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STATE OF THE ART REVIEW ON APPLICATION OF VALUE ENGINEERING,VALUE ANALYSIS AND VALUE MANAGEMENT ON CONSTRUCTION PROJECTS: HIGH RISE BUILDINGS

Khaled M. Heiza[1], Nagwan E. Abo Elenen[2] , Ibrahim M. Mahdi[3]

[1]*Professor of RC Structures, Vice Dean, Faculty of Engineering, Menofia University, Egypt.*
[2]*Phd candidate, Al-Delta University, Egypt.*
[3]*Associate Prof., Dept. of Str. Eng. and Mgmt., Faculty of Engineering, FUE Egypt*

Abstract:

Value Engineering (VE) concept does not mean a cost reduction only, but it extends beyond. VE is a powerful problem-solving tool that can reduce costs while maintaining or improving performance and quality requirements. It's a function- oriented, systematic team approach to providing value in a product or service. Construction project as a product or service is generally considered to have good value if this product or service has appropriate performance and cost. The construction product's characteristics differ than those in manufacture in many aspects such as immobility, complexity, durability, cost lines, and high degree of social responsibility. These characteristics are highly affected by the construction technology. Where, adopting these new technologies and working method in proper work environment can maximize the product with a working time reduction by 25% and cost reduction by 20% in average. Slip Form **(**S.F) is considered one of these common methods of construction. An assessment of the S.F includes productivity, appropriate speed in addition to auxiliary resource combinations. This research aims at create awareness of VE, and demonstrated the benefits gained when it applied to construction projects.

Keywords:Value engineering, management, life cycle cost, function analysis technique, job plan, and Slip Form

I. INTRODUCTION

Value Engineering (VE) technique is a powerful tool to investigate resources. The application of VE technique leads to find the best alternative or the best solution via proper investigation in all items which may impact selection decision. The approach of this technique directs the decision maker or developer to create new ideas by the creativity concepts and out box thinking. The creativity helps not only to introduce the new but also to gain the best. VE is defined as an organized effort directed at analysing the function of systems, equipment, facilities, services and supplies for purpose of achieving the essential functions at the lowest life cycle cost (LCC) consistent with the required performance, reliability, quality, durability, sustainability and safety…. etc. "VE is not a new concept. Its origin dates back to World War II. The evolution of VE from is beginning in the manufacturing industry, into government procurement sections, and eventually into the construction industry" Elayache (2010).

II. BACKGROUND

The value methodology can help organizations compete more effectively in local, national and international markets as illustrated by Heiza (2012): Decreasing costs, saving time, increasing profits, expanding market share, solving problems and using resources more effectively. Kelly, et al (2005) showed that value management (VM) provides a structured, challenging, analytical and mediated process that permits value systems to coalesce to the benefit of the client. By bringing the right team together at the right time, VM focuses on value system evolution and resolution. However, this makes it a change-oriented methodology. Dell,Isola (1975) described VE as a systematic approach for obtaining optimum value for any money spent. Also, Heggade (2002) showed that VE is a methodology used to analyse the function of the goods and services and to obtain the required functions of the user at the lowest total cost without reducing the necessary quality of performance. Function Analysis (FA) is the foundation of a value methodology and is the key activity that differentiates this body of knowledge from other problem-solving or improvement practices. During the FA phase, functions are identified that describe the work being performed within the scope of the project under study. These functions are described using two words, active verb and measurable noun pairings, SAVE International (2007). A function is always expressed by a verb and noun Bryant and Chapter (1998). Why should we analyse the characteristics of "Function"? As Miles said; "the language of function is the heart of the problem", when we work with VE (1993). A team defines the project functions using a two-word active verb/measurable noun context. The team reviews and analyses these functions to determine which need improvement, elimination, or creation to meet the project's goals SAVE International (2007). "The noun answers the question, "what does it do this to?" the verb should answer the question "what does it do?" Fahmy(2011). Building a high rise is a typical project in urban areas. High-rise buildings are rapidly becoming a developing nature of urban zones due to increased population and businesses. The core of high-rise buildings is one of the most important elements in such gigantic structures. Fast and efficient construction of the concrete core of a high-rise building is essential to maintain phased progress on other parts of the building. Some contractors have developed expertise in building cores using Slip Form (S.F).

