement of decision-makers and other key partners in VM workshop	[5]
	Bar.SK5	Lack of knowledge about VM	[11,65,66 12,36,41]
	Bar.SK6	Lack of gathered information in early stage causing difficulties in creating ideas and alternatives	[5,35]
Culture and environment	Bar.CE1	Resistance to accepting state-of-art innovations	[5]
	Bar.CE2	Lack of active involvement of clients and stakeholders	[35]
	Bar.CE3	Difficulty in establishing mutual project objectives by stakeholders	[5]
	Bar.CE4	Lack of commitment to implement VM	[67]
	Bar.CE5	Client's inability to communicate requirements and needs to the design team	[67]
	Bar.CE6	A self-justifying attitude of the original design team	[20]
	Bar.CE7	Client's unwillingness to fund VM exercise	[35,68]
Workshop dynamics	Bar.WD1	The procurement and contract strategies are inappropriate for implementing VM	[69]
	Bar.WD2	VM workshop incurs additional cost	[20]
	Bar.WD3	Difficulty in conducting analysis and evaluation of functions and alternatives	[20]
	Bar.WD4	Lack of time to conduct VM studies	[12,35,41,65]
	Bar.WD5	Difficulty in Selecting an inappropriate approach or method of VM	Interview opinion
	Bar.WD6	The problem of technological advancement in employing technology integration in the VM approach	[37]
Standardization	Bar.ST1	Lack of VM awareness among the clients	[11,35]
	Bar.ST2	Absence of local VM guidelines and legal framework	[11,18,36,65]
	Bar.ST3	Lack of encouragement on the part of the government	[36]
	Bar.ST4	Lack of legislation which provides VM application in the construction industry	[67]
	Bar.ST5	lack of readiness to adopt VM in the industry	[20,22]
	Bar.ST6	Lack of contract provisions for implementation VM between owners	[12,40]

Table 2
Factor loadings based principal component analysis with Varimax rotation.

	Component				
VM Barriers	1	2	3	4	5
Bar.CE4	0.798				
Bar.CE3	0.694				
Bar.CE1	0.680				
Bar.CE2	0.636				
Bar.CE5	0.635				
Bar.CE7	0.630				
Bar.CE6	0.624				
Bar.ST2		0.826			
Bar.ST6		0.817			
Bar.ST4		0.741			
Bar.ST1		0.638			
Bar.ST3		0.568			
Bar.ST5*		0.395			
Bar.SK5			0.911		
Bar.SK2			0.728		
Bar.SK3			0.681		
Bar.SK4			0.673		
Bar.SK1			0.638		
Bar.SK6			0.610		
Bar.WD4				0.755	
Bar.WD3				0.736	
Bar.WD2				0.696	
Bar.WD6				0.629	
Bar.WD5				0.500	
Bar.WD1*					0.463
Eigenvalues	3.817	3.536	3.319	2.845	1.132
Variance%	15.269	14.145	13.277	11.381	4.526
Cumulative %	15.269	29.413	42.690	54.071	58.597

6.2. Respondents' features and demographic profiles (questionnaire II)

In this research, the authors have classified the respondents according to their ears of experience, professionality, current positions, education, and organization function. Table 3 presents the respondent's distribution for all demographic variables.

These results for "Professionality" also indicated that the highest frequency was observed for "Civil Engineer" (24.8%) followed by "Architecture" (20.1%) and the lowest frequency 17.8% belonged to "Mechanical Engineer and Quantity Surveying". Results of the current position showed that the "Site Engineer" had the highest frequency (43.5%) followed by "Design Engineer" (24.3%) and the lowest frequency was observed for director (7.9%). Based on the results of educational most respondents had bachelor (37.9%) followed by a master's degree (24.8%). For organizations of the respondents, the highest percentage belonged to the contractor (39.3%) followed by the client/developer (31.8%) and consultant (29%) respectively.

VM implementation is always predicted by the readiness of the organization to adopt the technology and apply it in the business environment. Concerning the knowledge of the respondents in terms of VM practice, result in Table 3 shows that regarding "adopting and attending in VM workshop, it was founded that the majority (86.4%) of respondents did not attend any VM workshop nor receive any formal training on VM. any VM workshop nor receive any formal training on VM with percentage of (85) for respondents did not receive any VM training. This indicates that those organizations have not adopted VM.

