Value Engineering Practices in The Libyan Construction Industry: A Preliminary Study

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Abstract. The current reconstruction of Libya infrastructure requires the implementation of Value Engineering (VE) in the Libyan Construction industry for minimization of waste and efficient use of available resources. The purpose of this paper is to present a preliminary findings on the assessment of the current VE practices and factors that could influence the adoption of VE in the Libyan Construction industry. This study uses a quantitative approach to achieve the objectives. A pilot test was conducted prior to conducting a Delphi study. This is to ensure that participants of Delphi study understand the questions they are required to answer. A total of thirty (30) respondents participated in the pilot test. The purpose of pilot study is to verify and validate the questionnaire form that will be used in the Delphi study. With some minor changes, the Delphi study was conducted in four (4) rounds with participation of 31 respondents. Then, the data was analyzed using Statistical Package for Social Sciences (SPSS) version 20. The Cronbach Alpha values of the variables are between 0.692 and 0.92. This result showed that the reliability test result is within the acceptable values. The sample size for the main survey was determined by using the Slovin’s formula. Using a simple random sampling technique, a total of 390 respondents were determined as the minimum sample size for this study.

1. Introduction
The eight-year crises in Libyan resulted in the destruction of significant number infrastructure. Currently, a number of re-constructions of the destroyed infrastructure are being initiated. However, the current global fall in the price of crude oil has a significant impact on the economies of most oil producing countries such as Libya. There is therefore the need for efficient utilization of available resources, minimize unnecessary cost and enhancement of values of projects. This can be achieved through the application of Value Engineering (VE) on all construction projects in Libya. However, awareness, knowledge, readiness, organizational innovativeness, organizational culture, organizational resources and government policy could significantly enhance the adoption of VE in the Libyan construction industry. This paper therefore presents the result of pilot test and Delphi study. The Pilot test was conducted to assess the understanding of questionnaire by the respondents prior to conducting a Delphi study in Libya. The Delphi study was conducted to refine the questionnaire items derived from the literature. This is to ensure that the final survey instrument will be suitable to the Libyan construction industry.
2. Literature Review

2.1. Libyan Construction Industry

Over the last five decades, the Libyan construction industry (LCI) has been witnessing a series of transformations. According to Ali and Omran [1], the Libyan construction industry contributes very limited value to the country’s economy in the early 1950s, when Libya was just liberated from its colonial masters (Italy). During those trying periods, construction was only considered a social activity, where one generation transfers their construction skills to another, and the people’s cultural orientation and values became well reflected in construction end-products [2]. Immediately after the 1969 coup (The beginning of the second five-year plan for the Kingdom of Libya 1969-1974) and especially during the oil boom of the 1970s, Libyan construction industry played an important role in the country’s economic and social developmental processes. Consequently, Libya experienced a remarkable improvement in the volume of construction activities during this period, so much, so that in the late 1970s, the country has been recognized as the world’s leading per capita consumer of cement products [3]. According to Salah and Bloomer [4], this trend was sustained until the early 1980s, when the construction industry suffered a number of setbacks, particularly as a result of the newly introduced political and economic system at the time which eliminated the local private construction firms, and limited construction contracting only to public and international accompanies.

2.2. Value Engineering

Value engineering has been proven as one of the viable management techniques in the construction industry to improve the function of projects and prevent unnecessary cost [5]. By considering the fact that the construction industry is facing several challenges to attain a high-value project delivery in terms of time and cost, VE is being used to revamp the industry’s image in various countries globally for nearly a century, as it has gradually become an essential part of project development [6]. Table 1 shows the various definition of value engineering. Several studies reported that VE is reliable in optimization of resources. For instance, Zhang et al. [7], reported that VE has the ability of saving a significant percentage of construction project cost.