Typical projects that employ this formwork technique are: Core of high-rise buildings, silos, telecommunication towers, cooling towers, heavy concrete offshore platforms, etc., Zayed, et al (2008). Hurd (1990) and Jaafari, et al (1989) reported that many formwork methods could be used to construct a high rise building core, such as S.F, Climbing Formwork (C.F), and jump forms (J.F). It has been shown that, for building cores of less than 15 stories high, none of the alternative methods can compete with the conventional forms, Jaafari, et al (1989). Furthermore, tall structures greater than 30 stories, the alternative methods could potentially reduce the cost of conventional method by up to 30–40%. In addition, S.F showed cost advantages for more than 20 stories and larger than 600 m2 formed area per floor. For silos higher than 15 m, the slip-form method is the most economical and time saving technique Jaafari, et al (1989). Industrial silos, such as coal or production line storage silos are typically used to store grains as well as construction and industrial materials, Peurifoy and Oberlender (1996). Consequently, slip forms were extensively used in the core of high-rise buildings and silo construction in the past few decades [Hurd (1990) and Jaafari, et al (1989), Risser (1995), Anon (1987). S.F is a sliding-form construction method, which is used to place vertical concrete structures. S.F construction technology has becomes the important system in high-rise concrete structures, and the most common methods of construction in concrete silos Risser (1995). It differs from C.F because it moves semi continuously with-respect to the concrete surface in which form ties are not used Risser (1995). Recent improvements in larger yoke capacities and better laser guidance result in more efficient and faster slipping rates Risser (1995). After studying combinations of floor and wind framing systems by Pruitt 1987; it was concluded that S.F might cost somewhat more than other methods, but would shorten the total construction

schedule by at least 3 months. "S.F is an economical, rapid and accurate method of constructing reinforced concrete, or post-tensioned concrete structures. At its most basic level, S.F is a type of M.F which is slowly raised, allowing the continuous extrusion of concrete" Harrington Company Catalog (2013). "S.F is not only used on straight vertical concrete structures but, also structures where the geometry of structures and the wall thickness are changed during the operations" Fosse. K.t. (June, 2001).

III. THE CONCEPT OF WORTH AND ITS RELATION TO VALUE

The worth of a product or activity is the quality that makes that product or activity important to the customer JIA (1993) [9]. "In the value methodology, worth is defined as the lowest overall cost to perform a function without regard to criteria or codes. Comparing function cost to function worth is the primary technique to help study teams identify areas with the greatest potential for value improvement" Bryant (1998) [10]. (VE) emerged during World War II in the USA. Its beginnings are usually attributed to Lawrence Miles, who pioneered its use at general electric in 1947. since then, VE methods and applications have expanded significantly and have been applied in a wide variety of environments, from building construction to health care when shortages of critical resources necessitated changes in methods, materials, and traditional designs, many of these changes resulted in the development and implementation of on organized value analysis program for industry, and this technique was soon adopted by several other companies and government agencies. In 1962, VE became a mandatory requirement in the Armed services procurement regulations (ASPR). During1960and 1970,enteredvalue engineeringin many othercountries of the worldand nowheldhermanyperiodicconferencesin most countries ofthe world**.**

The Value Equation: Value = function / cost. , Dell'Isola (2003).

Where function is measured by the performance requirements of the customer and resources are measured in materials, labor, price, time, etc. required to accomplish that function. A value methodology focuses on improving value by identifying alternate ways to reliably accomplish a function that meets the performance expectations of the customer. And value is defined as a fair return or equivalent in goods, services, or money for something exchanged. SAVE International (2007).

IV. VALUE ENGINEERING APPLICATIONS and METHODOLOGY

Value methodology can increase customer satisfaction and add value to organization's investment in any business or economic setting. Value practitioners apply the value methodology to products and services. The VE methodology can be applied on each other fields such as: Construction, Manufacture, Transportation, Environment, Health care and Government. Value Methodology Standards, as SAVE international procedures, is a systematic process that follows the JP. Value methodology is applied by a multidisciplinary team to improve the value of a project through the analysis of functions. The Job Plan consists of the following sequential phases, as shown in Figure 1.

