The Adoption of Value Engineering Practices in the Libyan Construction Industry

M M Elsonoki¹, R Yunus¹*, S R Yunus² and A R A Hamid³

¹ Jamilus Research Centre (JRC), Faculty of Civil Engineering and Built Environment, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor Darul Ta’zim, Malaysia
² Bahagian Integriti, Cawangan Dasar dan Pengurusan Korporat, Ibu Pejabat Jabatan Kerja Raya (JKR), 50480 Kuala Lumpur, Malaysia
³ School of Civil Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor Darul Ta’zim, Malaysia
*Corresponding author: riduan@uthm.edu.my

Abstract. Libya is a developing country that suffers from an acute shortage of appropriate infrastructure and buildings. The reconstruction of Libya, especially in the aftermath of the 2011 uprising and the subsequent conflicts, requires applying effective strategies to minimize waste of, and efficiently manage, available resources. It is suggested that the adoption of Value Engineering (VE) may improve efficiency in decision-making. The aim of this paper is to present the process of using the Delphi Method to develop a research instrument suitable for assessing current VE practices as well as the factors that could influence the adoption of VE in the Libyan construction industry. The development of this research instrument has passed through three major refining phases, namely: (i) Back Translation, (ii) Pilot Study and (iii) Delphi Method. By the end of the Delphi study, 12 factors, derived from the literature, have been rated as relevant to the research instrument and considered as factors that could influence the adoption of VE in the Libyan construction industry. These factors are as follows; 1) awareness, 2) knowledge, 3) adhocracy culture, 4) market orientation, 5) transformational leadership style, 6) organizational learning, 7) product innovativeness, 8) process innovativeness, 9) business innovativeness, 10) information technology, 11) government regulations and 12) readiness to adopt VE. This paper may complement the existing body of knowledge on using the Delphi Method to enhance research instrument.

1. Introduction

Eight years of turmoil in Libya have resulted in the destruction of a significant number of infrastructure projects and available facilities. Currently, a number of reconstruction projects of the destroyed buildings are being initiated. However, the current global fall in the price of crude oil has had a negative impact on the economies of most oil producing countries, including Libya. Therefore, there is a need for efficient utilization of available resources, minimization of unnecessary costs and enhancement of project values. This can be achieved through the adoption of Value Engineering (VE) practices in all reconstruction projects in Libya. In order to create a positive impact on the economy, VE is recognized as a systematic method to regulate value in construction projects [1-2]. Most of other available techniques are focussing on time and quality rather than value [2]. However, Karunasena and Gamage [3] highlight that the implementation of VE in construction industry, compared to other sectors, is still low. Several factors that may influence the process of VE adoption have been
identified. Such factors include (1) lack of awareness among clients, (2) uncertainty of outcomes, (3) additional costs involved, (4) lack of government support, (5) time consumed, (6) lack of expertise, (7) lack of regulations and (8) policy applications.

Notwithstanding, factors (such as awareness, knowledge, readiness, organizational innovativeness, organizational culture, organizational resources and government policy) could significantly enhance the adoption of value engineering in the Libyan construction industry. Though there are research studies on VE across the globe such as Jay and Bowen [4]; Karunasena and Garnage [3] early findings on VE and the items for measuring VE in the literature might not necessarily fit the Libyan construction industry. Hence, there is a need to refine existing instruments of VE to study the applications of VE in the Libyan construction industry. This paper therefore presents the result of a back translation tool, a pilot test and a Delphi study; all of which aim to refine a research instrument suitable for a VE study in Libya. The respondents have first participated in the pilot test to assess their understanding of the questionnaire items prior to administering the actual survey in Libya. Then, the Delphi study has been conducted to seek a consensus among experts on the significant factors that contribute to adopting VE.

2. Literature Review

An intensive literature review was conducted to investigate the current adoption of value engineering around the world, with special attention to Libya as the target context of the study. The factors for VE adoption were identified and a questionnaire form was developed for the Delphi study.

2.1 Construction Industry in Libya

Over the last five decades, the Libyan construction industry (LCI) has been witnessing a series of transformations. According to Ali and Omran [5], the Libyan construction industry contributed very limited value to the country’s economy in the early 1950s, as Libya was just liberated from Italian colonialization. During such probation periods, construction was only considered as a social activity in which one generation could transfer acquired construction skills to another. The people’s cultural orientation and values became well reflected in construction products [6]. Immediately after the 1969 coup (just at the beginning of the second five-year plan for the Kingdom of Libya 1969-1974) and especially during the oil boom of the 1970s, the Libyan construction industry played an important role in the country’s economic and social development. Consequently, Libya experienced a remarkable improvement in the volume of construction activities during this period. In the late 1970s, the country was recognized as the world’s leading per capita consumer of cement products [7]. According to Salah and Bloomer [8], this trend was sustained until the early 1980s when the construction industry suffered a number of setbacks; this was seen as a result of the newly introduced political and economic system which eliminated local private construction firms and monopolized construction contracts to only public and international companies.

