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Critical Value Management Activities in Building Projects: A Case of Egypt

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Abstract: Value management (VM) is one of the principles adopted by stakeholders to manage issues in the building industry. This paper aims to examine VM diffusion between residential building entities in the Egyptian residential building industry. This research was confined to the Cairo and Giza regions, with enough residential building experience from clients, consultants, and contractors. A quantitative questionnaire survey was generated to find answers from those active in the residential building industry. The results show that although VM's most widely practiced activities in the Egyptian construction industry are only information phase activities, professionals in Egyptian building projects agreed that all VM activities are important. The results also demonstrated that there is a significant positive correlation among VM phases. The results constitute activities for the adoption of VMs in Egypt. Its guidelines will dramatically enhance the implementation of VMs both in Egypt and in other developing countries where similar projects are conducted. Finally, this research strengthens the residential building industry's present management by enhancing VM tools and elements to generate value for money.

Keywords: construction projects; project performance; residential building; value engineering; value management

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1. Introduction

The residential building industry represents one of the greatest active industries in several countries. There are demands to increase the efficiency and policies that aim to reduce residential building projects' costs, especially projects constructed by the government [1]. Furthermore, quality enhancement of the building sector is hardly done because the quality and value control system is poorly organized [2]. In developing nations, project success in the residential building industry is subservient. These nations have witnessed rapid growth, but there is no argument that the residential construction industry plays a vital role in ensuring basic living standards. [3]. Moreover, in many developing nations, the residential building field has suffered a dramatic transformation to accomplish their countries' financial ambitions [4]. It was confirmed that developing nations' financial strategies are quiet in the upgrading process [5]. Ofori [6] points out that construction firms have faced various problems resulting from their bad projects in developing nations. For instance, the project fails to achieve the project schedule plan, and the project ends with an unexpectedly high budget [7]. Even so, in the face of a shortfall in investment, Kim et al. [8] confirmed that several residential building projects were suspended or abandoned. Besides that, efforts to maximize residential building projects' investments in urban housing sectors are still not enough [9].

Egypt is a rapidly developing nation with extreme risk economies due to small incomes, massive unemployment, and safety pressures [10]. However, it is one of the major occupied nations in North Africa, with rapid population increases from 1950 to 2020 [11,12]. The Egyptian market's danger is dramatically fluctuating currency exchange rates, lack of private business decisions, and commercial models' restrictions, especially in the construction sector [13]. More broadly, the key reasons for construction building delay in this country have been established by Abd El-Razek et al. Ref. [14]: Challenges in financing building projects, customer conflicts in terms of safe payment, modifications of the concept design, and absence of building administration. These previous problems have stressed the improvement of "residential buildings success" through enhancing value, decreasing cost, and improving quality to achieve the Egyptian residential building requirements. It is important to adopt continuous enhancement projects to succeed in residential buildings [15]. Additionally, the traditional way to consider the building project's success is the so-named iron triangle of cost, time, and quality [16]. Consequently, by adopting value management (VM), building corporations can balance time, costs, and quality as VM decreases costs, but not by sacrificing benefits [17].

VM is a collaborative, team-oriented, operational, and systemic method to promote value-related customers or clients to enhance their project aims [18]. It has been verified as a process that begins with the early phase and continues until completion [19]. VM can stimulate and reduce unwanted costs while integrating success development into projects and budgetary conservation [20]. Tanko et al. [21] endorsed such demands, arguing that VM contributes to optimizing efficiency and performance without losing the product's value and quality. Furthermore, VM seeks to accomplish the anticipated value with lower costs without compromising building quality [22] and allows for an in-depth evaluation of a project's objectives from the owner's perception [23]. VM in the international building field seems to be accepted as a strategy of value for money and higher productivity [24]. This acceptance is based on previous evidence that VM's tools had decreased the cost of construction projects by 5–10% [25].

Furthermore, Ellis et al. [26] approved that the cost of capital in building projects could be reduced by 10–25% if VM were appropriately adopted at the early phase of the project. Atabay and Galipogullari [27] adopted VM to reduce the cost of motorway construction. Interestingly, the VM saved approximately $43,000,000 and 12 months, and this saving supported the project with financial gains of 6 percent and a 17 percent reduction in operating time. Subsequently, Kim et al. [28] applied VM as a cost-effective design alternative tool for road projects. The VM process and construction solutions are intended to act as a reference for roadway engineers and decision-makers.

The function of VM is instrumental because of the above observations. VM has become a commonly implemented tool in several nations worldwide to solve the issues mentioned above. Nevertheless, VM methods, activities, and stages do not receive comparable consideration in most developing nations, including Egypt [8]. Although past studies have discussed VM's benefits and activities in many countries and their technique efficiency, no efforts seem to be taken to examine VM implementation in Egyptian residential building projects. This gap is highlighted by Abdelghany et al. [29]. They noted that the adoption of the standard VM concept and activities are not achieved. This observation is confirmed by recent studies indicating that most building professionals did not adopt VM in their projects [12,19]. No wonder this encourages ad hoc methods such as uncoordinated teamwork that do not reduce building costs. Implementing the VM standard is important, as the country suffers from weak sustainable environmental success after the events in 2011; various standards and measures have remained at a standstill. [30]. In addition, the Egyptian country is arranging a strategy to be a nation with a strong economy. A total of 2030 Egyptian governments are looking forward to representing Egypt as one of the world's top thirty nations [31]. Consequently, there is a need to incorporate VM in Egyptian residential building projects [32]. However, no research has evaluated the VM phases and their construction field activities [33]. Consequently, this paper's purpose is to fill this gap by evaluating VM activities' importance and practice in Egypt's residential building projects. It employs a gap analysis between VM activities' importance and practice in Egypt's residential building projects. In addition, it uses a correlation analysis to reveal the association between VM phases in order to propose a critical VM activities framework. This would provide Egypt and other developing nations a yardstick to set the appropriate strategy for successfully implementing the VM concept via the proposed framework's activities. This research also attempts to support top managers and professionals in reducing extra costs and improving their quality by implementing VM in building projects. The rest of this paper consists of the state of the art, followed by the adopted research method. Then, the proposed framework and findings of this paper are discussed in light of the previous literature. Key findings and future recommendations are presented in the conclusion.

2. State of the Art

2.1. Nature and the Problem of Residential Building Projects in Egypt

The construction industry is one of Egypt's fastest growing industries, as residential building projects are rapidly increasing to contain Egypt's increasing demands for dwellings [34]. The dwellings shortage is a significant issue that the Egyptian government needs to solve, and it fulfills the residents' demands by providing suitable housing units [34,35]. It is predicted that the residential building market will expand due to an incremental increase in population and urbanization. Between 2008 and 2013, the Egyptian population increased from 75.2 million to 84.20 million (Figure 1), which was a 12% increase in five years. Despite that, the urbanization growth between 2001 and 2012 increased only by 1% from 42.80% to 43.70% (Figure 2) [12,34]. Therefore, there is a demand to inject more residential projects. Moreover, it has been projected that Egypt will have a massive expansion in its population of young people in the next 25 years, which increases the pressure on the government to raise the government expenditure on urbanization growth [34]. Over the past few years, the building and occupancy of twenty-seven urban towns have been finished. This expansion in the property sector can be seen across the country [36]. The accurate estimation of a project's budget during the project's initial phase is one of the main problems that causes overturn during the building process [36]. Therefore, VM can handle and solve this problem efficiently [12].

