

An Integrated Approach to Value Management and Sustainable Construction during Strategic Briefing in Saudi Construction Projects

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Abstract - The literature demonstrated that Value Engineering has been used in the Saudi Public Sector during or after the design stage. Furthermore, the procurement system utilized in the Saudi Public Sector is the design-bid-build method. This plan is evaluated because of its atomization and disconnection of task branches. However, an intensive article retrospect was handled to sympathize the main Value Engineering arbitration dots which suitable for this appropriation technique and to present main feature for their advantages. Aside from the application of Value Engineering at the plan setting in the Saudi Public Sector, it can be operated at the early stage to facilitate the good program judgment to accelerate with the project if it act for the greatest solving to the mystery at hand, and to design the critical compact by accommodating responders" attitudes respecting the designs of the business. Moreover, Value Engineering can be carried out at the brief stage to structure the requirements of the stakeholders and the project brief. Further, it can be employed to realign the client and contractor value systems during the construction stage, and to explain build ability subjects. Value Engineering is a powerful practice technique if it is coordinated with project management and joined with the phases of the work.

Keywords: Value Engineering, Value Management, Construction industry, Integrated Approach, Sustainable construction, Saudi Arabia.

I. INTRODUCTION

The successes obtained by Value Engineering in the United States of America reassure other countries to follow it. Approaches to Value Engineering should take approval of cultural oppositions, which can arise between unequal

institutions, accomplish areas or countries. Therefore, because of the difference between manufactures management and trade discrimination, Value Engineering systems have developed isolated and differently. Some citizens, such as the United Kingdom and Australia, made radical modifies for the Value Engineering approach to fit their situation and culture. Some other countries, e.g. China and Japan, made some modifications to this approach to fit their state and practice. However, Saudi Arabia, which is the context of this research, has adopted the traditional United States of America Value Engineering approach and utilized it without contextualization. This paper is part of an ongoing research aimed at appraising the Value Engineering approach utilized in the Saudi Public Sector, benefiting from other countries" Value Engineering approaches and developing an appropriate Value Engineering approach at institutional, organizational and project levels that suits the situation in the Saudi Public Sector. The developed approach will be presented in other publications. This paper reviewed the literature to identify Value Engineering interventions and explore those that fit the Design-tender, which is the procurement method used in the Saudi Public Sector.

II. PROJECT VALUE CHAIN

The value chain of a firm is embedded in a larger stream of activities, termed the, value system by Porter. This value system consists of the following:

- Firm value chain
- Supplier value chains
- Other business unit value chains
- Buyer value chain

He added that a firm's product becomes a part of the buyer's value chain. Achieving and sustaining antagonistic

advantage relies on comprehending a firm's value chain, as well as how the firm fits into the whole value system.

At the outset of a project, it is essential to ensure that the client's expectations and requirements have been understood before progressing to the next stage of the project lifecycle. Having defined clearly the client value system, the next task is to take the client's value from stage-to-stage, in order to end up with the final outcome that achieves project objectives and subsequently meets with the client's satisfaction. Standing (2011) stated that the project value chain goes through the following value systems and phases:

- The client value system – strategic phase
- The multi-value system – tactical phase
- The user value system – operational phase

He added that the basic project value chain consists of the following value transitions:

- Corporate value: a diverse element of organizational structure and a part of the client's corporate value chain, which eases the analysis of the corporate objectives and strategic directions of the project. Value engineering at this stage can be utilized to align corporate objectives, which provides the project with its mission statement. The focus at this stage is on needs as well as the client's strategic direction.
- Business value: a part of the clients business value chain, which sets up the project portfolio and project integration. In the context of a business need that has been defined earlier, the project is delivered. The concept brief for the project is developed into a working document, which provides the mission statement of the client's needs and requirements (value criteria). In this stage, it is understood that a project exists and provides business value. Furthermore, it should be decided if the project is viable or not, in order to make the decision to construct.
- Feasibility value: in which options are created and the suitable option that fits the client's value criteria proceeds to the next stages. The client may make some appointments to deliver the feasibility study, such as a project manager, a designer and a consortium at this stage using the appropriate procurement strategy. The key document created at this stage is the project brief.
- Design value: designers create designs that achieve value for the client. Value Management can be carried out at this stage to optimize designs and add value for the client.