Regarding "perception of value management or value engineering", 47.7% of respondents considered it as "a concept" and 47.6%

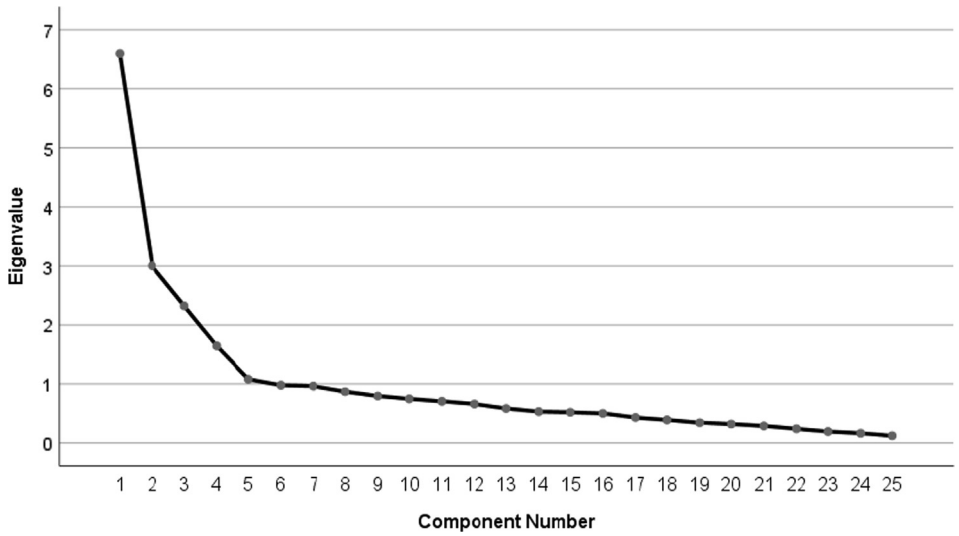

Fig. 2. Scree plot result.

Table 3
Frequency distribution of demographic characteristics.

Variable	Level	Frequency	Percent
Work experience	Less than five years	16	7.5
	Five to ten years	45	21
	Ten to fifteen years	69	32.2
	Fifteen to twenty years	56	26.2
	Greater than twenty years	28	13.1
Professional field	Architect	43	20.1
	Civil Engineer	53	24.8
	Electrical Engineer	42	19.6
	Mechanical Engineer	38	17.8
	Quantity surveying	38	17.8
Current position	Director	17	7.9
	Senior Manager	27	12.6
	Manager	25	11.7
	Design Engineer	52	24.3
	Site Engineer	93	43.5
Education	Diploma	44	20.6
	Bachelor's degree	81	37.9
	Master's degree	53	24.8
	PhD	35	16.4
	Others	1	0.5
Organization function	Client/Developer	68	31.8
	Consultant	62	29
	Contractor	84	39.3
VM workshop attending	Yes	33	15.4
	No	181	84.6
Formal training on VM	Yes	34	16
	No	180	85
Awareness	Totally Familiar	42	19.6
	Familiar	103	48.1
	Moderately familiar	51	23.8
	Not familiar	18	8.4
Perception	Technique	10	4.7
	A concept	102	47.7
	A profession	102	47.6
Knowledge	Very good	30	14
	Good	96	44.9
	Fair	44	20.6
	Poor	12	5.6
	Very Poor	32	15

as "profession ". According to the results of "awareness of value management or value engineering", 48.1% of respondents were "familiar "and 23.8% as "moderately familiar". Thus, the research can observe that despite professionals in Egypt construction industry having a moderate level of knowledge and awareness, the practice is yet to be fully embraced. The findings of this VM knowledge study comply with those of other developing countries, including Malaysia [36] and Myanmar [15]. VM knowledge between practitioners in construction can considerably enhance management decision to implement VM as an integral platform/element in planning. As compared to the reported 51% VM knowledge in an earlier study [74] we have highlighted that this estimate between the Egyptian construction practitioners is higher (67.7%) (familiar and totally familiar), which implies a moderate to high level. This can be attributed to their much smaller sample (35 respondents). The results of the present study can provide a high level of confidence with 214 participants from two major cosmopolitan areas in Egypt, Cairo and Giza. It is more likely to collect representative opinions of more competent practitioners with the higher population, principally from high construction projects areas.