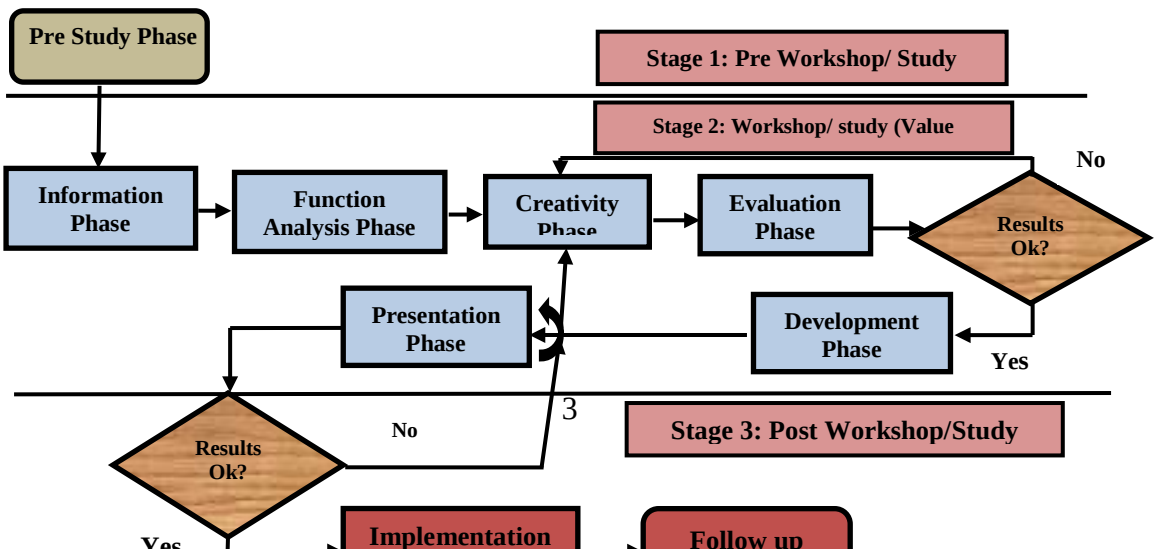

Figure 1: Value study stages (workshop activities)

The VE study started in stage 2 as illustrated in figure 1, it starts from left to right with the information phase then followed by function analysis, creativity and evaluation phases. If the results are OK, it will go to development phase and if its is No it will go to creativity phase again. The end of stage 2 is the presentation phase where another filter is considered in stage 3. The implementation and follow up activities are ending stage 3 as indicated.

The standard is three stages which are following

1. Pre – study stage.
2. Workshop (six-phase workshop job plan activities),
3. The Post-study stage.

As shown in Figure 2. The elements of each value management stage is pointed directly under each stage title box as indicated in Figure 2 for the three stages.

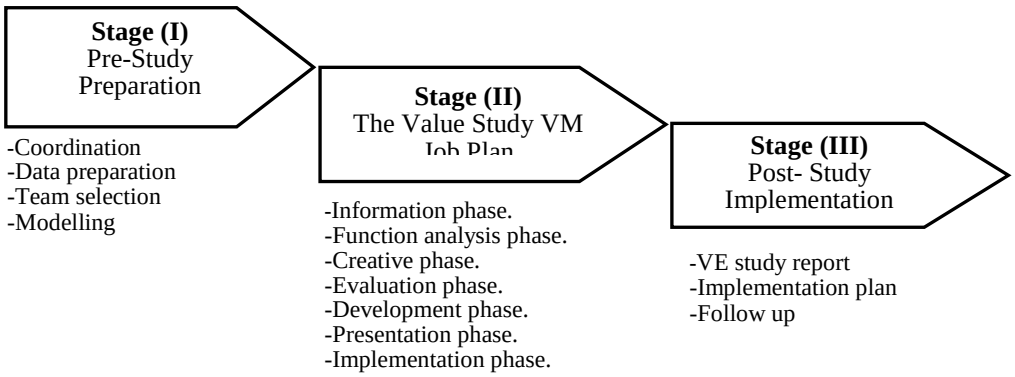

Figure 2: The value management stages SAVE international

PRE-STUDY (WORKSHOP) ACTIVITIES

Purpose: Plan and organize the value study.

The six phases of the Job Plan: The value methodology is applied using a process known as the "JP" The purpose of the JP is to guide the study team through the process of identifying and focusing on key project functions in order to create new ideas that will result in value improvements SAVE International (2007) **[6].** These phases include:

1. **Information Phase:** The team work reviews and defines the current conditions of the project and identifies the goals of the study.
2. **Function Analysis Phase:** The team defines the project functions using a two-word active verb/measurable noun context. The team reviews and analyses these functions to determine which need improvement, elimination, or creation to meet the project's goals.
3. **Creative Phase:** The team employs creative techniques to identify other ways to perform the project's function(s).
4. **Evaluation Phase:** The team follows a structured evaluation process to select those ideas that offer the potential for value improvement while delivering the project's function(s) and considering performance requirements and resource limits.

5. **Development Phase:** The team develops the selected ideas into alternatives (or proposals) with a sufficient level of documentation to allow decision makers to determine if the alternative should be implemented.
6. **Presentation Phase:** The team leader develops a report and/or presentation that documents and conveys the adequacy of the alternative(s) developed by the team and the associated value improvement opportunity.

POST-STUDY (WORKSHOP) ACTIVITIES

Implementation Activities *Purpose:* Ensure accepted value alternatives are implemented and that the benefits projected by the value study have been realized SAVE International (2007) [6].

Applicability of Value Engineering

Value Methodology can be applied during any stage of a project's development cycle, although the greatest benefit and resource savings are typically achieved early in development during the conceptual stages.