2.2 Value Engineering

Value Engineering (VE) has been proven as one of the viable management techniques in the construction industry to improve the function of projects and prevent unnecessary cost [9]. 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 for nearly a century to revamp the industry’s image in various countries globally, as it has gradually become an essential part of project development [10]. Several studies reported that VE is reliable in the optimization of resources. For instance, Zhang et al. [2] report that VE has the ability of saving a significant percentage of construction project cost. While it has been established that VE is best implemented during the detailed design and construction stages of a project, the process has also been claimed to be a subset of Value Management (VM) for which the major preoccupation is value improvement with the underlying principle of quality assurance [11]. 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 but also removes unnecessary costs.
within the project without compromising the quality, safety, reliability, performance, and whole life cycle cost optimization. The aim is to satisfy the critical factors that can meet user’s desires and expectations. Table 1 presents a couple of definitions of VE by some scholars. As shown in Table 1, there is a common understanding of VE among the scholars. In this study, VE is defined as a systematic approach to analyse the functions of product to enhance value and eliminate unnecessary cost or waste of resources.

| No. | Authors                | Definition                                                                                                                                 |
|-----|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 1.  | Miles [12].            | A discipline action system, attuned to one specific need: accomplishing the functions that the customer needs and wants at the lowest cost. |
| 2.  | Zimmerman [13].        | 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 [14].      | An attempt at cost avoidance by determining the most favourable connection between product function and costs at the design stage.         |
| 4.  | Connaughton and Green [15]. | A systematic approach to delivering the required functions at lowest cost without detriment to quality, performance and reliability. |
| 5.  | Fang and Rogerson [16]. | 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 [17].         | 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. [18].     | The process that identifies and eliminates unnecessary cost during design and construction stages.                                           |
| 8.  | Zhang, et al., [2].    | A management tool to achieve essential functions of a product, service or project with the lowest cost.                                    |

3. Methodology

3.1. Back Translation

The purpose of back translation is to compare the translated version of the questionnaire with the original to assess accuracy and quality. In order to secure the most authentic response possible for this survey. Arabic language is used in the questionnaire that was distributed to respondent in Libya. As the questionnaire is originally written in English, an attempt is made to control for any possible translation effect by making a double reversed translation. In other words, the Arabic translation of the text is translated back into English and, then, translated again into Arabic. Each translation is made by different certified translators who are fluent in both English and Arabic. Thus the present study has adapted the guideline recommended by Coffey [19] for the back translation of the questionnaire from English to other languages. Translation from English to Arabic is quite essential in this study because Arabic is the primary language of the target participants.

As shown in Figure 1, 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 had been retained in A2 version of the questionnaire. All discrepancies in A2 were corrected to reflect the content of E1. According to Usunier [20], this back-translation technique could be advantageous in ensuring that potential translation errors and discrepancies are minimized. In fact, the results from the translation process showed that there was a little difference between the “terms” used in the two English versions as well as the two Arabic versions. Having compared the second Arabic (A2) version with the original (E1) version and made the necessary edits on the Arabic version, the researches could arrive at a final version which could largely reflect the content of the original English language survey instrument.
3.2. Pilot Study
A pilot study is vital to examine the feasibility of the developed questionnaire form before it can be used in a larger scale study. The respondents of this pilot study have been selected based on their experience and academic knowledge related to VE and construction industry. In total, 30 respondents have participated in this pilot study. The respondents have been required to validate the questionnaire in terms of clarity and ease of understanding. A likert scale was used to evaluate the level of significance for the factors under investigation. Next, a reliability test was conducted in order to check the consistency of respondents in answering the questionnaire form.

![Flow chart of back translation](image)

**Figure 1.** Flow chart of back translation

Table 2 shows a summary of the reliability test results from the pilot test. The obtained alpha scores, which range between 0.692 to 0.928 for the constructs, are all within the acceptable limits [6]. According to Nunnally [21], a Cronbach Alpha score above 0.70 is considered as reliable. Moreover, Hair et al. [22] consider scores between 0.60 to 0.70 as moderate and adequate for use in research studies. Interestingly, the scores in all the variable of the current study are above the 0.6 level.

