

**IMPACT OF EVOLVING CONSTRUCTION PROJECT MANAGEMENT  
TECHNIQUES FOR PROPER PROJECT DELIVERY: REVIEW ON  
CONSTRUCTABILITY REVIEW, LEAN CONSTRUCTION (LC) AND VALUE  
ENGINEERING (VE) TECHNIQUES**

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**ABSTRACT:** *Throughout the existence of construction industry especially starting in the period of industrial revolution, there have been many developments of different construction techniques that can help the industry to reach success. Formed models but with unmet realities; unsuccessful timely delivery of the projects, out of projected budgets and intended quality are leading factors that still push industry players to seek the change in construction sector worldwide. In other words past experiences of failure of existing construction management tools have evidenced the search of the improved construction concepts that leads to industry success hence customers' satisfaction. One the other side, among different construction concepts developed in a way of enhancing the industry; include lean construction, constructability review and value engineering. Both latter tools focus on the use of knowledge management to assessing inputs ahead of production process so to successfully achieve the stated outputs. By that, they provide a good consideration for construction sector as significant and impactful principles for proper project delivery. This review article aims to study the importance of evolving construction project management techniques namely lean construction, constructability review and value engineering in the construction industry particularly on construction projects delivery; as well as to assess their current practice and impact.*

**KEYWORDS:** Impact, Evolving construction project management techniques, Proper project delivery, Constructability review, Lean construction, Value engineering

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## **INTRODUCTION**

For so many years ago, professionals in different industries have been seeking for improvement in their particular sectors especially based on the competition, past experiences of failure or success or even for the sake of delivering products that meet customers need, satisfaction or claims. In this same way, the construction industry was not left behind majorly as among top sectors contributing to the rapid world economic development and particularly in almost countries' national gross domestic product (GDP).

It is worldwide believed that the construction industry gets all its success to how buildable are the designs which further leads to successful project completion, sustainability and durability

of their products as the construction process is complex and starts with design and planning of what is to be constructed.[1]

Owners or developers can have different primary ambitions before the project starts still with the reflection to proper project delivery. The owner may primarily wish to have his property fixed in the affordable budget with less regard on how long it will take or the quality delivered; the other may primarily seek to see his project completed in a short period of time regardless of the huge cost required and the quality delivered; and thirdly there is an investor who first desires his property to be finished with the high quality countless of money and time it has to take.

On the other side, undertaking any construction project is a process that involves not only many bodies and organizations but also the effective and timely integration of construction knowledge from the conceptual phase throughout to the completion.

In the highlighted regard of seeking the more beneficial concept to enhance the construction industry success, not few concepts were developed and brought success to industry. Among different construction concepts developed in a way of advancing the achievement of the construction industry; include lean construction, constructability review and feasibility assessment. Both principles focus on the use of knowledge management to assessing inputs ahead of production process so to successfully achieve the stated outputs. Therefore they provide a good consideration for construction sector as significant and impactful principles for proper project delivery.

## **LITERATURE REVIEW**

### **Definitions and Historical Background**

Summarily, all the three named techniques share the common goals in terms of benefiting the project delivery such as fewer changes and delays throughout the construction, reduced overall project cost and increased value of the end product.

#### **(1) Constructability Review**

Historically, the concept of buildability emerged in the late 1970s as a direct result of research and practical applications aimed at improving the efficiency, cost effectiveness and quality of construction projects. In 1983, the Construction Industry Research and Information Association, CIRIA, defined it as 'the extent to which the design of a building facilitates ease of construction, subject to the overall requirements for the completed building'. [2]

In contrast, research and construction practice in the USA focused more purposefully on the concept of constructability [3]. Interests took advantage of the close link between building owners and contractors, emphasising a management systems approach to think creatively about the practicalities of the building process.

IPENZ (2008) [4] defined constructability as a project management technique to review construction processes from start to finish during pre-construction phase. It is to identify obstacles before a project is actually built to reduce or prevent errors, delays, and cost overruns.