Table 1. Various Definitions of Value Engineering

| Authors                  | Definition                                                                 |
|--------------------------|----------------------------------------------------------------------------|
| 1. Miles (1972)          | A discipline action system, attuned to one specific need: accomplishing the functions that the customer needs and wants at the lowest cost. |
| 2. Zimmerman (1982)      | A proven management technique using a systematized approach to seek out the best functional balance between the cost, reliability, and performance of a product or project. |
| 3. Mohan Reddy (1991)    | An attempt at cost avoidance by determining the most favorable connection between product function and costs at the design stage. |
| 4. Connaughton and Green (1996) | A systematic approach to delivering the required functions at lowest cost without detriment to quality, performance and reliability. |
| 5. Fang and Rogerson, (1999). | Measurement of the value of a product in terms of quality, performance and reliability at an acceptable price and to remove non value-added aspects where value is defined as worth/cost. |
| 6. Standing (2001)       | The systematic and creative process for the provision of the necessary functions of a project at the lowest cost by efficient identification and the elimination of unnecessary cost without detriment to: safety, quality, reliability, performance and delivery. |
| 7. Kelly et al. (2004)   | The process that identifies and eliminates unnecessary cost during design and construction stages. |
| 8. Zhang et al. (2009)   | A management tool to achieve essential functions of a product, service or project with the lowest cost. |
While it has been established that VE is best implemented during the detailed design and construction stages of project Illozor and Kelly [8], the process has also been claimed to be a subset of the Value Management, where its major preoccupation is value improvement with the underlying principle of quality assurance. VE has been described as an organized, innovative, problem-solving, and function-oriented process that uses a multi-disciplinary and proactive team approach for the achievement of best value for money in project delivery during both the design and construction stages. In this way, the process not only identifies unnecessary costs within the project, it also removes them without compromising the quality, safety, reliability, performance, and whole life cycle cost optimization with the aim of satisfying the critical factors that can meet user’s desires and expectations.

3. Methodology

3.1. Research Method
There are basically three major research approach commonly used by research in Social Sciences: quantitative, qualitative and mix method [9]. This research adopts a quantitative approach to collect data for the study. Figure 1 presents the research design for the conducted study.

![Research Design Diagram]

An intensive literature review was conducted to identify potential factors in adopting VE around the globe. The factors were analysed and considered to be potential factors that significantly improve the adoption if VE in Libya. The factors were compiled and the questionnaire form was prepared to the next process.
3.2. Back Translation

In order to secure the most enthusiastic response possible for this survey, the language used in the questionnaire was Arabic, which was back-translated twice from the original English version by different translators who were both fluent in English and Arabic. The present study adapted the guideline recommended by Coffey [10], for the back translation of the questionnaire from English to Arabic language. The translation from English language to Arabic language is necessary because Arabic is the official language in Libya. Figure 2 shows the back translation process.

Figure 2. Back Translation for Questionnaire Form

As shown in Figure 2, the original version of the questionnaire in English language (E1) was compared with final version of Arabic translated version (A2). The comparison was done by an expert language translator. This was necessary to ensure that the original meaning in E1 has been retained in A2 version of the questionnaire. Any discrepancy in A2 will be corrected to reflect the content of E1. According to Usunier [11], this back-translation technique is advantageous in ensuring that potential translation errors and discrepancies are minimized. In fact, the results from the translation process were that there was little difference in the “terms” used between the two English versions and Arabic versions. After comparing the second Arabic (A2) version with the original English (E1) version, and then conducting editing of the Arabic version, a final version was reached which accurately reflected the meaning of the original English language survey instrument.

3.2.1. Pilot Test

A total of 32 questionnaires were distributed to respondents in Libya between 27th December 2018 to 4th January 2019. In total, thirty (30) completed questionnaire was received between 6th and 15th January 2019. The questionnaires consist of eight sections. Section 1 is on respondents’ profile. Section 2 is on awareness of VE. Section 3 is on knowledge of VE. Section 4, 5 and 6 are on organizational culture, resources and innovativeness respectively. Section seven is on government regulation on VE and section 8 is on readiness to adopt VE.

3.2.2. Delphi Study Procedure

In the first round, there are only 11 items being rated 4.00 and above. 39 items were scored between 3.00 and 4.00. The rest of the items are (32 items) were being rated 3.00 and below. The total number
of items rated in round 1 is 82. At the end of second round, there is a slight increase of 10.6% (+0.106) in the overall average score (3.53). This is because some items had been rated higher compared to previous scores. A total of 41 items were rated 4.00 and above, while 19 items fall of between 3.00 and 4.00. A total of 23 items were being rated 3.00 and below. A Delphi study panel member suggested the inclusion of the item “there is government regulation on VE in Libya construction industry” in round 1. This item was then added to the 82 initial items. Hence, 83 items were rated in second round of the Delphi study.