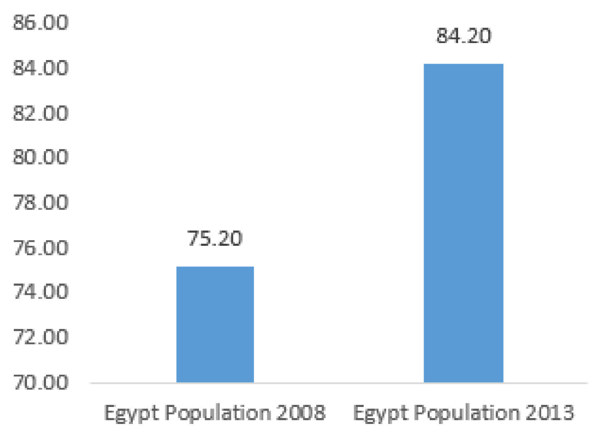

Figure 1. Egypt's population (millions), adapted from [12,34].

2.2. Background of VM

Value management (VM) is the primary approach for the planning and construction administration of multiple construction project elements. VM was built in the late 1940s in the U.S. by Miles at the General Electric Company because of a lack of parts after World War II [37]. At the time, substitute materials were prevalent, but they were also unlikely because of the war. It contributed to a search not for other elements, but for a different way of achieving its function and objective without decreasing performance. At the war's end, a strategy was introduced to reduce and generate needless costs for products [38]. VM is often referred to as the U.S. Value Engineers Association (SAVE) or value assessment (VA) [39]. Records showed that the first VM workshop was produced by SAVE [39]. As shown in Figure 3, the VM approach contains six phases: information, functional analysis, innovation, evaluation, development, and presentation.

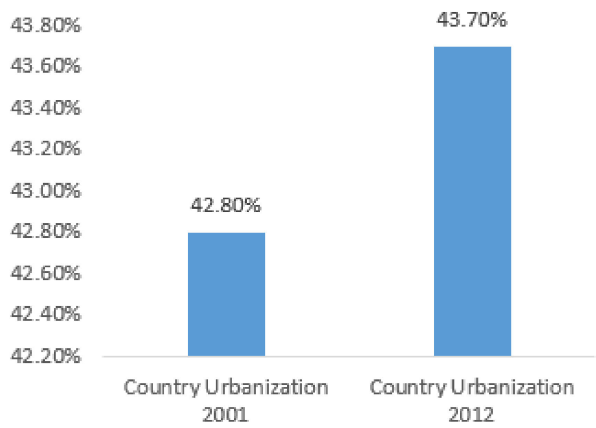

Figure 2. The country's urbanization rate, adapted from [12,34].

Figure 3. Phases to adopt the value management (VM) approach.

Furthermore, VM encourages selecting participants to improve the project to create a cost-efficient model [26]. Thus, it can be claimed that VM does not decrease costs, but instead is mainly involved with implementing a function or object [40]. This demonstrates that the management of resources and cost can be applied without compromising the project's efficiency and purpose at the lowest possible VM implementation cost.

2.3. *VM Implementation in the International Context*

Recently, emerging technology has rapidly transformed how work practices are handled and carried out [41]. This phenomenon also includes VM. VM represents a universal tool and technology accepted in many nations worldwide and has gained a great deal of interest in developed nations [7]. This interest in developed nations is due to the enormous benefits that developed countries have witnessed from the implementations of such a widely established approach. However, VM methods and applications in the building industry have demonstrated that they have not been adopted in many developing nations [8]. For example, in Malaysia's construction industry, VM is not generally adopted [18]. The major factors that hinder VM in the Malaysian construction industry are the absence of VM awareness, struggle to change by the parties comprised, and the different project aims among parties [42]. Furthermore, Kim et al. [8] investigated the problems for the application of VM in the Vietnamese building industry. Four core components were identified, including a lack of qualified personnel in the implementation of VM, the inherent difficulties in the workshop on VM, a shortage of VM experience, and records on VM applications.

Therefore, VM is rarely used in the building field in Southeast Asia [43] and is even less common in South African countries [44]. Kissi et al. [37] analyzed 22 VM problems in Ghana's public projects and identified five key components. These components included barriers to the VM team, VM study barriers, implementation problems, theoretical challenges, and obstructions to developing economies. Furthermore, the VM philosophy had only been adopted in Nepal's building industry [45]. In contrast, VM adoption in the field of the building industries in Nigeria and Myanmar was extremely low [46]. However, VM's practice remains a non-starter for the construction field given endorsements to adopt VM, enhanced VM knowledge between building professionals, and even the opportunity that VM can be adopted through the introduction. In Nigeria, VM implementation opportunities and problems were concluded to lack management legislation and standards, have a negative perception from the owners, and an absence of VM awareness [18]. More recently, Ezezue [38] has observed that insufficient emphasis and orientation on VM values could hinder the VM system's adoption.

There are specific causes for hindered VM. These causes include insufficient knowledge of VM amongst team members, the absence of assistance from the government, management, and reluctance from the clients to accept any added costs. Correspondingly, the lack of established directions on VM, combined with the shortage of information, tends to discourage adoption of the VM method. Therefore, it may be said that there is a probability of similarities in the VM barriers in their implementation, due to the similarities in how these developing countries implement projects. There is a need to examine VM activities that are currently practiced in the residential building field in developing nations to reduce the cost and enhance these projects' quality.

3. Research Methods

The current study is the second stage of two stages of research that aims to explore the VM activities in construction projects [12]. The research's two stages were the preliminary research stage and the advanced research stage. Figure 4 presents the design of the two stages, which followed the recommendations presented by Chileshe et al. [47] and Buniya et al. [48]. Separate quantitative questionnaires were utilized in each stage. Although the same set of variables was adopted, the earlier published paper examined VM activities' level of awareness among stakeholders in the preliminary research stage through a pilot survey, while the current study evaluated the importance and practice of these VM activities in the advanced research stage through the main survey. For this to happen, a literature review and a semi-structured interview were conducted to collect and categorize the VM activities, as shown in Table 1, followed by the above-mentioned two surveys.