The term "constructability" defines the ease and efficiency with which structures can be built. The more constructible a structure is, the more economical it will be [5]. Constructability is in part a reflection of the quality of the design documents; that is, if the design documents are difficult to understand and interpret, the project will be difficult to build. [6]

The term refers to:

- The extent to which the design of the building facilitates ease of construction, subject to the overall requirements for the completed building. [7]
- The effective and timely integration of construction knowledge into the conceptual planning, design, construction, and field operations of a project to achieve the overall project objectives in the best possible time and accuracy at the most cost-effective levels [3].

The integration of construction knowledge in the project delivery process and balancing the various project and environmental constraints to achieve the project goals and building performance at the optimal level. [8]

As per reference [4], the constructability need for different contractual approaches, and came up to the following concepts:

- Constructability reviews are easily managed for projects, where the contractor is determined beforehand. The preferred contractor is engaged at the first client briefing stage and is involved all the way through the design phases. The contractor is an integral part of all design meetings and reviews all documents, plans, drawings, specifications, tender documents and procurement schedules.
- Construction companies involved in the tendering phase of a design-bid-build project must conduct a constructability analysis before pricing the bid documents. This is usually very difficult as there has been no prior communication about the design. Constructability reviewers working for the construction company have to be very experienced and fast on their feet in order to advise the bidding company on the constructability issues that are likely to affect costs and schedules. Severe constructability issues on design-bid-build projects can bankrupt a construction company. There is a greater chance of bankruptcy if these issues are not identified up front, or if uncompensated constructability risks are not properly analysed.

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Douglas and Gransberg in 2009 [9], studied the constructability contributions during project phases and the following were remarks of considerations at each phase of the project:

(i) *Feasibility Phase:* Often owners of projects do not have any “in-house” capability for construction services, so they procure the services of a consulting firm to perform the initial “feasibility phase” constructability review. The consulting firm works from the preliminary design documents and provides useful suggestions that are incorporated into the design package. The results of the constructability review can literally make or break a project’s viability.

Constructability input as a service provided by either a consultant or construction management firm during project activities prior to the start of construction is referred to as constructability services. This constructability services approach during the conceptual or feasibility phase of the project provides the owner with a facility that meets all its project objectives. This approach often combines the benefits and costs of constructability with other services provided such as value engineering, risk management, and project planning. The services are primarily to supplement an owner’s limited resources for early planning and design evaluation. Constructability improvements obtained through the use of constructability services “is more a by-product of early construction involvement rather than an intentional attempt to avoid unnecessary construction difficulties. As a result, this approach tends to be informal.”[5] Additionally, an owner that is exploring the potential feasibility of a given project will want to limit its costs to the minimum necessary to determine economic feasibility. Thus, the focus of a feasibility phase constructability review will be to generate alternatives that can be expanded by conceptual design decisions in a manner that permits the necessary financial and schedule considerations for each alternative to be determined with the requisite degree of certainty by cost engineering specialists or equivalent. Essentially, the constructability reviewer/consultant will furnish the owner with options that were not contemplated by the designer.

(ii) *Early Design Phase:* As the architects/engineers develop the project design; the owner typically retains a second team of specialists who specialize in providing construction management (CM) services. The constructability review takes place as the construction documents are being developed. This CM team will perform a detailed constructability review (CR) of the proposed project documents: design drawings, technical specifications including specified construction materials, the proposed site layout and if available; the construction cost estimate and project milestone schedule. This review effort will focus on whether the project can be built as designed and must be conducted at a point in time where design effort is not lost by incorporating CR recommendations. The CM/CR team effort will provide suggestions on ways to improve the project: such as a more efficient site layout, alternate construction materials, and identifies possibly detrimental design specifications that could result in long lead time procurements or exotic construction techniques. All of this constructability review information is provided to the owner (who has optimally been a participant throughout) along with their expert construction opinion about the probability for the construction success of the project.