Function Analysis System Technique (Fast -Diagram)

"FA can be enhanced through the use of a graphical mapping tool known as the (FAST), as shown in Figure 3 which allows team members to understand how the functions of a project relate to each other" SAVE International (2007)**.**

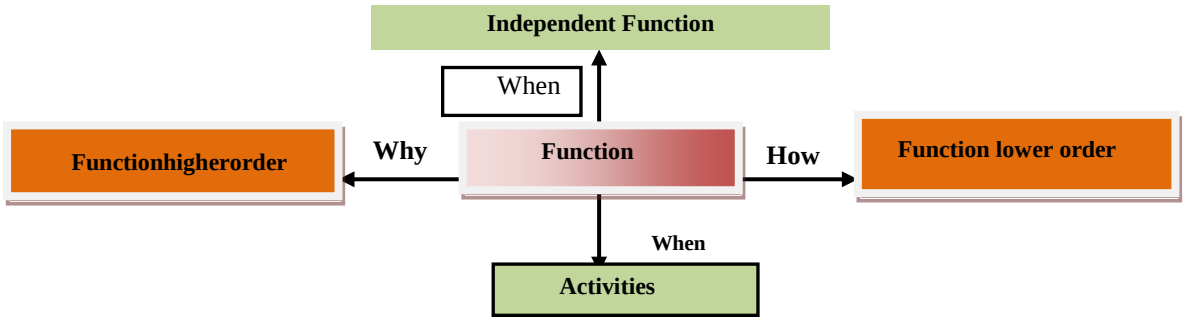

Figure 3: The Four Directions Logic Diagram

Types of Function

Basic Function; is the primary purpose(s) for which the item or service was designed when it is operating in its normally prescribed manner. This function must be accomplished to meet the purpose of the product, structure, or service. A product or service may have more than one basic function Bryant (1998).

Secondary Functions; are ones that support the basic function Bryant (1998) [10].

Life Cycle Costing Analysis (LCCA):It is the present value of the total cost of the building/asset over its entire operating life and includes the initial capital and construction costs, operating and maintenance costs and the cost or the benefit of eventual disposal of the asset. LCC goes hand on hand with a VM study and it is important to look at what it is and how it is incorporated into VM **Coetzee(2009)[11].** LCCA is defined by **Emam** (1995) as a method of calculating the total cost of ownership over the life span of an asset. LCC is a technique permitting the appraisal of the owning and operating costs of a facility, component, or material over a selected life cycle or estimated useful life period**, includes:** Construction cost**,** Operational costs**,** Cost of money**,** Replacement costs, Salvage valueand Maintenance and repair costs over the service life.

Experimental Studies Related to VE

Several researches [2, 7, 8, 20 to 35] discussed what is the VE [meaning, applications, methodology, history, how it be consider a powerful tool in many fields such as constructions,

manufacture, transportation, environment, health care, and government. Also the objectives ,benefits, in what stage of the project the VE gives the best results, the principles of VE, The JP, and the LCCA, the VE practice, the comparison of VE methodologies, the FAST, the value index, the value equation, VM team and how to coordinate the VE team are discussed. As well as, the influence of the inflation on the cost (total coast) of the project, the road blocks of the VE study, and how to prepare the final report for the VE study was explained. they contained some of case studies for several different projects all emphasized the efficiency of VE to solve the problems by finding alternatives and solutions and achieving the high performance and optimizing the cost, the VECP's, and some of typically duties of value program unit. They cleared that the VE needs to an organized team and thoughts to give the best results. All the last references improved that the VE becomes more important to every projects study to achieve the best savings, in the total cost, time and improve quality. **Heggade** (2002) discussed the VE in the construction projects, improved that this information technology can integrate the compartmentalized nature of the construction industry and play the role of 'incredible facilitator or enabler' in both knowledge management and VE.**JIA** (1993) discussed the analysis of the function, why should we analyze the characteristics of "Function"? The ways of drawing the FAST diagram, How to calculate the value index, and the classification of the function. **Pett** (1996) presented report as a continued to be increasing emphasis on cost reduction programs by the department of defense and the military services. One of the VE result is the submittal of (VECPs) emphasized; that the cost savings resulting from such changes are obvious. Reliability improvement may also result from the change, and some of the cost reduction attained as the result of the VE program. **Thorson and Snidar (2011)** focused in their research on the establishment of contractual incentives and mutual working relationships between prime and subcontractor that will stimulate submission and acceptance of VECPs. A principal measure of the success of a prime/subcontractor value engineering program is the quantity and quality of VECPs that are successfully and profitably negotiated between them. The preparation and acceptance of VECPs is a most vital end product of this relationship. The need for subcontractor VE incentives that give considerable latitude in the methods they use to carry out the requirements specified in the subcontract or purchase order. Under fixed-price arrangements, they may have a strong incentive to increase profits by improving their methods after the purchase order is awarded. With cost incentive arrangements, they share under the share pattern these savings with the prime.