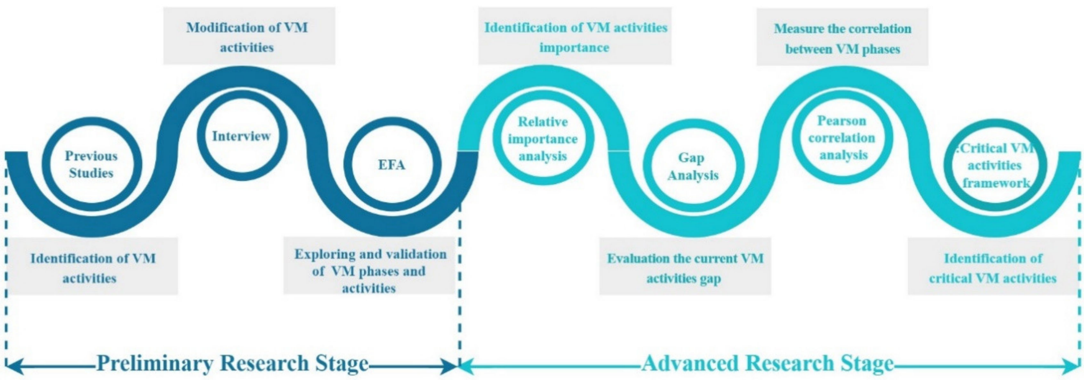

Figure 4. Research process adapted from [47,48].

Table 1. VM activities in the construction industry.

VM Phases	Code	Activity Name	Studies
Information Phase	VM.IP1	Carry out a site visit	[49]
	VM.IP2	Collect related past information on the proposed project	[50]
	VM.IP3	Define the project time and scope	[49]
	VM.IP4	Involve owners in the initial project stage	[51]
	VM.IP5	Involve and allocate duties to construction specialists at the initial stage of the project	[49]
	VM.IP6	Clarify related project information and constraints	[50]
	VM.IP7	Share project information and knowledge among professionals	[51]
	VM.IP8	Identify the high-cost areas of the project	[52]
Function Phase	VM.FP1	Make the owner specifically express the scope and goals of the project	[52]
	VM.FP2	Presentation of project constraints by stakeholders	[51]
	VM.FP3	Express and recognize the aims and responsibilities of the project	[49]
	VM.FP4	Establish and classify roles with their associated costs for essential and secondary functions	[50]
Creativity Phase	VM.CP1	Brainstorm ideas and concepts to achieve the desired functions and costs	[50]
	VM.CP2	Categorize brainstormed session alternatives and ideas as theoretically acceptable to be implemented	[50]
	VM.CP3	Defining the strategy of project procurement and contract policy	[52]
Evaluation Phase	VM.EP1	Estimate the cost of each alternate life cycle	[12]
	VM.EP2	Analyze brainstormed solutions and alternatives to perform the desired functions	[52]
	VM.EP3	Investigate the criteria of alternative evaluation	[12]
Development and Presentation Phase	VM.DP1	Develop an alternative action plan	[52]
	VM.DP2	Meet and ask for a review of the action plan	[50]
	VM.DP3	Track the output action plan for VM proposal	[12]

3.1. Preliminary Research Stage

3.1.1. Semi-Structured Interviews

A critical literature review was carried out to reveal effective VM activities. In addition, 15 experts from Egyptian residential building projects were interviewed to validate and categorize these activities into the groups set out in Table 1. Their vast knowledge in the building industry spans from nine to forty years, and the respondents were selected according to three criteria: background, education, and employment [12]. Four academics, five practitioners from the private industry, and six consultants were interviewed. They held a range of positions, including consultant, site engineer, project manager, executive director, and manager. Their principal roles covered all key stakeholders, customers, and contractors in the industry, ensuring rich experience from a wide variety of viewpoints. They have worked with government, private, and independent agencies. Consequently, interviewed experts concluded that a more systematic framework should guide VM deployment in the residential building industry and classify VM activities into five groups. Various VM activities have been updated, and the list includes three new activities [12]. Consequently, the pilot study questionnaire was generated.

3.1.2. Pilot Survey

A pilot study was carried out to explore those groups in the Egyptian building industry by sending a pilot questionnaire to two hundred residential building professionals. There was an acceptable number of participants that could be used as a representative sample [53]. As shown in Table 1, exploratory factor analysis (EFA) was used to validate the VM activity categorization which resulted from the interview sessions. The VM activities were categorized into five categories after removing one uncorrelated activity from the information phase (VM.IP5, involving and assigning responsibility to building professionals at the initial stage of the project) [12]. The reliability analysis for these activities indicated that Cronbach's alpha values were accepted, as they ranged from 0.74 to 0.84 [12], indicating a high level of survey reliability [54].

3.2. Advanced Research Stage

For this research to reach a level where it could be able to recommend a critical VM activity framework for Egypt's residential building projects, three steps needed to be fulfilled. These steps were identifying VM activities' importance, evaluating the current VM activities gap, and measuring the correlation between VM phases, which were the components of the advanced research stage [47,48]. These steps involved the usage of a quantitative questionnaire survey. This instrument took into consideration the previous preliminary research stage and suggestions by Fellows and Liu [55], which were determining whether the questions were simple, easy to answer, and precise and preparing the questionnaire and assessing the length of time that the respondent would take to complete it.

3.2.1. Ranking Analysis

Besides identifying VM activities, this study used the mean rating and listed the relative importance index (*RII*)-based variables to reveal the most significant VM activities that led to VM implementation in the Egyptian residential building industry. Salleh [56] identified *RII* as a statistical approach used to determine the ranking of various reasons, and it was a highly used method for ranking and evaluating variables [57–59]. The five-point Likert scall and *RII* shall assess the responses' events' frequencies, and the intensity shall be assessed by Equation (1) [60,61]:

$$RII = \frac{\sum W}{A \times N} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5 \times N} \tag{1}$$

where W indicates the weighting given to each attribute by the participant, A is the maximum weight, and N is the total number of participants. Based on these parameters, the statistical means, the standard deviations, and the *RII* values are shown in Table 2. Subsequently, this calculation's ranking was used to do a cross comparison of the relative significance of the factors, as viewed by the respondents' three chosen clusters (consultants, owners, and contractors). As a result, this study was able to reveal the most significant VM activities that led to VM implementation in the Egyptian residential building industry.

Table 2. Relative importance of VM activities in residential building projects.

VM Phases	Activity Code	*RII*	SD	Overall Rank	Importance Level
Information	VM.IP1	0.85	0.76	5	H
	VM.IP2	0.77	0.88	20	H–M
	VM.IP3	0.82	0.81	15	H
	VM.IP4	0.84	0.75	6	H
	VM.IP6	0.87	0.72	1	H
	VM.IP7	0.81	0.80	17	H
	VM.IP8	0.84	0.79	8	H
Function	VM.FP1	0.83	0.82	11	H
	VM.FP2	0.84	0.72	7	H
	VM.FP3	0.83	0.79	14	H
	VM.FP4	0.86	0.71	4	H
Creativity	VM.CP1	0.86	0.71	3	H
	VM.CP2	0.84	0.76	9	H
	VM.CP3	0.82	0.84	16	H
Evaluation	VM.EP1	0.83	0.74	13	H
	VM.EP2	0.83	0.77	12	H
	VM.EP3	0.87	0.68	2	H
Development and Presentation	VM.DP1	0.81	0.77	18	H
	VM.DP2	0.84	0.71	10	H
	VM.DP3	0.80	0.83	19	H

3.2.2. Gap Analysis

The gap analysis was achieved in this study by determining the gap size according to the Aksorn and Hadikusumo [62] procedure. Generally, gap analysis is a problem-solving phase that seeks to find ways to fill gaps to reach the desired states. The success of a VM largely depends on several VM phases and their activities. Therefore, the degree of influence of each activity must be studied, and the actual status of compliance of such activities is assessed. Subsequently, the variances between VM importance and practice were calculated.