- Construction value: the project is built at this stage and value is transferred via the contractual documents submitted to the contractor. The separation of design and construction is considered a major problem for the construction industry. Value Management can be carried out by the contractor and VMCPs may provide value to the client, but it should be assessed against cost, time and risk.
- Commissioning value: this is where a project is tested and prepared for use. Value Engineering can be carried out at this stage, after the completion of construction, to assess the success of the project in achieving its objectives and benefits for the clients and other organizations involved in the project, and to pull out lessons learnt to improve future performance.
- Operational value: The constructed project is taken over by the users, who take over its operation. Value Engineering can be carried out to devise maintenance methodologies to reduce operational and maintenance cost and to increase project value.

Alajmi (2012) added "Disposal value" to the plan value chain, as illustrated in Figure 1. This stage focus on disposing of unnecessary, ineffective or non-performing assets at the appropriate time, with the least disruption to the organization's business, community and environment.

He added that there should be an effective project management, appropriate procurement management and effective use of RM and Value Engineering to achieve value for money. Figure 1 shows the project value chain, including these value systems and phases. At the point between the strategic and tactical phases, there is a transformation from problem orientation to solution orientation. A decision has to be taken at this point, depending on the outcomes of the strategic phase, which is either not to construct, if the project is not the optimal solution, or to construct, which is a business commitment to the fact that the project is the right solution.

The transition of value from step to step within the project lifecycle creates a project value chain. It is vitally important to maintain it intact throughout the entire length of the project, to achieve project value and subsequent project success. On the other hand, there is a potential that this transference may expose the project to failure if the project value chain is dissected. However, the project value chain is cut at some item of the project lifecycle depending on the adopted procurement strategy. The chief objection for Value Engineering is to reorganize the consumer value system, which will be explained in the following sections.

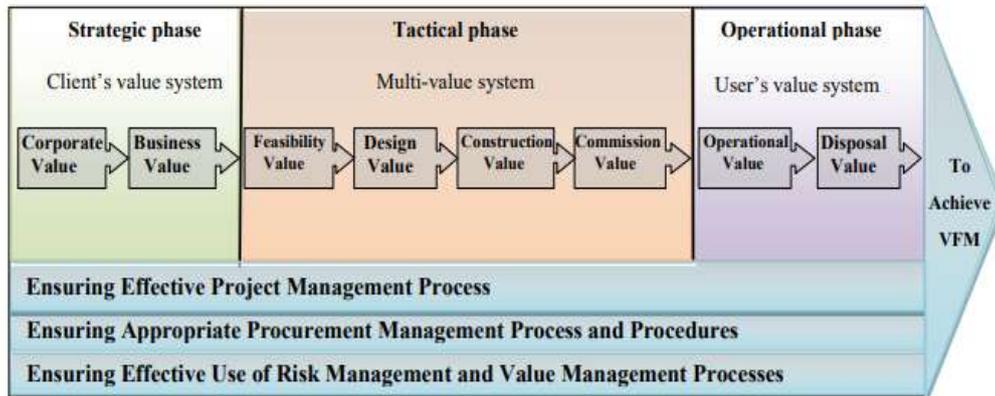


Figure 1: The project value chain and the VFM process

III. THE TRADITIONAL PROCUREMENT SYSTEM INFLUENCE ON PROJECT VALUE CHAIN

The chief feature of this kind of attainment system is that there is a separation between judgment and construction. The consumer assigns a consultant to prepare the project design and tender documentation. The next stage is to invite competitive tenders to introduce bids, and the contractor is chosen using a balanced view of risks and cost. Generally, accountability and scrutiny have a priority in public sector organizations. Therefore, the traditional procurement system is the utilised procurement system in the Saudi Public Sector.

Public contracts in Saudi Arabia are open to contractors who have a convenient arrangement issued by The Saudi Ministry of Public Works and Housing (recently merged with the Ministry of Municipal and Rural Affairs). This classification subdivides construction works into twelve categories, and ranks contractors into five grades, from 1, which is assigned to large companies, to 5, which is allocated to small firms. A contractor can be classified in one or more of these categories, and his grade may vary from one to another depending on his experience, size and other factors in the works included in that category. The government specifies a minimum grade for each intended project, while a contractor is allowed to bid for contracts that are equal to or less than the cost limit of his grade. However, there are twenty-seven categories in the new contractors' classification system. Contractors are assessed according to two main aspects. The first is the technical aspect, which involves the following factors: device group, equipment, projects, on-site performance and an owner poll. The second is the financial aspect, which covers financial situation, profit and loss account, financial ratios and main office inspection. Apart from this classification system, there are no other procedures or requirements for bidding on public projects.