6.3. Reliability and RII analysis of VM barriers

The Statistical Package for Social Science (SPSS) version 20 was used to conduct statistical analysis of data Before conducting the RII analysis, the internal consistency reliability and how well the set of 23 VM barriers are correlated to one another were checked using the Cronbach's Alpha (α). A Cronbach's Alpha of 0.720 was obtained. According to Field [73] a Cronbach's alpha of 0.70 is considered acceptable. Therefore, as shown in Table 4 the Cronbach's alpha gives indication that the 23 VM barriers are internally consistent and well correlated to one another.

The collected data then analyzed by using the RII Method (Relative Important Index) method. The method was adopted in this study to determine the relative importance of the barriers affecting VM implementation within the range from 1 to 5 as mentioned above. Table 5 and Fig. 3 show the detailed statistical and ranking results of barriers of VM implementation. There are five subscales; stakeholders and knowledge with 6 items, culture and environment with 7 items, workshop dynamics with 5 items and standardization with 5 items. Every scale is based on a 5-point Likert scale.

6.3.1. Stakeholders and knowledge

For the first and highest subscale "Stakeholders and knowledge", the mean value for "Difficulty in the involvement of decision-makers and other key partners in VM workshop" (M = 3.92, SD = 0.67) and "Inadequate facilitation skills and training" (M = 3.89, SD = 0.64) have the highest RII level with 0.78 and the lowest mean value belongs to "lack of gathered information in early-stage causing difficulties in creating ideas and alternatives" with (M = 3.50, SD = 0.80) and "lack of knowledge about VM" (M = 3.48, SD = 0.80) have the lowest RII level with 0.78. The overall mean for all the indicators was M = 3.70 and overall RII = 0.75. This indicates that the level of barriers and obstacles of value management implementation related to stakeholders and knowledge was the highest subscale rank and higher than the median of scale (3), which revealed a more than moderate level for this indicator among the respondents. Xiaoyong and Wendi [65] support this finding and noted that this inferred that VM experts are necessary for the implementation of VM in the Nigerian construction industry. For construction professionals, it is thus vital to cut project costs, completion time and project quality via the VM methodology. Kissi et al. [18] reported that the Royal Institution of Chartered Surveyors (RIC) declared VM to be among the top 10 drivers in search of increasing productivity and value for money.

Furthermore, the VM experts can be forerunners who would aid the application of VM in domestic construction projects. Based on this finding, insufficient VM facilitation skills/knowledge and resis-

Table 4
Reliability analysis of VM barriers.

Subscales	Items	Cronbach's Alpha
Stakeholders & Knowledge	Bar.SK1	0.896
	Bar.SK2	0.895
	Bar.SK3	0.898
	Bar.SK4	0.898
	Bar.SK5	0.892
	Bar.SK6	0.890
Culture and environment	Bar.CE1	0.894
	Bar.CE2	0.892
	Bar.CE3	0.892
	Bar.CE4	0.891
	Bar.CE5	0.892
	Bar.CE6	0.894
	Bar.CE7	0.894
Workshop dynamics	Bar.WD2	0.900
	Bar.WD3	0.899
	Bar.WD4	0.901
	Bar.WD5	0.892
	Bar.WD6	0.892
Standardization	Bar.ST1	0.891
	Bar.ST2	0.894
	Bar.ST3	0.894
	Bar.ST4	0.891
	Bar.ST6	0.893

Table 5
Ranking of Hindrance Factors for VM Application.