On the Construction Phase, Government, and Privet Sector construction:

Al-Nsour, *et al* (2011)studied the appliance of VE in public service sector namely Greeted Amman Municipality. This study aim at investigate the possibility of cost optimization in the environment protection department in Abu Nseer, which constitutes the highest expenditure from its budget. The results reduced the cost of the crusher path about 33.33% and for the pressers' paths about 45.56%. **El-Badry** (1997) applied the VE procedure in the construction phase as a management tool presented its cost benefit. He had applied it on a resort project in SINAI - Egypt as a practical case study. The resulted showed the advantages of considering VE approach in the construction phase; the resulted savings were encouraging to use the VE application in construction projects as a way of better usage of budget, and resources. **Simpkins** (2000) studied the importance of appliance of VE in government and private sector construction; the Federal acquisition regulations require the use of VE in all Federal construction contacts with working estimates of $ 100, 0000.00 or more. the result from this research showed that the appliance of VE, on government contracting or on the private sector achieve savings about billions of dollars in the construction field alone, also found that the VM, which includes VE, VA, value monitoring and VECP, is a vital part of any construction program.

On transportation and Bridges; there are many studies in this topic as follows:

Clark (1999) studied the development of the methodology for conducting VE on small transportation projects that would make efficient use of available personal and require little VE

training. The author examined the results and procedures of several Dot VE programs, including some that conduct studies on projects as small as $ one million. It was improved that the appliance of VE achieves the minus cost, time, and the best quality for the small transportation projects. **Mansour (2013)** applied the VE technique on box-girder bridges which consider as one of the most common systems of Nile bridges constructed in Egypt. The results improve the importance of applying the VE technique, and recommended to use this technique for other materials like steel bridges, and other different bridge cross sections.**OQA** (2009) represented a report showed how the VE technique applied on the transportation projects. Accordance with 23 CFR parts 627, state highway agencies must establish programs to assure that value engineering studies are performed on all Federal-Aid high projects on the NHS (National Highway System) with estimated cost of $ 25 million or more and for bridge projects with an estimated cost of $ 20 million or more.

In the Environmental Services*:*

In five waste water projects study which were subjected to VE under EPA's voluntary VE program. The results improve the effect of VE application on such projects **[38].**

Discussion for the need of the environmental protection agency to establish and implement a VA program to reduce the costs of waste treatment plants funded under the federal water pollution control. It was recommended that the administrator, EPA, incorporate the VA program into EPA's construction grant program to insure that treatment facilities are constructed at lowest cost, The Comptroller General of the United States (1975) [40]. Another study showed in its reports that the VE is only one of a number of approaches used by the services to control costs; they examined the 11 weapons system programs. Found that the VE is the best tool to achieve the best quality with the optimizing cost. In 1984 GAO reported that greater use of VE had the potential to save the department of transportation 3 to 5 percent of project costs **G.A.O (2003) [41].** A value study results on the plan for the Franks Tract Pilot project for the department of water resources (DWR) was carried out to reduce salinity at the export locations in the southern Delta by reducing seawater intrusion. The results of this value study improved that the VE, VA is the best tool to obtain the optimal solution for the cost reduction maintenance the function for any project.

Design and Construction of the Forms: Slip Form (S.F.) Example

"The vertical S.F system consists of five basic elements:

- Forming panels (S.F),
- Whalers,
- Yokes,
- Jacks and jack rods,
- Work or storage decks and scaffolding"**.[4]**

Figure 4 showed the these five componenets where the plate forms take the golden colour while steel panels (decks and scaffolding) takes move colour and Jaks has the silver clour as illustarted in Figure 4.

According to **Risser** [4] the S.F is raised on jacks that climb on vertical rods or tubes that remain buried in the concrete. The jacks are mounted in upside-down U-shaped steel assemblies called yokes. The S.F is attached to the yoke legs; scaffold brackets and work deck joists are attached to or bear on the S.F whalers. The yokes resist hydrostatic concrete pressure (replacing form ties) and transmit vertical scaffold and work deck loads to the jacks. Once the vertical slip forming process is started, concrete is placed continuously in the form in 4- to 10- inch layers (6 to 8 inches is average) at a constant rate. Vertical rebar, horizontal column ties, and through wall ductile ties can be placed in advance of form movement. However, horizontal rebar cannot be positioned until the crossbeams of the yokes are raised above the location of the reinforcing steel.