3.2.3. Pearson Correlation Analysis

Pearson correlation was introduced by Carl Pearson in the late 1880s and is commonly used in natural and human sciences [63]. It is used to determine the association between two variables, X and Y, with values between −1 and 1. The Pearson correlation coefficient of the measurement equation is as follows [64]:

$$r = \frac{\sum_{n=1}^{n}\left(X_i - \overline{X}\right)\left(Y_i - \overline{Y}\right)}{\sqrt{\sum_{n=1}^{n}\left(X_i - \overline{X}\right)^2}\sqrt{\sum_{n=1}^{n}\left(Y_i - \overline{Y}\right)^2}} \tag{2}$$

where $\overline{X}$ is the average value of Sample 1, $\overline{Y}$ is the average value of Sample 2, and r is the Pearson correlation coefficient. The value range of r is from −1 to 1. The greater the value of the absolute value, the greater the degree of correlation. As the coefficient of correlation reaches 1 or −1, the degree of correlation becomes greater and vice versa; the closer the coefficient of correlation to 0, the lower the correlation. These thresholds were adopted to explain the association between VM phases with the Pearson coefficient. The correlation of the VM phases was then determined using the Pearson correlation analysis via Statistical Package for the Social Sciences (SPSS) software.

4. Data Collection

The research was performed in Egypt's residential building sector with participants from two major states of the country, Cairo and Giza, which hold building projects in Egypt [65]. Research in Egypt's construction field was scoped to VM implementation in Egyptian residential construction projects, owing to the accessibility of the appropriate and mandatory knowledge on these projects. The questionnaire survey was structured in three main sections. The early one was to collect data and knowledge on the context and extent of awareness of the participants' VM practices and their perception of VM adoption in the residential building industry, while the two remaining parts were activities that influenced VM and open-ended questions to include any activities that the participants considered essential to be included. Participants assessed VM activities according to their experience and background using two types of the Likert scale. The first scale was a five-point scale where 5 was very high, 4 was high, 3 was average, 2 was low, and 1 was not at all or very low. This five-point scale was widely used in numerous previous VM studies [42,66]. This scale was used to identify the importance of the VM activities in context, while the second scale was used to measure VM activities in current practice, using a rating scale that included three options: rarely, sometimes or very often, and frequently. This scale also was implemented in several previous VM studies [33].

A total of 335 questionnaires were distributed, and 226 of them were successfully completed. After screening, 214 responses were appropriate for analysis, and 12 responses were omitted as they were incomplete responses. The rate of return was 67.5% which, according to [67,68], was considered normal, and no issues related the questionnaire needed attention.

Furthermore, the researcher self-administered the questionnaires and performed the analysis in a duration of 4 months and 3 weeks. In the end, 20 potential VM activities for residential building projects in Egypt were identified, following a one-factor reduction through a pilot study phase by EFA examination, as stated in Table 1. Descriptive analysis and evaluation tables for the relative value index (*RII*) were used to determine the findings.

5. Results and Findings

The results of the data analysis are presented in this section. They are organized into four subsections. These subsections are the current practice of VM activities, the importance of VM activities in Egyptian residential building projects, gap analysis, and Pearson correlation analysis.

5.1. Current Practice of VM Activities

VM implementation studies have been dedicated to factors motivating the successful use of VM. However, the activities and methods from VM implementation were not considered or evaluated in any study [33]. The current practice of VM activities is discussed in Figures 5–9 to address this gap in this study.

Figure 5 shows the frequency distribution of seven (7) variables (VM.IP1–VM.IP8), excluding VM.PR.IP5 from the pilot stage of the study concerning the low correlation with the information phase items. Information phase activities were assessed by various residential building professionals in the Egyptian construction industry. In general, only 5.6% of construction professionals always carried out value management information activities, while 52.6% and 15.6% very often and sometimes carry out these activities, respectively. However, no more than 22.8% and 3.3% of respondents rarely and never carried out these activities and methods, respectively.

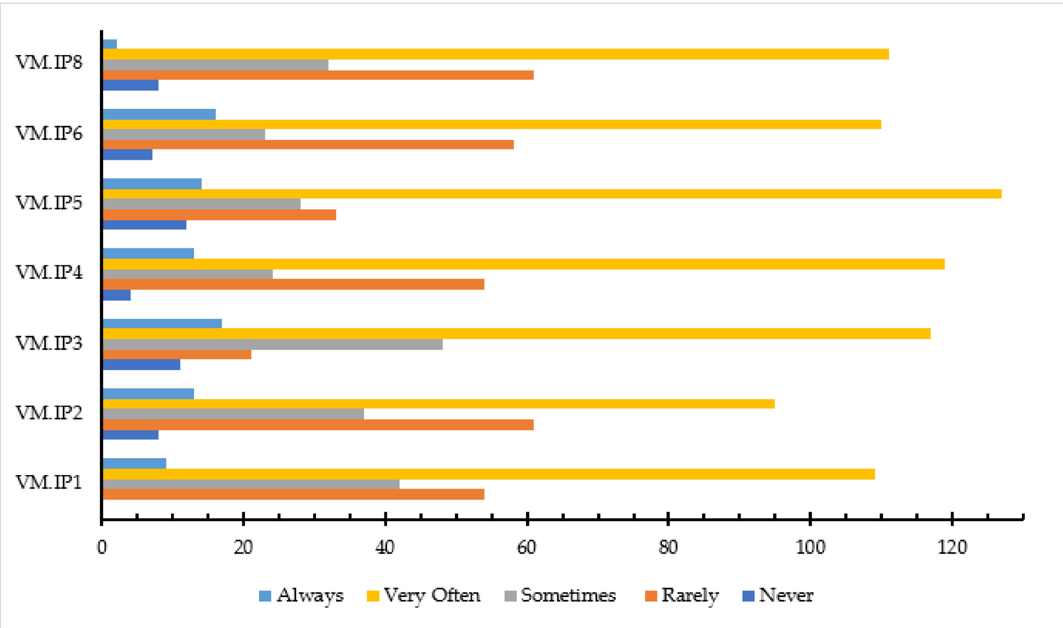

Figure 5. Frequency distribution for the information phase.