Subscales	Items	Item Name	RII	Item Mean	SD	Rank Items	Ranking Group
Stakeholders & Knowledge	Bar. SK1	Lack of VM experts	0.74	3.69	0.55	2	1
	Bar. SK2	Poor collaboration and working relationship among stakeholders	0.74	3.70	0.47	2	
	Bar. SK3	Inadequate facilitation skills and training	0.78	3.89	0.64	1	
	Bar. SK4	Difficulty in the involvement of decision-makers and other key partners in VM workshop	0.78	3.92	0.67	1	
	Bar. SK5	Lack of knowledge about VM	0.70	3.48	0.80	3	
	Bar. SK6	Lack of information gathered early in the process causes problems in generating proposals and alternatives	0.70	3.50	0.80	3	
	Total		**0.75**	**3.70**	**0.47**		
Culture and environment	Bar. CE1	Resistance to accepting state-of-art innovations	0.67	3.35	0.87	5	3
	Bar. CE2	Lack of active involvement of clients and stakeholders	0.61	3.07	0.93	9	
	Bar. CE3	Difficulty to establish mutual project objectives by stakeholders	0.62	3.09	0.90	8	
	Bar. CE4	Lack of commitment to implement VM	0.67	3.27	0.90	5	
	Bar. CE5	The inability of clients to inform the design team of requirements and needs	0.67	3.34	0.88	5	
	Bar. CE6	A self-justifying attitude of the original design team	0.65	3.33	0.89	6	
	Bar. CE7	Client's unwillingness to fund VM exercise	0.64	3.22	0.91	7	
	Total		**0.65**	**3.24**	**0.65**		
Workshop dynamics	Bar. WD2	VM workshop incurs additional cost	0.58	2.92	0.88	11	4
	Bar. WD3	Difficulty in conducting analysis and evaluation of functions and alternatives	0.58	2.89	0.87	11	
	Bar. WD4	Lack of time to conduct VM studies	0.62	3.11	0.90	10	
	Bar. WD5	Difficulty in Selecting of an inappropriate approach or method of VM	0.62	3.12	0.93	10	
	Bar. WD6	Issue of technological progress in the use of VM solution integration	0.62	3.08	0.94	10	
	Total		**0.60**	**3.01**	**0.60**		
Standardization	Bar. ST1	Lack of VM awareness among the clients	0.67	3.37	0.86	5	2
	Bar. ST2	Absence of local VM guidelines and legal framework	0.69	3.43	0.84	4	
	Bar. ST3	Lack of encouragement on the part of the government	0.67	3.37	0.88	5	
	Bar. ST4	Lack of legislation which provides VM application in the construction industry	0.65	3.23	0.90	6	
	Bar. ST6	Failure to enforce VM among owners of contract provisions	0.67	3.35	0.88	5	
	Total		**0.67**	**3.36**	**0.56**		

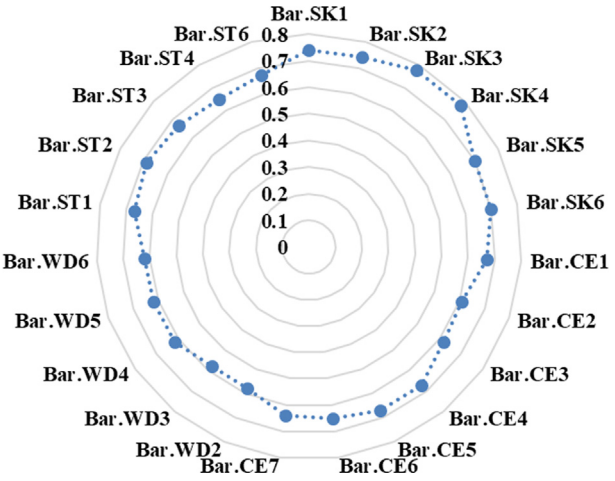

Fig. 3. RII levels for VM barriers.

tance to change would inevitably affect the existence and application of VM. Hence, construction professionals should be trained on the aspects of VM. It is implausible for professionals who have inadequate facilitation skills to request their clients to apply VM in their projects.

6.3.2. Standardization

The second subscale and second RII rank of barriers and obstacles of value management implementation was related to "Standardization", the mean value for "Absence of local VM guidelines and legal framework" (M = 3.43, SD = 0.84) was the highest value and highest RII level with 0.69 and the lowest mean value belongs to "lack of legislation which provides VM application in the construction industry" with (M = 3.21, SD = 0.90) and lowest RII level with 0.65. The overall mean for all the indicators was M = 3.36 and overall RII = 0.67. This indicates that the level of barriers and obstacles of value management implementation related

to standardization also was higher than the median of scale (3), which revealed more than the moderate level for this indicator among the respondents. This implies that there is a need to orientate both private and public clients on the potential and benefits of applying VM in construction projects. Likewise, Al-Yami [35] found that lack of awareness about VM is a significant barrier to VM application in the Saudi construction projects.