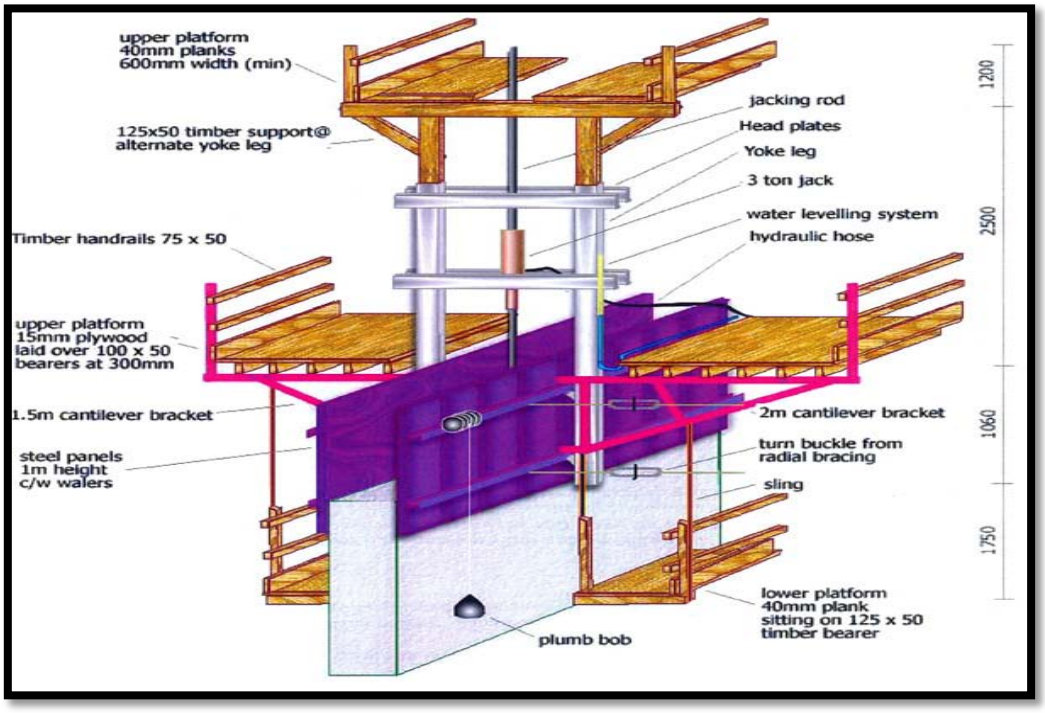

Figure 4: The Components of the Slip Form.

"The S.F is most frequently 4.0 feet and is constructed to produce the shape of the building in plan. Locomotion is accomplished by jacks climbing on smooth steel rods or pipe cast into the hardened concrete below. These jacks may be manual, electric, pneumatic or hydraulic and operate at speeds up to 2.0 feet per hour. Jacks usually have capacities between 3 and 25 tons, but much higher capacities are available working decks, storage decks and scaffold are supported by the forms and carried upward with them. The entire weigh of the decks and supported scaffold is transmitted on to the Wales. Through the yokes, and in to the jack and jack rods. The only function of the concrete is to support its own weigh and to prevent the jack rods from buckling. In addition to the dead loads; line loads of 40 to 50 pounds per square foot of deck and 50.0 pounds per linear foot of scaffold must be supported, storage for reinforcing steel. As shown in figure (3.4). Block outs, inserts and other construction necessities must also be provided for in the design. Since the S.F are subjected to the hydrostatic pressure of the plastic concrete. The sheeting must support this lateral pressure with beam action between the Wales and as a cantilever at the bottom. The whales in turn must carry the hydrostatic pressure as horizontal beams between yokes. Although the material most commonly used is wood, S.F sheeting may be made from any number of materials; wood or steel form. The yokes are inverted us consisting of two legs and across beam. The legs being attached to the whales and caring the vertical loads in tension and the lateral loads as cantilever beams. Although these yokes are normally steel they may be constructed of wood. Jack rods are usually spaced from 4.0 feet on centers upwards to almost any spacing, depending on the form design and jack capacity, yokes are most often designed at 5.0-8.0 foot spacing depending on the maximum allowable span of the Wales. Jacks are concentrated at corners, deck beams. Concrete hoppers, bridge landings, and other heavy loaded locations, the proper layout of the jacking system greatly affect the success of the slip form operation" [8]**.** "Therefore, the speed of S.F is a function of concrete properties, number of stoppages, weather conditions, and management capabilities. The slipping rate depends on how fast horizontal reinforcements and anchor plates can be placed. In addition, concrete setting time greatly influences the S.R. The S.F can move