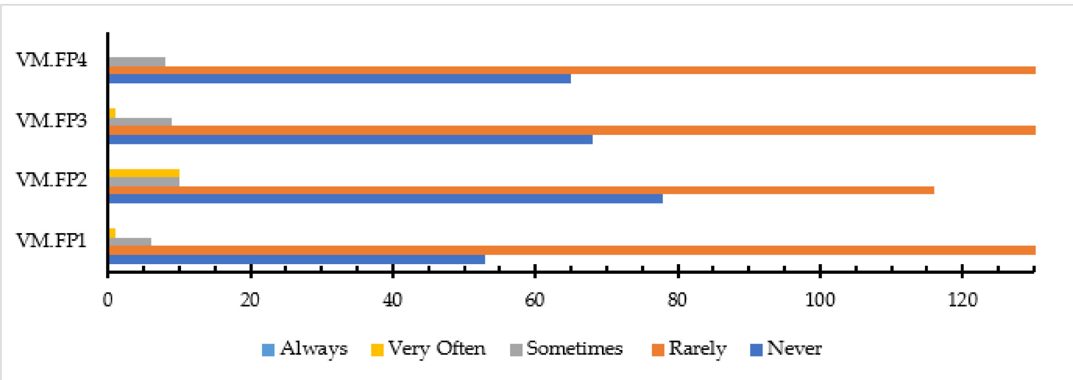

Figure 6. Frequency distribution for the function phase.

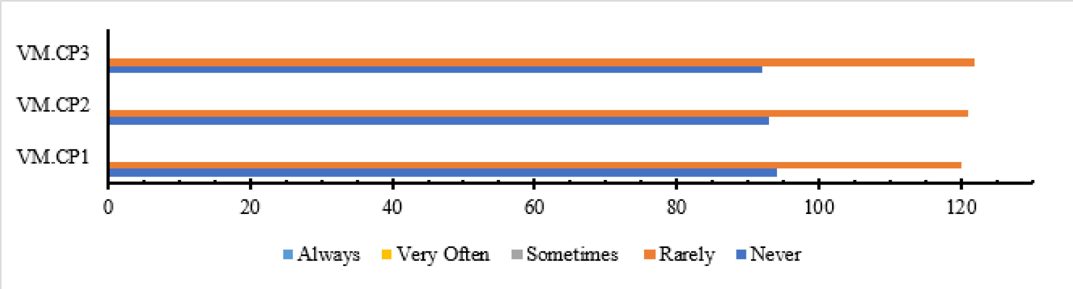

Figure 7. Frequency distribution for the creativity phase.

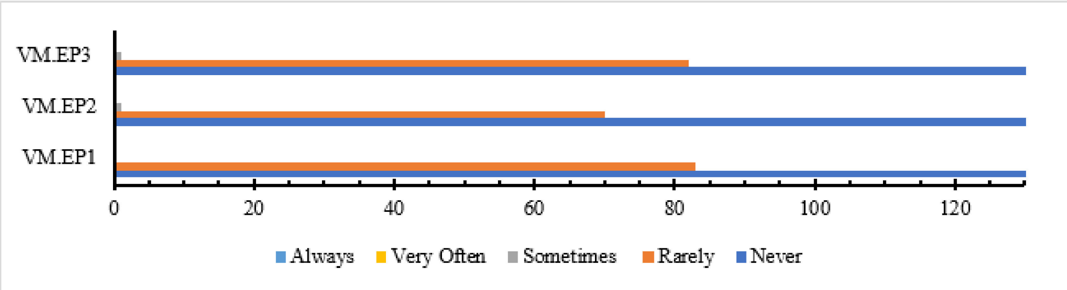

Figure 8. Frequency distribution for the evaluation phase.

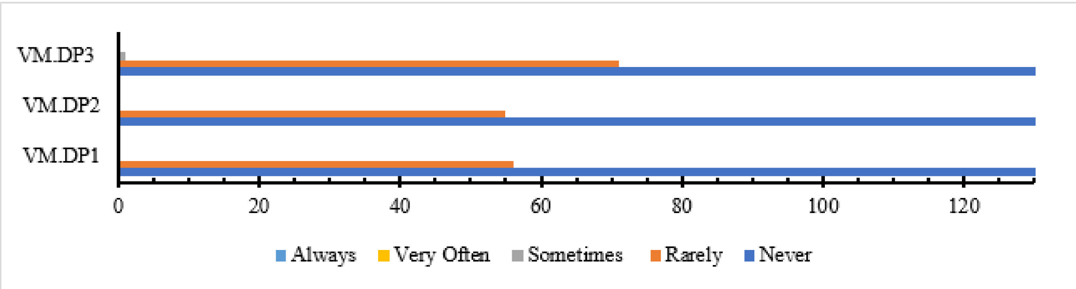

Figure 9. Frequency distribution for the development and presentation phases.

Figure 6 indicates the distribution frequency of four (4) variables (VM.FP1–VM.FP4) in the functional phase, as assessed by various construction professionals in Egypt. Generally, none of the construction professionals always performed the function activities of value management, while only 1.4% and 3.9% were exercising these activities very often and sometimes, respectively. However, these activities and methods were rarely and never performed by no more than 63.9% and 30.8% of respondents, respectively.

Figure 7 shows the frequency distribution of three (3) variables (VM.CP1–VM.CP3) for the creativity phase, as measured by various residential building professionals in the Egyptian construction industry. In general, none of these professionals always, very often, or sometimes performed value management creativity activities. However, 56.5% and 43.5% of the respondents indicated that they rarely and never performed these activities and methods, respectively.

Figure 8 shows the frequency distribution of three (3) variables (VM.EP1–VM.EP3) for the evaluation phase, as assessed by various residential building professionals in the Egyptian construction industry. For the creativity phase, it seems that nobody from the professionals always, very often, or often conducted value management creative practices. However, 36.3% and 63.1% of the respondents rarely and never carried out these practices and methods, respectively.

Figure 9 demonstrates the frequency distribution of three (3) variables (VM.DP1–VM.DP3) for this combined phase (development and presentation phases) as measured by various residential building professionals in the Egyptian construction industry. Regarding the creativity and evaluation phases, not one of the construction professionals always, very often, or sometimes carried out the creative activities of VM. However, 28.3% and 71.5% of the respondents rarely and never carried out these activities and methods, respectively.

5.2. Importance of VM Activities in Egyptian Residential Building Projects

The residential building industry's main goal in adopting VM is to raise productivity and proficiency and, therefore, reduce the projects' costs. Furthermore, the literature has identified many activities that have led to significant improvements in successful construction. These activities affect the decision of construction practitioners to adopt VM. The research identified 20 activities to implement VM in construction practices.

The collected data, via questionnaire, was entered into the SPSS software and analyzed using the *RII* method (important relative index). The methodology was implemented in this analysis to establish the relative importance of activities affecting VM implementation. The value of the *RII* range was between 0 and 1, with 0 not inclusive. It is read like this: the higher *RII* value; the more important the essential activities are, and vice versa. As suggested by Chen et al. [69], the transformation matrix is an assessment of *RII* with the corresponding level of significance and derived level of importance from *RII*, which are as follows:

High (H)	$0.8 < RII < 1.0$
High–Medium (H–M)	$0.6 < RII < 0.8$
Medium (M)	$0.4 < RII < 0.6$
Medium–Low (M–L)	$0.2 < RII < 0.4$
Low (L)	$0.0 < RII < 0.2$

Table 2 and Figure 10 show the results of the relative importance index (*RII*) of the VM activities, along with the accompanying ratings and their levels of importance. It was confirmed from the ranking analysis that all activities were recognized as having high importance levels, except for one activity, VM.IP2, which was high–medium. However, across all participants, the top five ranked factors, with the highest *RII* being above 0.85, were as follows: clarify project background information and constraints; investigate alternative assessment criteria; brainstorm ideas to meet the desired functions, elements and associated costs; generate and classify functions or elements into essential and secondary elements with their associated costs; and carry out site visitation. These activities were mostly aimed at professionals through the adoption of VM. Other activities were also significant and considered valuable for the residential building industry. Table 2 lists the 20 activities used, with the *RII* scores and standard deviations in this research. The results indicate the *RII* and standard deviation, which show that the respondents' perceptions were highly agreeable and displayed significant deviation. VM is viewed in the construction industry as a catalyst for innovation. Organizations should, therefore, understand the successful VM implementation process for projects.