These construction management specialists can also assist the owner in establishing the philosophy, procedures, and tracking systems during pre-detailed design activities for the project. Although typically an informal aspect of the constructability program, the application of this approach to provide construction input is typically limited to specialized projects. Formal corporate-level tracking of lessons-learned and cost/benefit data resulting from constructability implementation is a best practice but is not routinely performed.

(iii) *Procurement Phase:* When the overall project design is approximately 60 to 90 percent complete, the owner retains a construction management firm to prepare the project for the

procurement phase: the preparation of subcontracts and procurement bid packages, pre-qualification of vendors, suppliers and trade contractors. These procurement bid packages must be complete design packages in order to provide the qualified bidders with the information necessary to make intelligent cost proposals for the overall success of the project.

On the hand, during the subcontractor procurement process, after receipt of the request for proposal (RFP), the various bidding contractors will normally conduct their own constructability reviews prior to bidding. Constructability clarification questions are frequently transmitted to the owner's representative who provides additional information about site conditions, ambiguous or missing construction details, and often the bidding contractors may propose alternate construction methods for consideration. Although typically not a formalized aspect of the constructability process, these are also important elements of constructability and this request for information (RFI) process during the request for bids must be established in a manner that allows it to capture unexpected constructability input from subcontractors during the procurement phase.

*(iv) Construction Phase:* Constructability continues to be a viable tool for the success of the project after the award of the major contracts and purchase orders. For example, a mechanical contractor, employing formal or informal constructability reviews for their scope, may determine that certain piping components could be fabricated in their shop and economically transported by truck to the project site, thereby improving both labour productivity and reduce the field costs for that large component of the work on a project. The owner, the engineer, and the CM must remember that trade subcontractors are the technical experts in their field and must include construction contract language that encourages constructability improvement suggestions as well as requests for material and means substitutions. The submittal review process must be established to identify potential constructability improvements and then analyse the impact of implementing them on both project budget and schedule.

*(v) After Action Reviews:* Constructability does not end when the project is completed. Often the project participants are in a hurry to close out the project and move on to another assignment. Either there is elation over the success of the project, or there is a strong desire to put their bad experiences behind them and move on. In either case, there should be a formal review to capture the constructability lessons learned on the project. The corporation should establish a constructability database. "Implementing that approach, it is believed that the constructability review program will initially experience large incremental increases in total-annual documented savings. However, as the program matures, and the design and construction processes are optimized, the program's incremental increase in total annual documented savings reach a steady-state condition. In the "mature" state, additional documented constructability savings are realized through application of new construction methods and technologies." [5]

## **(2) Lean Construction**

Abdelhamid (2007)[10], defined Lean construction as a combination of operational research and practical development in design and construction with an adaption of lean manufacturing principles and practices to the end-to-end design and construction process. Unlike manufacturing, construction is a project-based production process. Lean construction is concerned with the alignment and holistic pursuit of concurrent and continuous improvements in all dimensions of the built and natural environment: design, construction, and activation, maintenance, salvaging, and recycling. Koskela et al. (2002)

[11], explained Lean construction as a “way to design production systems to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value”.

Historically, Lean construction came out as a new concept since the mid-1990s. Lauri Koskela, in 1992, challenged the construction management community to consider the inadequacies of the time-cost-quality trade-off paradigm. [12]

### **(3) Value Engineering**

Value engineering (VE) is a structured and analytical process that seeks to achieve value for money by providing all necessary functions at the lowest cost consistent with required levels of quality and performance [13]. It is sometimes taught within the project management or industrial engineering body of knowledge as a technique in which the value of a system’s outputs is optimized by crafting a mix of performance (function) and costs. In most cases this practice identifies and removes unnecessary expenditures, thereby increasing the value for the manufacturer and/or their customers

Value Engineering (VE) is conducted to provide recommendations for:

1. Providing the needed functions safely, reliably, efficiently, and at the lowest overall cost;
2. Improving the value and quality of the project; and
3. Reducing the time to complete the project

Referring to Wikipedia notes, Value engineering began at General Electric Co. during World War II. Because of the war, there were shortages of skilled labour, raw materials, and component parts. Lawrence Miles, Jerry Leftow, and Harry Erlicher at G.E. looked for acceptable substitutes. They noticed that these substitutions often reduced costs, improved the product, or both. What started out as an accident of necessity was turned into a systematic process. They called their technique "value analysis".