Additionally, the bidder who has introduced the lowest price must be accepted.

According to the Project and Contracts System, initiated by the Ministry of Finance, the public client's design team in the public sector, or an employed consultant, should prepares a detailed design and set of specifications for the intended project, and then it should be proclaimed in newspapers and on websites. As long as a contractor has the specified classification for this project, he is allowed to contribute to this competition. At a specified announced time, a committee from the client's organization opens envelopes containing bids, in the presence of the contractors who want to attend, and proclaims the total bid amounts. The project should be awarded to the bidder who has introduced the lowest bid price.

If the traditional procurement system is properly implemented, it is seen as the least risky approach, as there is a level of certainty about design, cost and duration inherent in this strategy. Furthermore, the traditional procurement system has the following advantages: contractors compete fairly, client design leads, price certainty, satisfactory public accountability, well known procedures and changes are easier to arrange and value.

Despite the fact that the traditional procurement system still the most frequently adopted method in practice, it has been strongly criticized because of its fragmented approach in project result, and because it does not encourage integration, cooperation and communication between the project parties involved, as it isolates the design team from the construction team, which affects the project effectiveness. Additionally, the traditional procurement system takes longer to prepare the design and other documents, contractor build ability experience is absent in the design stage and disputes are common. Furthermore, it is argued strongly that the traditional route is adversarial, which makes it the reason for contractual conflicts.

At the outset of the project there is only the client value system. Once the client has taken the decision to build a project, the design team is employed to start the design work. Consequently, there will be two value systems at this stage – the first is the client value system and the second is the designer value system. At this transition point between the strategic and tactical phases, there is a possibility that the project value chain and the client value system may be affected. Therefore, there is a need to realign the client value system. Figure 2 shows the influence of the traditional procurement system over the project value chain. Point 1 in the figure shows this transition point.

After the tender stage when the client awards the project to a contractor, the value system of the contractor and his subcontractors starts to be considered. Point 2 in the figure represents this transition point. Therefore, there is a need to realign these value systems at this transition point. Additionally, the segregation between the contractor and other

project parties, caused by the traditional procurement system, reduces integration, which prevents the consideration of the contractor’s inputs during the design stage.

Value Engineering and Value Management can ally or realign the project value chain through a series of value opportunities interventions, relying on whether they are used proactively or reactively as part of project delivery. Therefore, Value Engineering / Value Management interventions can be utilised to align and realign the client and the contractor value systems at these points. The intervention point for Value Engineering in the Saudi Public Sector is illustrated in Figure 2; intervention is carried out to optimize the project designs. Therefore, it is vital to consider using Value Engineering / Value Management at the two points (point 1 & point 2) in the Saudi Public Sector. However, the following section will discuss Value Engineering interventions that suit this procurement system to mitigate its.

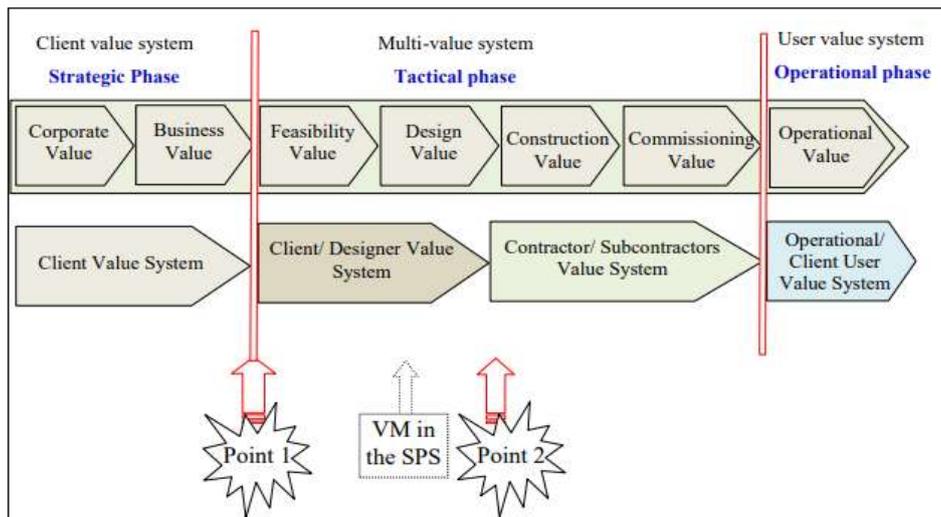


Figure 2: The points at which Value Engineering / Value Management studies are required to protect the project value chain in the traditional procurement system