whenever concrete can carry the load of its weight in lowest parts of form sheet; therefore, slipping rate is directly related to the concrete setting time. Because S.T is influenced by W.C (temperature, humidity, etc), cement ratio, type of cement, slump, and admixtures" **Hurd (1990**). "Generally, the S.F rises at a rate which permits the concrete to harden by the time it emerges from the bottom of the form" **Nawy (2008).**"Together, the concrete form and working platform are raised by means of hydraulic jacks". **Nawy (2008) [9].** It is a wide range of different structures that are S.F, but typical are vertical structure, S.F are not only used for straight vertical concrete structures where the geometry of the structure and wall thickness is changed, S.F is normally a continuous working operation (24 hours a day), which require a well-planned supply of materials. Problems that occur during this process needs to solve instantly, S.F is a rather complicated operation compared to other construction techniques. It is similar in nature and application to J.F, but the formwork is raised vertically in a continuous process. It is a method of vertically extruding a reinforced concrete section and is suitable for construction of core walls in high-rise structures – lift shafts, stair shafts, towers, etc. It is a self-contained formwork system and can require little crane time during construction. This is a formwork system which can be used to form any regular shape or core. Commonly, the formwork has three platforms. The upper platform acts as a storage and distribution area while the middle platform, which is the main working platform, is at the top of the poured concrete level. The lower platform provides access for concrete finishing. The materials that may use for the S.F., are; wood, steel, aluminum, GFRP or combined, the five famous combines in this filed are; Doka system, MFE formwork technology (MIVAN), PERI, VSL, and RMD system.

Experimental Studies Related to Slip Form

Several researches [13 to 17 and 49 to 60] illustrated the S.F component, methodology, technique, process, economy, benefits, and safety. In addition, they described the history of the S.F improvement and their architectural and structural impact on the construction process, the effect of the concrete mix and admixtures, curing, and finishing of the concrete. These studies showed that the S.F can be considered one of the most important methods of the new construction techniques, which has a significant impact in cost saving and construction time reduction. **Jaafari [2]** showed in his study that for buildings of less than 15 stories high or silo less than 15 m high, none of the alternative methods can compete with the C.F method. This study further stated that for tall structures (greater than 30 stories), the alternative methods could potentially reduce the costs by up to 30-40%. In addition, S.F showed cost advantages for more than 20 stories and larger than 600 m2 formed area per floor. For silos higher than 15 meters, S.F method is the best economically and time wise. Fosse showed in his research **Fosse (2001**) [7] the friction between concrete and S.F panel. The prime objective of the research is to improve the understanding of slip form technique as a construction. The objective is to identify the parameters affecting the net lifting stress (friction) that occur during lifting of the S.F panel. The result show that the rate of lift slide and the concrete mixtures affect, effectively on operation of construction by the slip form system. The Aberdeen Group **Thomas and Taylor (2012)** [19] described the S.F technique as a powerful tool to the high-rise and heavy buildings. It was just take 7 days in a nuclear plant and 10.5 hours. The 16- story high- vacuum building at Ontario's half- Billion Dollar nuclear colossus at Pickering was encased with reinforced concrete in a non-stop S.F operation in less than 8 days- 7 days, and 10.5 hours. The results illustrated that the S.F as the most economical technique, which achieve the best savings in the cost and the time. Sharifi [21] and Zayed [22] showed in their studies that the value of application S.F in cores and silos. They assessed its productivity and identified its speed appropriateness as well as auxiliary resource using simulation models. Micro CYCLONE is developed in which the potential control units in a slip form system are described for cores and silos. Discussed the formwork for implementing forms to core and silos constructions, also

explained what is the S.F background. They used in their study some of modelling to simulate this process such as micro cyclone. The results show that the developed simulation predict the productivity of case study projects with 99.7 and 93.3% accuracy for cores and silos respectively.
The construction steps of Slip Form is illustrated ion Figure 5 starting from step 1 at the left of figure 5 up to step 4 to produce one work cycle.