### **Differences of Constructability, LC and VE**

Despite sharing some goals and responses towards the challenges facing the construction industry; the 3 tools have some differences in terms of their application in achieving the project objectives.

#### **(1) Constructability Review versus Value Engineering**

In their investigation, David A. & et.al, 2002 [14]; compared value engineering to constructability approach and found that, there is agreement by the large majority of the respondents (91%) that value engineering (VE) cannot replace constructability. This was rationalized by the comments made by respondents to stress the distinction between the two processes, such as “these are two different issues,” and “these have different goals,” and “VE comes much later in the process.”

The primary objective of VE is to reduce the total life-cycle cost of a facility; whereas, constructability focuses on the optimization of the construction process. VE is normally performed during the design phase of the delivery process. An effective formal constructability program ideally begins during the conceptual planning phase and continues through construction. Conducting constructability reviews can act as a precursor to VE, providing

information through construction input and lessons learned from past projects so that VE may be more effective. Although constructability reviews and VE might differ in terms of focus, implementation, and timing, activities within the two work processes may complement each other in achieving their goals [15].

## **(2) Differences between LC to Constructability Review & VE Approaches**

There exist differences between the Lean Construction (LC) approach compared to constructability review and Value engineering.

Howell, 1999 [16] as well as many writers talked about the difference between LC to other project management approaches, including:

- Managing the interaction between activities and combined effects of dependence and variation, is a first concern in lean construction because their interactions highly affects the time and cost of projects;
- Lean construction is developing new forms of commercial contracts to give incentives to suppliers for reliable work flow and optimization at the deliverable to-the-client level;
- Lean construction tries to increase transparency between the stakeholders, managers and labourers, in order to know the impact of their work on the whole project;

In his PhD thesis; Ballard, 2000 [17] highlighted differences of LC to other approaches and said that:

- In the lean approach, pull techniques govern the flow of information and materials, from upstream to downstream; whereas in others, push techniques govern the release of information and materials.
- In lean construction, decision making is distributed in design production control systems; by comparison, whereas in others, decision making is centred to one manager some times
- In the lean approach, downstream stakeholders are involved in front end planning and design through cross functional teams, while doesn't consider this issue.

Abdelhamid et al. 2008 [18] stated that Lean Construction encompasses Project and Production Management, and formally recognizes that any successful project undertaking will inevitably involve the interaction between project and production management.

## **2.3 Principles of Practise of Constructability, Lean Construction and Value Engineering**

### **(1) Constructability Review**

The Construction Industry Institute (CIIA 1993) [19], described the principles of working of constructability as follows:

**Integration**, Constructability must be made an integral part of the project plan.

**Construction knowledge**, Project planning must actively involve construction knowledge and experience.

**Team skills**, the experience, skills and composition of the project team must be appropriate for the project.

**Corporate objectives**, Constructability is enhanced when the project team gains an understanding of the client's corporate and project objectives.

**Available resources**, the technology of the design solution must be matched with the skills and resources available.

**External factors**, External factors can affect the cost and/or program of the project.

**Program**, The overall program for the project must be realistic and construction-sensitive, and have the commitment of the project team.

**Construction methodology**, the project design must consider construction methodology.

**Accessibility**, Constructability will be enhanced if construction accessibility is considered in the design and construction stages of the project.

**Specifications**, Project constructability is enhanced when construction efficiency is considered in specification development.

**Construction innovation**, the use of innovative techniques during construction will enhance constructability.

**Feedback**, Constructability can be enhanced on similar future projects if a post-construction analysis is undertaken by the project team.