6.3.3. Culture and environment

For the third subscale related to "Culture and environment", the mean value for "Resistance to accepting new innovations" with (M = 3.35, SD = 0.87), "lack of commitment to implement VM" with (M = 3.27, SD = 0.90), and "Client's inability to communicate requirements and needs to the design team" with (M = 3.34, SD = 0.88) have the highest value and highest RII level with 0.65. The lowest mean value belongs to two items, "lack of active involvement of clients and stakeholders" with (M = 3.07, SD = 0.93) and "difficulty to establish mutual project objectives by stakeholders" with (M = 3.09, SD = 0.90) and lowest RII level with 0.61, and 0.62, respectively. The overall mean for all the indicators was M = 3.24 and overall RII = 0.65. This indicates that the level of barriers and obstacles of value management implementation related to culture and environment also was higher than the median of scale (3), which revealed more than the moderate level for this indicator among the respondents. Jaapar et al. [5] maintained that resistance to change is a significant barrier to the VM application. Therefore, stakeholders should welcome innovations and ideas in order to promote this technique.

6.3.4. Workshop dynamics

The last and lowest subscale in rank of barriers and obstacles of value management implementation was related to "Workshop dynamics", the mean value for "lack of time to conduct VM studies" with (M = 3.11, SD = 0.90, RII = 0.62) and the lowest mean value belongs to "VM workshop incurs additional cost", "difficulty in conducting analysis and evaluation of functions and alternatives" has the highest value with (M = 2.92, SD = 0.58, RII = 0.88), and (M = 2.89, SD = 0.58, RII = 0.87), respectively. The overall mean for all the indicators was M = 3.01 and overall RII = 0.60. This indicates that the level of barriers and obstacles of value management implementation related to workshop dynamics was equal to the median of scale (3), which revealed a moderate level for this indicator among the respondents. According to Tanko et al. [69], regular VM workshops should be introduced in the construction industry as a capacity-building initiative in order to make clear to construction professionals and other stakeholders the significance of VM practice.

7. Conclusion

This research aims to investigate the current level of adoption of VM in building projects. On the other hand, the second objective is ranking and prioritizing the impeding factors of VM adoption which was collected from the previous studies, interviews, and pilot study stage. To this end, the study used Egypt as a case study to evaluate measures for avoiding and enhancing the system's implementation in the building sector. The most significant finding of this study is that VM implementation in Egypt in the building and construction sector is still at a very low level. The majority of the surveyed organizations are not using VM and the team is not practicing its concept. Therefore, in this study, it is recommended that intensive workshops to promote VM should illustrate the process of the VM implementation rather than only promoting the advantages and the implementation benefits.

The study identified 23 barrier variables and by using a quantitative research approach to obtain answers from participants in the construction industry in Cairo and Giza in Egypt. The interpretation of the data collected was based on descriptive statistical tools. The RII will address the classification of VM barriers among customers, consultants and contractors in this study. The ranking of the VM barriers determined that insufficient facilitation and preparation, weak coordination and working relationships between stakeholders were the four most significant obstacles to VM application. Throughout practice and in academia, the information gained from this analysis is intended to be useful. The results can help in practice to identify potential areas of weaknesses in order for appropriate standard corrective measures to be proactively taken based on VM attributes. The research has provided insights into existing knowledge and theories including challenges to VM practice in the field of building economy and management within the academic field. This contribution could be useful to improve the content and curricula of education programs for improving the project managers and management of building stakeholders. The purpose of this study was to recognize and assess barriers to VM practice in Egypt. The study on VM has been missing in the Egyptian construction industry and there is also no known work on the barriers to the implementation of VM. However, the results from this study can help Egyptian decision makers to implement VM to optimize its project costs as costs have not been converted from Egyptian pound to dollars due to the significant price change of the dollar and the floating of the Egyptian currency in the recent period [75]. In addition, the results from this study contribute to the implementation of VM in Egyptian construction projects by recognizing VM 's aim to minimize excessive cost-efficiency and cost allocation for each project.

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