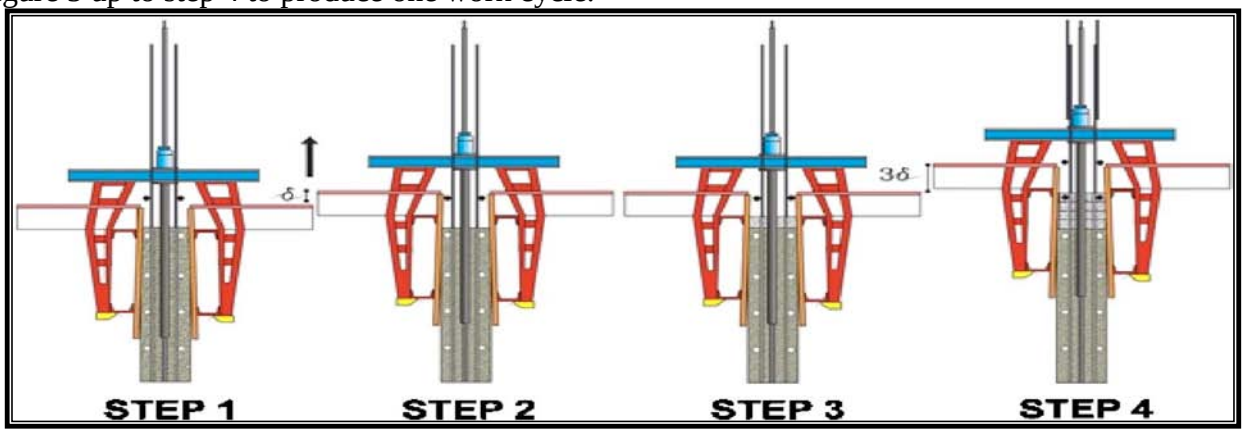

Figure 5: Construction Steps for Concrete Core Using Slip Forms

I. DISCUSSIONS

VE becomes a significant tool in solve many problem and to enhance the quality or performance of project, product, service and system with the optimizing cost. The term quality or performance expresses about the value of the project, product, service, or the system. It is concerned with the elimination or modification of anything that adds cost to an item without adding to its function. VE analyses function by asking such questions: What is it? ; What does it do? ; What must it do? ; What does it cost? ; What other materials or methods could be used to do the same job? ; What would the alternate material or method cost?

- The foundation of a value methodology is the FA; this process develops the full understanding of the project purpose(s). The function always described by using two words, active verb and measurable noun pairings. The FAST is the tool of the function analysis. From the previous studies VE can be used in any field of the work. The benefits of having a VE session on a project outweigh the costs by far, more so if it is implemented in the early development phases of a construction project and for larger more complex projects. The result from this research showed the importance of applying the VE, on government contracting or on the private sector and how it helps to achieve savings neither in the construction field but also in any other field. Also it found that the VM, which includes VE, VA, value monitoring and VECP, is a vital part of any construction program.
- The results showed that the S.F can be considered one of the most important methods of the new construction techniques, which achieves the best savings in the cost and time. The rate of lift slide and the concrete mixtures affect, effectively on operation of construction by the S.F system they must be in the accurate time to permit the cohesion between concrete surface and the inner deck also it should be sufficient to the concrete slump. For tall structures and the mega structures S.F achieve more savings than the other methods. It becomes viable on regular shaped structures generally four stores or greater in height, although multiple uses on shorter structures have been achieved economically in the past. The results improved that the slip form has many advantages, include:
  - Offsite assembly.

- High production rate which minimize the construction projects duration. Early completion of lift motor rooms and early installation of lifts, plumbing and electrical services.
- Reduced carnage as forms are lifted by hydraulic jacks,
- Reduced scaffolding and temporary work, platforms as the S.F system contains its own platforms for working. This also results in a cleaner and less congested constructed site,
- A uniformity of wall sections and layouts can be achieved with the S.F method this is not achievable with C.F systems.
- Labor cost reduction, as the system provides an intensive work environment.
- Reduction of project construction duration.
- Safety and stability.
- Flexibility in combining S.F with other techniques such as the use of lift- slab method after the use S.F. method in the erection of central cores.
- Faster method of constructing vertical structures.
- No construction joints are necessary and through ties are not used.
- Accommodates requirements of even the most complicated structures.
- Tall or repetitive applications.
- In hornet efficiency.
- Adverse weather disruption unusual.

II. CONCLUSION

As a rough guide any organization responsible for over than $ 10 million in expenditure should consider establishing a full-time program. Smaller firms should limit their VE investment to a part time program.

- For any VE study should consider the constructability point of view, owner priorities, requirements, life cycle cost into the account during the workshop of the VE study and not account only on the initial cost.
- Applying the FAST concept during studying the project, or system give a good chance to determine the items which will need to study, and aid to the creativity to find alternatives and solutions for these items laid under study, that lead to reduce the project duration
- Slip Form (S.F.) is an economical, rapid and accurate method of constructing reinforced concrete, or post-tensioned concrete structures. It has the major affect on a project speed, quality, cost, and safety of work. Several studies illustrated the value of S.F. is highly gained as a construction technique in the high-rise and heavy buildings. It increases our capabilities in construction time reduction for special structures. The S.F method of construction has been used successfully in special structures, such as core of high- rise buildings, chimneys, silos, bridge piers, telecommunication and monitoring towers, apartment houses, cooling towers and heavy concrete off shore plat form. For such structures; S.F have proved priceless tools in construction by cutting cost and man-hours and in the same time permitting construction to proceed with maximum safety. A major savings when using S.F construction comes from the low cost of forms per square foot of contact area. To gain optimum benefits from S.F every effort must be made to incorporate the choice of materials and techniques in to the design concept at the very earliest stages. This is a formwork system which can be used to form any regular shape or core. "It increases our capabilities in speed of construction, automation, minimum disruption of an area durability, fire proofing, sound proofing and use of local unskilled labor. The use of S.F result in significant cost benefits when compared with C.F and/or J.F systems.

III. RECOMMENDATIONS

For gigantic construction projects (high rise building, silos, bridges, dames, planets… etc.); recommended to use S.F system as the best new technology improved its efficiency of savingsinboth time andeffortand totalcostsover theproject life cycle for such types of constructions

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