## (2) Lean Construction

As summarized by Womack & Jones (1996) [20], There are five fundamental principles for lean thinking, which have to be followed step by step to gain the maximum benefit of the lean success: (1) *Specify Value*: Specify value from customer's own definition and needs and identify the value of activities, which generate value to the end product; (2) *Identify the Value Stream*: Identify the value stream by elimination of everything, which does not generate value to the end product. This means, stop the production when something is going wrong and change it immediately. Processes which have to be avoided are miss production, overproduction (repeat production of the same type of product, etc.), storage of materials and unnecessary processes, transport of materials, movement of labour workforces and products, and finally production of products which does not live up to the wished standard of the customer as well as all kind of unnecessary waiting time; (3) *Flow*: Ensure that there is a continuous flow in the process and value chain by focusing on the entire supply chain. Focus has to be on the process and not at the end product. However, the flow will never get optimal until customer value is specified, and the value stream is identified; (4) *Pull*: Use pull in the production and construction process instead of push. This means produce exactly what the customer wants at the time the customer needs it and always prepared for changes made by customer. The idea is to reduce unnecessary production and to use the management tool "Just In Time"; and (5) *Perfection*: Aims at the perfect solution and continuous improvements. Deliver a product which lives up to customer's needs and expectations within the agreed time schedule and in a perfect condition without mistakes and defects. The only way to do so is by having a close communication with the customer/client as well as managers, and employees are between.



### **(3) Value Engineering**

Apart from project selection, team selection done during pre-study, the value engineering workshop is done in the following 6 key steps [21]:

**Information;** this first phase requires an assembling a package to distribute information to invitees. Plus oral presentation at beginning of study.

**Functional;** the purpose of this phase is to clearly identify the function of the project and to formulate a concept from which new direction can be taken.

**Speculation;** the team studies and brainstorms as many ways as possible to reduce initial or lifecycle cost while still maximizing the function.

**Evaluation;** the team evaluates ideas produced during brainstorming. Some ideas become part of final solution while others are deemed inefficient or unworkable.

**Development;** Many of the ideas that passed the evaluation phase are further developed into workable proposals. Each recommendation will be accompanied by a short narrative with a list of positive and negative aspects of each proposal along with cost comparisons.

**Presentation;** lastly, the team makes a formal written presentation of their findings accompanied with an oral presentation to clients, users and designers. In this final stage, the client can determine which value management proposals will be incorporated into the project in order to reduce costs and increase overall value.

At the end of all above key steps performed during work study, there come the implementation and report results to be done as post-study's duties.

### **Barriers to Constructability Review, Lean Construction and Value Engineering**

#### **Constructability Review**

A barrier to constructability is any significant inhibitor that prevents effective implementation of the constructability program. Barriers to successful implementation of constructability programs are present in almost all organizations at both corporate and project levels.

According to O'Connor & Miller [22], initial efforts should focus on determining the presence and relative significance of constructability barriers.

Project constructability is mainly affected by factors such as;

- Faulty, ambiguous, or defective working drawings
- Lack of construction experience/qualified personnel
- Lack of financial incentive for the designer
- Incomplete specifications and budgetary limitations
- Lack of early involvement of project contractor during the design stage and the regulatory not being vigilant.

- Complacency with the status quo
- Reluctance to invest additional money and effort in the early stages of a project
- Limitations of lump-sum and design-build contracts
- The designers' perception that they already perform an analysis
- Lack of mutual respect between constructors and designers
- Construction input that is requested too late to be of value
- Etc

### **Lean Construction**

The lean principles can only be applied fully and effectively in construction by focusing on improving the whole process where all parties have to be committed and work together to overcome obstacles that may arise from conventional contractual preparation [23]. However in order to achieve the successful implementation of lean construction, the barriers are inevitable. In an attempt to understand the barriers, the review on the various literatures have enabled the authors to identify and generalized the specific barriers into six different categories.