5.3. Gap Analysis

Table 3 and Figure 11 show the gap analysis results between the importance and current VM activity practices. The highest observed gaps were in implementing the activities related to the function, creativity, evaluation, and development and presentation phases, and the significance of these activities. These activities need the most considerable attention in order to fill the gap between implementation and importance. Furthermore, these also need attention and support from the stakeholder. However, information phase activities represent the lesser gap between the VM's effectiveness and implementation. In addition, the highest gap in the information phase was in VM.IP6 (Gap = 1.03), followed by VM.IP8 (Gap = 1.02), VM.IP1 (Gap = 0.89), and VM.IP4 (Gap = 0.83), and other information activities were below the highest gap activities. On the other hand, as shown in Table 3, other VM phase activity gaps were above 2.5. This means that these results are supported by the above results for the practice and importance of VM activities for those phases, which indicates that these activities are vital, but have not been carried out so far.

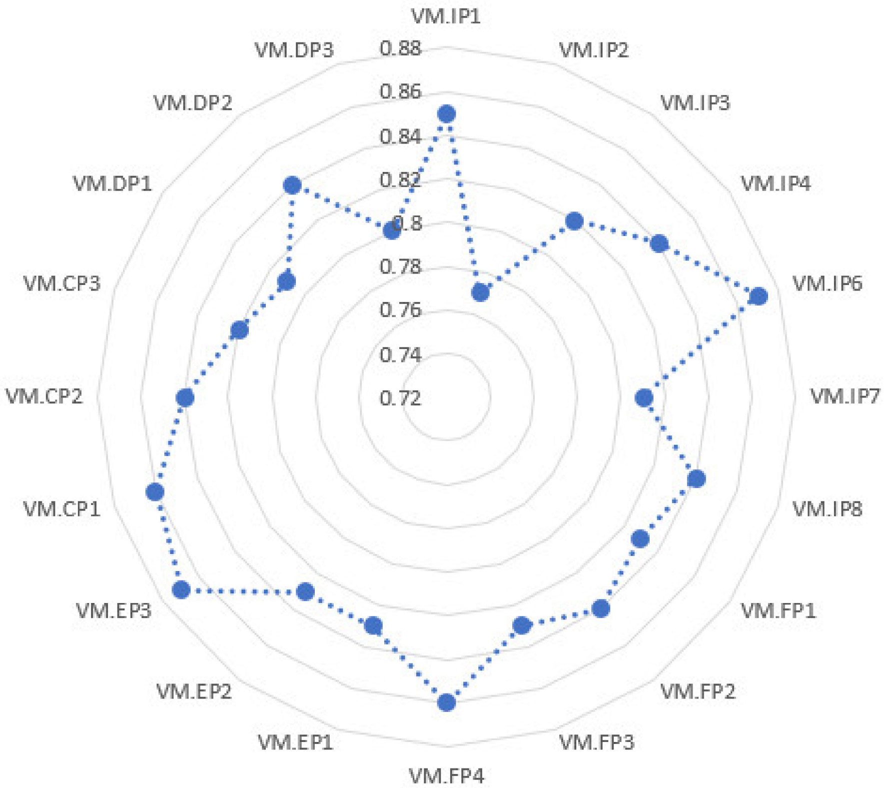

Figure 10. Relative important index (*RII*) levels for value management (VM) activities.

Table 3. Gap analysis between the importance and practice levels of VM activities.

VM Phases	Activity Code	Importance	Practice	Gap
Information Phase	VM.IP1	4.23	3.34	0.89
	VM.IP2	3.85	3.21	0.64
	VM.IP3	4.12	3.50	0.62
	VM.IP4	4.22	3.39	0.83
	VM.IP6	4.36	3.33	1.03
	VM.IP7	4.07	3.50	0.57
	VM.IP8	4.20	3.18	1.02
Function Phase	VM.FP1	4.17	1.79	2.38
	VM.FP2	4.21	1.78	2.43
	VM.FP3	4.14	1.73	2.41
	VM.FP4	4.28	1.73	2.55
Creativity Phase	VM.CP1	4.31	1.56	2.75
	VM.CP2	4.19	1.57	2.62
	VM.CP3	4.10	1.57	2.53
Evaluation Phase	VM.EP1	4.15	1.39	2.76
	VM.EP2	4.16	1.34	2.82
	VM.EP3	4.33	1.39	2.94
Development and Presentation Phase	VM.DP1	4.04	1.26	2.78
	VM.DP2	4.18	1.26	2.92
	VM.DP3	4.01	1.34	2.67