In this round, there is a slight increase of 0.07% (+0.0007) in the overall average score (3.53). This is because some items had been rated higher compared to previous scores. A total of 45 items being rated 4.00 and above, 14 were scored between 3.00 and 4.00, and 24 items were rated 3.00 and below. The total number of items rated is 83. The scores for all 83 items are relatively stable in this final round. The difference between the total average scores of Round 3 and Round 4 is only 0.04% (+0.0004) and overall average score of 3.53.

3.3. Data Collection

3.3.1 Pilot Study Result
Data was analysed using SPSS version 20 to determine the values of Cronbach Alpha. Table 2 presents the result of pilot study conducted to assess the understanding of the questionnaire among the respondents prior to conducting the Delphi study. Table 2 shows a summary of reliability test results of 30 respondents from the pilot test. The alpha scores, which range from 0.692 to 0.928 for the constructs are all within the acceptable limits [4].

| Measurement                              | N of item | Cronbach’s Alpha |
|------------------------------------------|-----------|------------------|
| Awareness                                | 10        | 0.813            |
| Knowledge of Value Engineering           | 9         | 0.692            |
| Adhocracy culture                        | 11        | 0.773            |
| Market Orientation                       | 10        | 0.709            |
| Transformational leadership style         | 6         | 0.709            |
| Organizational learning                  | 6         | 0.799            |
| Product innovativeness                   | 3         | 0.928            |
| Process innovativeness                   | 4         | 0.778            |
| Business system innovativeness           | 4         | 0.695            |
| Information technology                   | 6         | 0.749            |
| Government Regulation                    | 5         | 0.753            |
| Readiness to Adopt Value Engineering     | 7         | 0.825            |

3.3.2 Delphi Study Result
A total of thirty-four (34) experts who satisfied the pre-determined criteria for the panel of experts (having more than 20 years of experience in the Libyan Construction Industry) were identified and invited to participate in the Delphi survey. The minimum age criteria used in selecting the panel is based on previous study that considered age limit as an important criterion in selecting experts in construction industry [12]. The invited experts are from both public and private sectors in the Libyan Construction Industry.

Out of the 34 experts invited, only thirty-one (31) expressed their interest and agreed to participate; yielding a total of 91.2%. However, only 28 experts were able to complete all the four (4) rounds of Delphi study, yielding a response rate of 90.3%. This provides a solid basis for the analysis and enhances the validity of the Delphi results. In general, the above response rate indicates that the research received a high level of attention from experts within the Libyan construction industry.
Furthermore, having an al-most equal number of experts from both public and private sectors participating in Delphi Surveys presents a balanced view of the respondents. The participating experts were senior representatives and stakeholders in construction industry in Libya. The expert from the public sector comprised of; 3 General Managers, 3 Heads of Department, 7 Project Managers 3 Engineers and 1 Architect from various government departments currently taking charge of major infrastructure and housing projects. The expert from the private sector comprised of 5 Executive Directors, 1 Heads of Department, 1 Project Managers 3 Engineers and 4 Architects from in either construction or consulting firms. It is worth mentioning that the experts came from the various professional backgrounds equipped with substantial working experience in the area of construction, engineering, design, contract, project management, and management. These high-ranking professionals and their organization have extensive experiences in housing (residential) and infrastructural projects.

The experts’ composition and profiles infer that the opinions collected in the Delphi survey represent holistic stakeholders’ views and provide highly valid outcome, given the diverse experts’ professional backgrounds, their decision-making roles in respect organizations related to the construction industry in Libya. In addition, the fact that the experts had previously undertaken national projects and worked in different cities suggests that their views represent Libyan the context. On the minimum cut-off of the items ranked by experts during Delphi study, previous studies have shown that 50% consensus among the Delphi experts on every item is acceptable. Following Okoli and Pawlowski [13], on the minimum cut off for the ranked items, this study considered items that have the mean score of 3 and above. Relating to the 5-point likert scale used for ranking the items in the Delphi questionnaire, a mean score of 3 is above 50 percent consensus among the experts. Hence only the items that have been scored 3 and above were considered to be included in the final survey. Table 3 presents list of items rated from 3 and above in the research instrument by the Delphi panel. Table 4 shows the total number of items score for each Delphi Round and its modifications that being made by the experts. The process is complete once the consensus is achieved.