**Table 2.** Cronbach’s Alpha values for the Antecedents of VE Adoption

| 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          | 7         | 0.825            |
3.3. Delphi Study
The purpose of implementing the Delphi method in this study is to identify, and seek consensus on, the factors that play a role in VE adoption. This is achieved by surveying the opinions of industry experts and professional authorities. The technique is a replication of a previous study conducted by Lim [23]. The Delphi study solicits opinions from the target groups in an iterative process of answering questions. The application of Delphi study undergoes several rounds. In each round, the responses are summarised and redistributed for discussion in the next round.

The study has recruited thirty four (34) experts who satisfied the pre-determined criteria for the panel of experts. The selection of experts is based on their knowledge and expertise with VE and construction industry. The minimum requirement to participate in the study is having a 20-yearlong professional experience in Libyan construction industry. Only top management staff can participate in the study. The determination of expertise in this study is exceeding the minimum criteria that have been set by Fei and Khan [24], who highlighted that an ‘expert’ should have been working in the construction industry for more than 10 years. The expert must hold a management position with direct involvement in decision making. The invited experts are from both the public and the private sectors of the Libyan construction industry. Thus the experts recruited in this study have come from various professional backgrounds and equipped with substantial work experience in the area of construction, engineering, design, contract and project management. These high-ranking professionals and their organizations have extensive experience in running housing (residential) and infrastructure projects.

Table 3 shows the demography of the experts that participated in the study. Out of the 34 experts recruited, only thirty one (31) have expressed their interest and consent to participate; yielding a total of 91.2%. The most commonly faced challenge in the Delphi study is to retain respondent’s participations throughout multiple rounds. In this study, 28 experts have been able to complete the full (four) 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 almost equal number of experts from both public and private sectors participating in the Delphi survey presents a balanced view of responses.

| No. | Respondent’s Position | Public Sector | Private Sector | Total of respondents |
|-----|-----------------------|---------------|---------------|----------------------|
| 1.  | General manager       | 3             | 0             | 3                    |
| 2.  | Head of Department    | 3             | 1             | 4                    |
| 3.  | Project Manager       | 7             | 1             | 8                    |
| 4.  | Engineers             | 3             | 3             | 6                    |
| 5.  | Architect             | 1             | 4             | 5                    |
| 6.  | Executive directors   | 0             | 5             | 5                    |
|     | Total                 | 31            |               |                      |

The expertise composition and profiles indicate that the opinions collected in the Delphi survey represents holistic stakeholders’ views and provide highly valid outcomes, given their diverse professional backgrounds and their decision-making roles at active organizations in the construction industry in Libya. In addition, the fact that most of these experts had previously undertaken nationwide projects and worked in different cities suggests that their views may represent the wider construction context in Libya.

4. Results and Discussion
The Delphi study allowed the participants of this study to work towards a consensus by conducting a circulating series of questionnaires and releasing related feedback to further the discussion with each subsequent round. The experts' responses shifted based on the information brought forth by all respondents in the analysis as rounds completed. There were four rounds in this study. The number of rounds was determined based on the consensus achieved in the survey. In round 1, which was carried
out from 1st February 2019 to 1st March 2019, the experts were asked to rate the level of significance for each listed factor assessing applications of VE in the construction industry and to contribute any additional factors that was not covered in the list. Then, in round 2, which was carried out from 5th May 2019 to 25th May 2019, the experts were asked to reconsider the relative importance for each factor, considering its average score in the first round. They were given an opportunity to adjust the scale. The respondents were to do the same in the third round, which was carried out from 27th May 2019 to 21st June 2019. They were asked to reconsider the relative significance of each factor. Later, the same process was conducted again in round 4, which was carried out from 23rd June 2019 to 8th July 2019. The percentages of modification that was made by the respondents was 0.04%. The small amount of changes showed that a consensus was achieved among experts. Table 4 presents the items that were considered highly relevant to the VE questionnaire by the Delphi panel.