*(i) Management aspect:* Management operate through functions that are often classified as planning, organizing, leading and controlling. This group of people will reinforce and promote the substantial amount of initiative to the subordinates to participate, drive and control the work and management of each project [24]. Therefore the success of lean implementation practice will depend on how well they support and motivate the people to work toward each planned goal.

*(ii) Financial aspect:* Managing the project's finances is among the complicated job in the construction project management. One of the crucial parts is to obtain the source of funding to finance the projects. Substantial amount of funding is needed to obtain relevant equipment for the project and to hire the lean specialist in order to guide each party involved in the implementation of lean concept [25].

*(iii) Educational aspect:* This factor is crucial for the implementation process to be successful since it provides the practitioner with the relevant knowledge and guidance relating lean construction while improving the communication and integration among each party [26]

*(iv) Governmental aspect:* This factor touches the issue regarding the government policies and their attitudes toward the construction industry players. As asserted by Alinaitwe [27] in the research finding it stated that government bureaucracy, lack of social policies, inconsistency in policies, lack of social amenities and infrastructure, material unavailability and fluctuation in commodities price were among the barriers associated with governmental aspect.

*(v) Technical aspect:* According to Kamar et al [28] the technical knowledge of a construction project can be derived from the process of training and education. Thus, the personnel will be equipped with the relevant knowledge and have a clear understanding on any technical issues related to the construction work process. An example of technical aspect is lack of technology, complexity of design and construction and lack of specialist.

## **Value Engineering**

Majorly, the barriers to value engineering are based on perception of any contract players and the familiarity and experience of the project team in applying VE principles. Some of barriers to VE include:

- The owner's perception of an engineering firm's desire to increase their margin by maximising their fee
- Owners unfamiliar with value engineering objectives can view contractor developed value engineers proposals as a failure on the engineers part, believing such savings should have been part of the original design [29]
- Little capabilities of hired design firms in terms VE familiarity concepts
- Short time given to VE workshop which may lead to unimpressive results
- Unmotivated evaluation team due to lack of incentives by the client during VE evaluation phase. This may lead
- Lack of professional experience to VE evaluating team which doesn't bring a different perspective to the project
- Etc

## **Benefits of Constructability, LC and VE**

Talking about how much Constructability, LC and VE has benefited the construction industry and the project management in particular; it's an aspect that goes beyond being successful but of the change that impacted the whole industry players to have new orientation about construction project delivery. As simply saying is maximizing client's satisfaction through proper allocation of available resources, few delays time and credible quality.

## **Constructability Review**

There are tangible benefits to be gained from implementing constructability in any building project. Some of these benefits may be manifest, others more obscure, some quantitative in nature while others are more subjective. Benefits can also be quite pragmatic, measurable not only in terms of cost, time and quality, but in terms of the physiological and psychological gains for the building team members. The benefits of constructability have become well recognised ([3]; [7]; [2]) and may extend across the total building process and include the following: better conceptual planning; more effective procurement; improved design; better construction methods; more accomplished site management; more effective teamwork; higher job satisfaction; increased project performance; and enhanced recognition for the participants.

## **Lean Construction**

Benefits of Lean approach to construction depend on tools and techniques used during the implementation in any construction project delivery. Based on the latter, the following are benefits of applying Lean construction principles as studied by O'Connor & Swain, 2013 [30].

- Improved project delivery performance in terms of value, quality, programme and cost

- Alignment of all parties to deliver against an agreed set of project objectives
- Clarity of communication
- Less process waste, which should result in less time and/or resources
- Improved performance in safety, quality, delivery and cost
- Provides a clear view of the best way to carry out a project and/or to operate business
- Processes in a way that seeks to maximise customer value
- Improves predictability and productivity through all processes
- Identifies opportunities for pre-fabrication to aid on-site productivity
- Provides detailed information to help develop the current best standard practice to support
- Productivity and reduce variability in methods and performance
- Creating standard operations (or job details) with those people who carry out the work
- Helps to develop ownership of identifying the best current method and supports continuous improvement
- **Etc**

### **Value Engineering**

Although value engineering began as a cost-saving measure, it is becoming a valued project management technique that addresses all aspects of the building lifecycle from the initial construction through the sustainability of sourced materials and utility efficiency of the final project [31]. The project team can bring positive environmental and social impact solutions to the table including methods for reducing carbon footprint of transportation, building, and operation as well as suggestions that positively affect the safety and wellness of surrounding community.