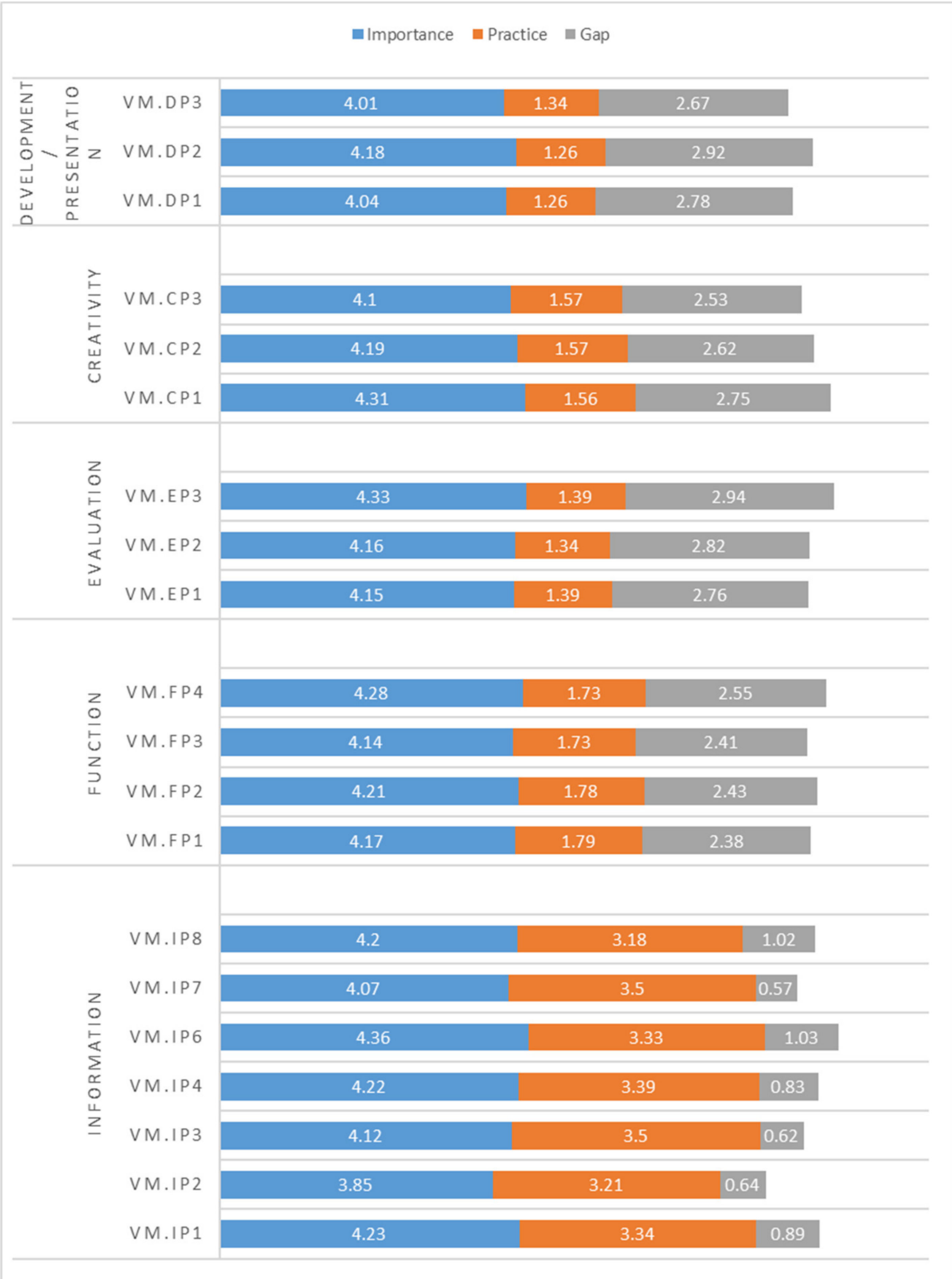

Figure 11. Gap analysis between the importance and practice levels of VM activities.

5.4. Pearson Correlation Analysis

To confirm the association of VM phases, the Pearson correlation coefficient was conducted using SPSS software. The findings are shown in Table 4. It contains the results of the means (M) and standard deviations (SD). The results are as follows: information phase (M = 4.148, SD = 0.534), function phase (M = 4.200, SD = 0.576), evaluation phase (M = 4.216, SD = 0.609), creativity (M = 4.200, SD = 0.639), and development and presentation (M = 4.076, SD = 0.651).

Table 4. Correlation analysis results between VM phases.

VM Phases	Information	Function	Evaluation	Creativity	Development and Presentation
Information	1	0.236 ** 0.001	0.174 * 0.011	0.352 ** 0.000	0.231 ** 0.001
Function		1	0.246 ** 0.000	0.268 ** 0.000	0.202 ** 0.003
Evaluation			1	0.305 ** 0.000	0.319 ** 0.000
Creativity				1	0.269 ** 0.000
Development and Presentation					1
Mean	4.1489	4.200	4.216	4.200	4.076
Standard Deviation	0.534	0.576	0.609	0.639	0.651

** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level.

To determine the strength of the relation between VM phases, the coefficient of the Pearson correlation was calculated. The Pearson correlation indicates the nature and intensity of the relationship between two variables (both positively and adversely) and the interaction between the variables [70]. A positive association implies that if one variable improves, the other variable increases too, and the other variable drops if one variable increases [71,72]. The Pearson correlation coefficient ranges from −1 (perfect negative correlation) to +1 (perfect positive correlation). The correlation findings advocate that there is a strong positive association among the VM phases.

6. Critical Value Management Activities Framework

The proposed framework is outlined in Figure 12. After confirmation of VM phase association through the Pearson correlation coefficient, the framework was developed to include critical VM activities within the Egyptian residential building industry, specifically the activities that needed considerable attention to fill the gap between implementation and importance, identified from the gap analysis. These activities represent critical activities with the highest activities gap between importance and practice. These VM activities should be satisfied before VM can be effectively introduced in the Egyptian construction industry, requiring more consideration from policy makers. Moreover, the proposed framework is concerned with connecting variables, which will serve as the foundation for the critical VM activities framework [73]. Furthermore, each VM practice's scope was defined using five (5) questions proposed by Aini [18], who developed a framework for VM guidelines in Malaysia. The proposed framework (Figure 12) answers questions to support VM's role in enhancing Egyptian residential project values as follows:

- Who is involved in a VM study? The owner and stakeholders (architects, quantity surveyors, and electrical, civil, and mechanical engineers). Zainul-Abidin [74] agreed that communication among stakeholders enhances the chance to encourage owners and end-users to express the project's goals and aims;
- What is the importance of adopting a VM study? Mainly, it is to raise the value of residential projects, and VM's introduction grants an assessment of the project's performance by evaluating the ideas to meet the desired functions [23]. However, it is represented as a value enhancement tool by developing creative analysis [49];
- When is a VM study required? VM study should be invited in the decision-making process. Rosłon [75] agreed that decision-making is a vital and complicated period because of the details of the building process negotiated at this time. However, adopting VM in this critical time can

improve the project by defining and understanding the project's aim [39]. Consequently, generating the ideas and alternatives would be useful to generate, according to this understanding [76];

- Why is the VM study needed? VM is invited because of its potential for improving value advantages. VM is frequently adopted as an analytical tool, organized to improve the value for money by delivering the required functions with the lowest cost in line with the quality criteria required [77]. Furthermore, it supports the stakeholders in allocating the project resources integrated with its functions effectively [78]. Through the proposed VM development phase, the suggested VM proposal action plan can support the project not only for technical arrangements, but also for business improvements;
- How can a VM study be carried out? VM can be carried out by VM activities and phases (information, function, creativity, evaluation, development, and presentation) [79]. However, from the proposed framework (Figure 12), we can observe that VM adoption in the Egyptian construction industry needs more consideration to develop the last five phases (function, creativity, evaluation, development, and presentation).