**Table 4.** Factors in adopting Value Engineering for Construction Company in Libya

| Factor of VE’s Adoption                                                                 | Mean  | Rank |
|----------------------------------------------------------------------------------------|-------|------|
| Know the process in Value Engineering.                                                 | 4.64  | 1    |
| Be an early adopter of innovative construction materials.                               | 4.5   | 2    |
| Top Management support the adoption of Value Engineering.                              | 4.46  | 3    |
| Emphasizes on acquiring new resources.                                                  | 4.43  | 4    |
| Recognize the benefits of Value Engineering.                                            | 4.32  | 5    |
| Strong commitment to learning.                                                         | 4.32  |      |
| Top management regularly discusses competitors’ strength.                               | 4.29  | 6    |
| Motivating the rest of the organization employees.                                     | 4.29  |      |
| Creating new business systems as critical to our success.                               | 4.25  | 7    |
| We need fundamental education on Value Engineering.                                     | 4.21  | 8    |
| Our organization promotes open-mindedness.                                              | 4.21  |      |
| Rigorous value engineering standards.                                                   | 4.21  |      |
| We are completely ignorance about Value Engineering.                                    | 4.18  | 9    |
| Understands the meaning and function of Value Engineering.                             | 4.14  |      |
| Provide sufficient Information regarding value engineering to staff.                   | 4.14  |      |
| Concerned with value engineering and do organize training among staffs.                 | 4.14  | 10   |
| We are completely ignorance about Value Engineering.                                    | 4.14  |      |
| Dynamic and able to coop with new technologies                                         | 4.14  |      |
| Develops in-house solution to improve our construction services.                       | 4.14  |      |
| Able to implement innovative business systems used by other organizations.             | 4.14  |      |
| Government regulation on value engineering in Libya                                     | 4.14  |      |
| The leadership in our organization generally exemplifies risk-taking.                   | 4.11  | 11   |
| Our organization is well computerized.                                                  | 4.11  |      |
| Our organization conducts most business transactions online.                           | 4.11  |      |
| Needs to comply with government regulation                                             | 4.11  |      |
| Our organization looks forward to adopt Value Engineering at work.                     | 4.11  |      |
| Our organization inclines to try new ideas.                                             | 4.11  |      |
| Support system to implement Value Engineering.                                          | 4.07  |      |
| The leadership in our organization generally exemplifies innovativeness.                | 4.07  |      |
| Our organization is an entrepreneurial place.                                           | 4.07  |      |
| Business objectives are driven by customer satisfaction.                                | 4.07  |      |
| Our management team has a clear view of its final goals.                                | 4.07  |      |
| Early adopter of innovative construction process.                                       | 4.07  | 12   |
Table 4. Factors in adopting Value Engineering for Construction Company in Libya (Cont.)

| Factor of VE’s Adoption                                                                 | Mean | Rank |
|----------------------------------------------------------------------------------------|------|------|
| We need significant improvement on Value Engineering.                                   | 4.04 |      |
| Our organization respond rapidly to competitive actions.                                | 4.04 |      |
| Always on lookout for new opportunities for the organization.                           | 4.04 |      |
| Our organization promotes a learning culture.                                           | 4.04 |      |
| Able to implement innovative process used by other organizations.                      | 4.04 |      |
| Employees are computer literate.                                                        | 4.04 |      |
| Our organization is seen to be supporting change.                                       | 4.04 |      |
| Our organization is commitment to development.                                          | 4.04 |      |
| High commitment to meet customer needs.                                                 | 4    | 14   |
| Capable to guide employees on their job.                                                | 4    |      |
| Seeks innovative business systems from outside this organization.                       | 4    |      |
| Incentives from government                                                              | 4    |      |

As set in previous studies, a minimum cut-off percentage to establish consensus among the participants of a Delphi study would be 50% in each given variable. Following Okoli and Pawlowski [25] in setting the minimum cut off for the ranked items, this study has only considered items with mean score of 4 or above. Considering the 5-point likert scale (1= Not Important; 2 = Less Important; 3= Important; 4 = Very Important; 5= Most Important.) used for ranking the items in this Delphi questionnaire, a mean score of 4 is above 50 percent and represents a consensus among the experts. Hence only the items that have been scored 4 or above have been included in the final survey.

Out of 83 factors that have been extracted from an extensive literature review, only 45 factors have been ranked by the experts as significant in improving adoption of Value Engineering in Libya. The highest ranked factor in Table 1 is ‘know the process of VE’. Most of the experts agree that it is very important for construction stakeholders to understand and know how value engineering can be conducted. Clear understanding will provide knowledge for all stakeholders (including consultants, contractors and clients) as to contribute to the value of each project that have been designed. Some construction components can be eliminated or replaced by others to satisfy the needs of the clients. Most importantly, any suggestion must serve the purpose of the building’s components. There is an opportunity for experts to provide trainings for industry players in adopting VE in construction industry.

The other top two factors that have been identified in this study are ‘Be an early adopter of innovative construction materials’ and ‘Support the adoption of VE’. It is interesting to notice that the construction players in Libya are positive about adopting new technologies and inventions in the industry. Their willingness to learn and use new products or processes for improving construction deliverables is encouraging. Overall, it can be concluded that the construction industry experts in Libya maintain positive attitudes about VE and see a lot of potential in adopting VE to make the best decisions that can contribute to the development of their country. The factors need to be investigated further to gain better insights on the adoption of VE by construction practitioners.