Other benefits of VE in construction, includes:

- Improve Project Schedule Time
- Improve constructability quality
- Resolve stakeholders issues
- Reduce operating costs
- Reduce overall project costs

## METHODS

As for this research, to study the importance of evolving construction project management techniques namely lean construction, constructability and value engineering in the construction industry particularly on construction projects delivery; as well as to assess their current practice and impact.

This research is limited only to building construction projects only as stated in the topic title. The research was conducted countrywide. The questionnaire for the first survey was distributed either personally or via e-mail to 164 professionals involved in construction industry. All questioned participants were returned for analysis in time with 100% overall response rate. In this research, participants are currently either involved in construction related fields such academics and construction projects works. Based on work experience and employment position, it was deduced that their responses have adequate knowledge of the activities associated with construction project risk. The procedure, findings, and relevant discussion of the analyses are detailed in the following section.

## DISCUSSION & CONCLUSION

### Discussion

With exception of Lean Construction, the majority of participants confirmed their knowledge of other two construction project management (CPM) techniques discussed in this research. Respondents were supposed to use “Yes “or “No” to answer about their familiarity with these concepts as shown.

**Table 1. Participants’ familiarity with Constructability, LC and VE**

CPM Technique	YES (Number)	NO (Number)	Total
<b>Constructability Review</b>	113	51	164
<b>Lean construction</b>	67	97	164
<b>Value Engineering</b>	134	30	164

Respondents of the current research said that anywhere properly implemented during project delivery; any of the three techniques brings efficiency and effectiveness regarding project delivery. Participants gave their answers by means of rating the production of using any of the three techniques as per table 2.

**Table 2. Productivity during project delivery**

CPM Technique	High (%)	Medium (%)	Low (%)	Total
<b>Constructability Review</b>	87	12	1	100
<b>Lean construction</b>	78	20	2	100
<b>Value Engineering</b>	88	11	1	100

Most of the interviewees of this research confirmed that the main reasons hampering the quick application of evolving project management techniques in project delivery are majorly based on relying on traditional methods of project management and lack of knowledge concerning those techniques. That is per table 3 below.

**Table 3. Barriers to application of evolving project management techniques**

<b>Barriers</b>	<b>Frequency (No)</b>	<b>Percentage (%)</b>
Professionals lack knowledge concerning evolving techniques	54	32.93
Clients don't provide enough resources for process study	21	12.80
clients don't recognize the value of applying new techniques	12	7.32
Relying on traditional methods of project management	54	32.93
Past experience of failure of evolving PM techniques	19	11.59
Others	4	2.44
<b>Total</b>	<b>164</b>	<b>100.00</b>

Finally, the interviewed professionals confirmed the need by construction industry of applying any of the evolving project management techniques. Participants advised construction related platforms and institutions to make known those techniques to all concerned parties; design and construction firms to increase their motivation to value the benefits of using any of the evolving construction project management tools so as to maximize the project objectives.

## CONCLUSION

Constructability puts much focus on proper integration of knowledge management at both technical and managerial levels at all stage of the construction to achieve the drawn objectives. Lean construction apart from seeking proper project delivery, it places its much emphasis on to design production systems to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value.

Value Engineering focuses on the sustainability of sourced materials and utility efficiency of the final project.

Conclusively saying, Constructability review, Lean construction and Value engineering techniques tools focus on the use of knowledge management to assessing inputs ahead of production process so as to successfully achieve the stated outputs. Therefore they provide a good consideration for construction sector as significant and impactful principles for proper project delivery.

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