Table 3. The total items (59) rated 3.00 and above.

| Factor of VE’s Adoption                                      | Mean | Rank |
|-------------------------------------------------------------|------|------|
| Know the process in VE.                                     | 4.64 | 1    |
| Be an early adopter of innovative construction materials.   | 4.5  | 2    |
| Support the adoption of VE                                 | 4.46 | 3    |
| Emphasizes on acquiring new resources.                      | 4.43 | 4    |
| Recognize the benefits of VE                               | 4.32 | 5    |
| Strong commitment to learning.                              | 4.32 | 6    |
| Top management regularly discusses competitors’ strength.   | 4.29 | 7    |
| Motivating the rest of the organization employees.         | 4.29 | 8    |
| Creating new business systems as critical to our success.  | 4.25 | 9    |
| We need fundamental education on Value Engineering.         | 4.21 | 10   |
| Our organization promotes open-mindedness.                  | 4.21 | 11   |
| Rigorous value engineering standards.                       | 4.21 | 12   |
| We are completely ignorance about Value Engineering.        | 4.18 | 13   |
| Understands the meaning and function of value engineering. | 4.14 | 14   |
| Provide sufficient Information regarding value engineering to staff. | 4.14 | 15   |
| Concerned with value engineering and do organize training among staffs. | 4.14 | 16   |
| Our organization finds adopting Value Engineering to be pleasing. | 4.14 | 17   |
| Dynamic and able to coop with new technologies              | 4.14 | 18   |
| Develops in-house solution to improve our construction services. | 4.14 | 19   |
| Able to implement innovative business systems used by other organizations. | 4.14 | 20   |
Table 3. The total items (59) rated 3.00 and above (Cont.)

| Factor of VE’s Adoption                                                                 | Mean  | Rank |
|----------------------------------------------------------------------------------------|-------|------|
| Government regulation on value engineering in Libya                                    | 4.14  | 21   |
| The leadership in our organization generally exemplifies risk-taking.                  | 4.11  | 22   |
| Our organization is well computerized.                                                 | 4.11  | 23   |
| Our organization conducts most business transactions online.                           | 4.11  | 24   |
| Needs to comply with government regulation                                            | 4.11  | 25   |
| Our organization looks forward to adopt Value Engineering at work.                     | 4.11  | 26   |
| Our organization inclines to try new ideas.                                            | 4.11  | 27   |
| Support system to implement VE.                                                        | 4.07  | 28   |
| The leadership in our organization generally exemplifies innovativeness.               | 4.07  | 29   |
| Our organization is an entrepreneurial place.                                          | 4.07  | 30   |
| Business objectives are driven by customer satisfaction.                               | 4.07  | 31   |
| Our management team has a clear view of its final goals.                               | 4.07  | 32   |
| Early adopter of innovative construction process.                                      | 4.07  | 33   |
| We need significant improvement on Value Engineering.                                  | 4.04  | 34   |
| Our organization respond rapidly to competitive actions.                               | 4.04  | 35   |
| Always on lookout for new opportunities for the organization.                          | 4.04  | 36   |
| Our organization promotes a learning culture.                                          | 4.04  | 37   |
| Able to implement innovative process used by others organizations.                    | 4.04  | 38   |
| Employees are computer literate.                                                       | 4.04  | 39   |
| Our organization is seen to be supporting change.                                      | 4.04  | 40   |
| Our organization is commitment to development.                                         | 4.    | 41   |
| High commitment to meet customer needs.                                                | 4     | 42   |
| Capable to guide employees on their job.                                               | 4     | 43   |
| Seeks innovative business systems from outside this organization.                      | 4     | 44   |
| Incentives from government                                                             | 4     | 45   |
| Our organization emphasizes on creating new challenges.                                | 3.82  | 46   |
| Our organization seeks for innovative building materials from outside this organization. | 3.75  | 47   |
| Our organization seeks for innovative construction process outside this organization.  | 3.71  | 48   |
| Our organization shared vision provides a focus for learning.                          | 3.68  | 49   |
| We can apply Value Engineering on projects successfully.                               | 3.46  | 50   |
| Our management team always act as the organizational leading force.                    | 3.46  | 51   |
| Our organization competitive advantage is based on understanding customers’ needs.     | 3.43  | 52   |
| Our organization has commitment to innovation.                                         | 3.36  | 53   |
| Our organization provide the staff with value engineering guidelines.                  | 3.25  | 54   |
| Our organization proactively questions long-held way routines.                         | 3.25  | 55   |
| Our organization’s top management support the staff in understanding value engineering. | 3.21  | 56   |
| Our organization finds adopting Value Engineering to be pleasing.                      | 3.14  | 57   |
| Our organization’s leaders are capable of motivating the employees on their job.       | 3.07  | 58   |
| Our organization’s employees support the application of information technology.        | 3.07  | 59   |
Table 4. The total number of items score for each Delphi round.