5. Conclusion

The adoption of VE in Libya requires better understanding and support from various stakeholders in the construction industry. This paper presents the results of three processes (a back translation process, a pilot study and a Delphi study) conducted to assess the perceived impact of adopting VE in the construction industry. The results of the back translation show that there is no significant difference between original English version and the translated Arabic version adapted in the study. The results of pilot test have demonstrated that the research instrument is reliable and proved that the respondents have similar understanding of the research instrument. The results of the Delphi study, in which 45
items have been rated 4.00 and above, indicate the suitability and importance of the variables examined in this research. This paper may also contribute to the understanding and existing knowledge related to applying Delphi studies to refine a research investigation.

6. References

[1] Rameezdeen R and De Silva S 2002 Trends in construction procurement systems in Sri Lanka Built Environment Sri Lanka 2(2) 2-9
[2] Zhang X, Mao X and AbouRizk and S M 2009 Developing a knowledge management system for improved value engineering practices in the construction industry Automation in construction 18(6) 777-789
[3] Karunasena G and Rajagalgoda Gamage K 2017 A decision-making formula for value engineering applications in the Sri Lankan construction industry J. of Financial Management of Property and Constr. 22(1) 77-91
[4] Jay C I and Bowen P A 2015 Value management and innovation J. Eng. Des. Technol. 13(1) 123-143
[5] Ali H and Omran A 2016 Strategies for Improving the Safety Performance of Construction Contractors Annals of the Faculty of Engineering Hunedoara 14(1) 109-113
[6] Ghadamsi A and Braimah N 2016 The Impact of Design-Bid-Build procurement methods on project performance in Libya J. of Constr. Eng. and Project Management 6(2) 16-23
[7] Ngab AS 2007 Libya-The Construction industry-An overview In International Workshops: Cements based Materials and Civil Infrastructure (Karachi, Pakistan)
[8] Salah A and Bloomer S 2014 Problems related to construction and building materials in Libya J. of Constr. Eng. and Project Management. 4(4) 1-8
[9] Park C S, Kim H J, Park H T, Goh J H and Pedro A 2017 BIM-based idea bank for managing value engineering ideas Int. J. of Project Management. 35(4) 699-713
[10] Chen W T, Chang P Y and Huang Y H 2010 Assessing the overall performance of value engineering workshops for construction projects Int. J. of Project Management 28(5) 514-527
[11] Ilozor B D and Kelly D J 2012 Building information modelling and integrated project delivery in the commercial construction industry: A conceptual study J. of Eng., Project, and Production Management 2(1) 23
[12] Miles L D 2015 Techniques of value analysis and engineering, Miles Value Foundation. 3rd Edition (New York: McGraw-Hill).
[13] Zimmerman L W and Hart G D 1982 Value engineering: a practical approach for owners, designers, and contractors (New York; London: Van Nostrand Reinhold)
[14] Mohan Reddy N 1991 Defining product value in industrial markets Management Decision 29(1) 14-19
[15] Connaughton J N and Green S D 1996 Value Management in Construction: a Client’s Guide (Westminster. Construction Industry and Research Information Association)
[16] Fang W H and Rogerson J H 1999 Value engineering for managing the design process Int. J. of Quality & Reliability Management 16(1) 42-55
[17] Standing A 2001 Value management incentive programme (London: Thomas Telford)
[18] Kelly J, Male S and Graham D 2004 Value management of construction project (London, E. & F. N Spon)
[19] Coffey W V 2005 The organisational culture and effectiveness of companies involved in public sector housing construction in Hong Kong (DBA Thesis, Graduate School of Business, Curtin University, Perth, Australia)
[20] Usunier J C 1998 International and cross-cultural management research (London: Sage)
[21] Nunnally J C 1978 Psychometric theory (New York: McGraw Hill).
[22] Hair J F Jr, Babin B, Money A H and Samouel P 2003 Essentials of business research methods (New Jersey: John Wiley & Sons)
[23] Lim, Soon Kam 2009 *Framework and processes for enhancing sustainability deliverables in Australian road infrastructure projects* PhD thesis (Queensland University of Technology)

[24] Fei and Khan 2015 Identifying attributes for expert construction project managers in the context of China *Int. J. of Asian Social Science*. 5(7): 407-418

[25] Okoli C and Pawlowski S D 2004 The Delphi method as a research tool: An example, design considerations and applications *Information & Management* 42 15–29

**Acknowledgments**

The authors would like to thank Universiti of Tun Hussein Onn, Malaysia and the Ministry of Higher Education, Malaysia for their generous sponsorship of this research.