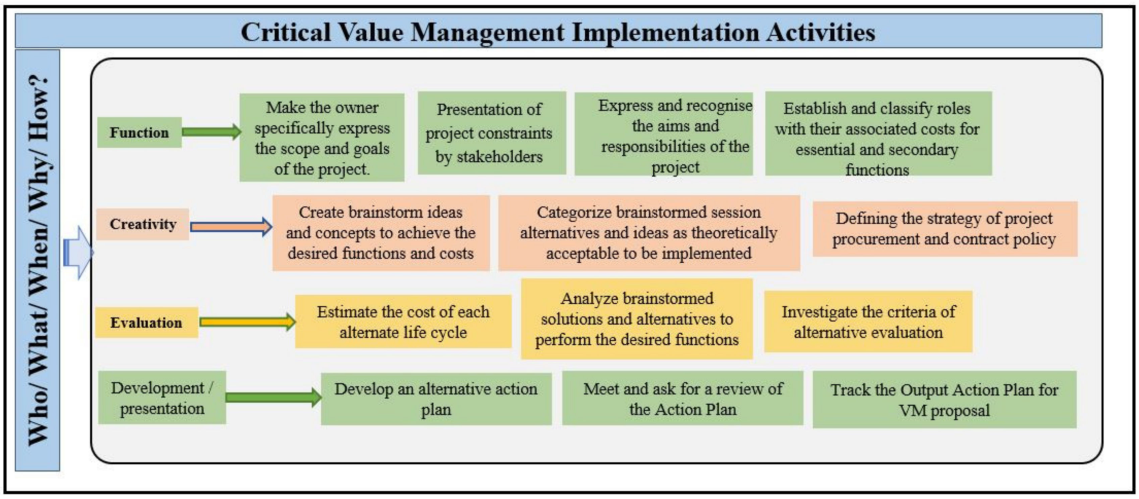

Figure 12. Critical VM activities framework.

7. Discussion

The residential building field is responsible for affecting the environment, and it is giving more attention to the concepts of the circular economy [80,81]. Over time, the residential building industry has grown by incorporating new technologies in different construction phases, including planning and execution [82]. Building professionals should also be aware of the current techniques and information to optimize executions, maintenance, rehabilitation procedures, belief in the mechanism of degradation, and the risk of quality over time [83]. VM represents one of the most important technologies to enhance projects. Previous research on VM implementation activities and methods have paid less attention to residential building administration. Tanko et al. [33] noted that, in developing countries, most empirical work on VM did not examine critical VM activities. As such, this paper attempts to fill this gap by examining the critical VM activities required in the Egyptian residential building industry.

Most of the companies investigated reported not using VM for several reasons, including inadequate knowledge, cost, lack of awareness, and difficulties with changing traditional practices. However, if these organizations in the country are willing to achieve sustainable construction using VM, then more actions are required toward the adaptation of VM. Although VM was proposed as a concept of successful building projects in many nations, it has not yet been widely applied in developing countries [8,44,84,85]. Thus, researchers can see that despite the moderate level of knowledge, professionals in the Egyptian residential building industry still need to be fully adopted.

The VM knowledge study findings are consistent with other developing countries' findings, including Malaysia [25] and Myanmar [46].

On the other hand, from the analysis of VM activity practices, it is essential to note that most of these activities or methods fall under the typical VM methodology's information phase. In other words, the creativity phase, the evaluation phase, the analysis of functions, the development, and the presentation phases are not commonly practiced by these professionals in the Egyptian residential building industry. This finding is in line with Tanko et al. [21], who showed that the information phase was the only one practiced by the Nigerian construction industry. It can, therefore, be concluded that VM activities are being carried out in Egypt. Regarding the importance of VM activities, it is surprising that although Egypt's residential building professionals have been engaged in only information phase activities, they have confirmed that all other phases' activities are essential and vital. Consequently, through gap analysis, the study suggested a critical VM activities framework for recognizing the most critical activities.

8. Conclusions and Recommendations

There is no known research related to the VM activities framework for the Egyptian residential building industry, which examines the implementation and gap analysis between VM activity practices and importance. This study's main purpose was to identify VM application activities in the Egyptian residential building industry. It also ranked the VM activities that have been accumulated from the previous literature, interviews, and the pilot phase of the study. A gap analysis between VM activity practices and importance was conducted, as well as Pearson correlation analysis to reveal the correlation between VM phases before suggesting the framework. The proposed framework included the highest activities that should be considered for implementing VM.

The observation from this investigation is that VM's adoption in Egypt's residential building field is still at a deficient level. Most surveyed organizations did not use VM, and their teams did not implement its method. This study found an important influence on stakeholders and management skills to adapt and use the organization's VM concept. Willingness always leads to effective participation in adaptation and encourages teamwork to increase awareness of VM implementation. This research suggests that organizations initiate the adoption of VMs and enable professionals to improve their VM implementation skills. Attending training or seminars will enhance the participant's theoretical knowledge, while practicing technology will improve skills and knowledge. The study revealed 20 activities and employed a quantitative research approach for responding to participants in Cairo and Giza in Egypt, specifically in the residential building industry. The findings are anticipated to contribute in enhancing the practice of VM in the Egyptian residential building industry. In addition, the findings recognize possible areas of deficiency, and effective standard curative measures can be taken proactively, according to VM elements. The proposed framework can be developed as a curriculum of education programs to develop project directors and residential building professional management.

Finally, this research produced a series of recommendations and a clear VM framework that industry practitioners can follow to ensure that VM is implemented and total quality products are reached. Related future studies might focus on identifying the drivers for VM activities, with the highest gap in importance and practice. As part of the future work of this study, a further detailed study should be carried out on the implementation of the VM and investigate the relationship between the implementation of the VM and the overall success of the project. Such a study will reveal the advantages of implementing VM that could contribute in enhancing the adaptation of the VM.

9. Implementation of the Study

The study provides a variety of theoretical and practical implementations at the academic and industrial levels. The execution of residential building projects by the same process, like the unwillingness to accept improvement, can be part of the primary explanation of the failure to progress residential building sector delivery within Egypt's nation. If these changes are to be made, stakeholders must be willing to implement creative alternative philosophies, especially those directly impacting project delivery. Therefore, this study shows no implementation of the VM method, as there is a need to adopt a VM in Egypt's residential building sector. For this to happen, stakeholders must be educated via lectures and seminars on the need to incorporate novel concepts, which would help projects to succeed. Doing this makes it possible to address the client's misunderstanding about VM's increasing cost and reduce their fears. Accordingly, the insight gained from this research will provide owners or employers with an understanding of the main barriers hindering the adaptation of VM. Therefore, residential building professionals need to be educated on the philosophies, concepts, and tools elaborated on in the VM procedures.

Furthermore, respective residential building stakeholders' bodies in Egypt should hold regular training seminars for their members on VM and comprise the same in their ongoing evaluation of professional improvement. The government also plays a significant role in implementing public projects and creating and enforcing standards and policies across diverse industries. Therefore, the government will encourage VM's use by developing laws and legislation that will promote its adoption in the country on residential building sector projects. Residential building sector organizations cannot implement VM at the company level. Similarly, employees cannot be trained without top management guidance. Appropriate implementation mechanisms for these policies also need to be given to ensure compliance. Finally, through the proposed framework, the standards for project teams in Egyptian residential building projects can be generated to manage a successful project by adopting VM efficiently.

Author Contributions: A.F.K. initiated the research project, carried out the mixed methods empirical research, and drafted the manuscript. I.O. supervised the project and provided feedback on the manuscript drafts. A.E.O. supervised the project and provided feedback on the manuscript drafts. N.C. provided feedback on the manuscript drafts. B.A. provided feedback on the manuscript drafts. All authors have read and agreed to the published version of the manuscript.

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