| The Variables                  | Round 1 Number of items Rated from (5) | Round 2 Number of items Rated from (5) | Round 3 Number of items Rated from (5) | Round 4 Number of items Rated from (5) |
|-------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|
|                               | Above 4 Between 4 and 3 Below 3 Above 4 Between 4 and 3 Below 3 Above 4 Between 4 and 3 Below 3 Above 4 Between 4 and 3 Below 3 |
| Awareness                     | 10 2 5 3 5 2 3 5 2 3 5 2 3           |                                        |                                        |                                        |
| Knowledge of Value Engineering | 9 2 2 5 4 1 4 4 1 4 4 1 4            |                                        |                                        |                                        |
| Adhocracy culture             | 11 0 7 4 3 5 3 6 2 3 6 2 3           |                                        |                                        |                                        |
| Market Orientation            | 10 1 3 6 4 1 5 4 1 5 4 1 5           |                                        |                                        |                                        |
| Transformational leadership style | 6 0 5 1 4 2 0 4 2 0 4 2 0          |                                        |                                        |                                        |
| Organizational learning       | 6 2 1 3 3 2 1 3 2 1 3 2 1           |                                        |                                        |                                        |
| Product innovativeness        | 3 1 2 0 2 1 0 2 1 0 2 1 0           |                                        |                                        |                                        |
| Process innovativeness        | 4 0 4 0 3 1 0 3 1 0 3 1 0           |                                        |                                        |                                        |
| Business system innovativeness | 4 0 3 1 3 1 0 3 0 1 3 0 1         |                                        |                                        |                                        |
| Information technology        | 6 1 2 3 2 2 2 3 1 2 3 1 2          |                                        |                                        |                                        |
| Government Regulation *       | R1=6 R2/R3/R4=7                      | 0 3 3 3 4 0 3 4 0 3 4 0 3           |                                        |                                        |
| Readiness to Adopt Value Engineering | 7 2 2 3 4 1 2 4 1 2 4 1 2 |                                        |                                        |                                        |
| Total number of items for each score in the Rounds | R1=82 R2/R3/R4=38 | 11 39 32 41 19 23 45 14 24 45 14 24 |                                        |                                        |                                        |
| The overall average rounds score increase | - The initiate round 10.6% (+0.106) 0.07% (+0.0007) 0.04% (+0.0004) |                                        |                                        |                                        |

*A Delphi study panel member suggested the inclusion of the item “there is government regulation on value engineering in Libya construction industry” in round 1

4. Conclusion

This paper presents three processes conducted relating the research instrument: back translation, pilot study and Delphi study and their results. The result of the back translation shows that there is no significant difference between original English version and the translated Arabic version. The result of pilot test has demonstrated the research instrument is reliable and respondents did have similar understanding of the research instrument. The result of the Delphi study show that 59 items have been rated 3 and above, indicating their suitability and importance of the items in measuring the variables this research examines.

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