IV. VALUE ENGINEERING INTERVENTIONS

The first section decorated the value of defining clearly the client value system and keeping it aligned throughout the project lifecycle, in order to realize satisfaction. The second section revealed that the procurement system most disruptive to the project value chain is the traditional one, which is used in the Saudi Public Sector, because it separates the design from the construction process. However, the procurement strategy has an effect on deciding the number and stage of Value Engineering studies, in order to protect the project value chain and keep it intact from the strategic phase to the operational phase. This section presents Value Engineering

interventions illustrated by the literature and identifies the appropriate Value Engineering interventions that fit the traditional procurement system.

Although there is a consensus in the literature that Value Engineering can be conducted at any time throughout the project lifecycle, it is crucial that Value Engineering is conducted as early as feasible. Different standards, organizations and scholars suggest various Value Engineering / Value Management opportunities throughout the project lifecycle stages. Table 1 summarizes the stages of the main intervention opportunities suggested by the literature. Additionally, it shows the primary purpose of each

intervention and the workshop duration for each. It is supposed that conducting Value Engineering at these points helps the project sponsor to take informed decisions, in order

to obtain the highest benefits from the Value Engineering studies.

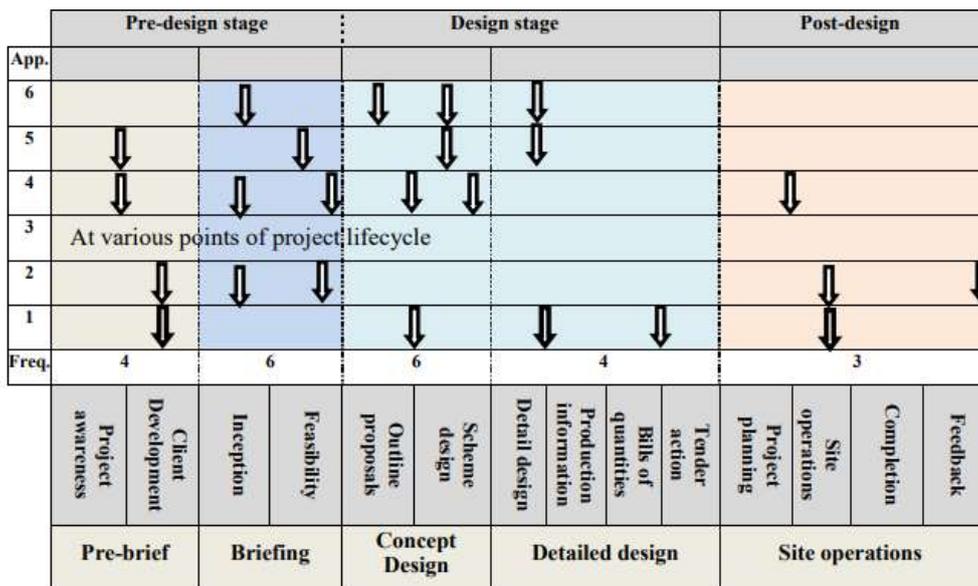
TABLE 1
Value engineering intervention stages in the literature

Approach (App.)	Intervention stages	Primary purpose	Workshop duration
(1)SAVEI (2013)	Although it is stated that Value Engineering can be carried out at the concept development, preliminary design, final design, procurement and construction phases, there is a stress on conducting Value Engineering at the conceptual, detail design and construction stages.	Value Engineering is used throughout the project with a different focus at each stage. At the conceptual stage: to determine the cost vs. worth of basic project functions, and to gain the total perspective of real needs vs. wants of project stakeholders. At the design phase: Value Engineering focuses on functions of each element or component, to assess which alternatives are economically feasible based on the client's requirements	A typical duration is 5 days. Less time can be used to perform projects with concise scope or a low level and 10-15 days or more can be consumed to achieve study's objectives of projects of very large scope or complexity
(2)The European standards (2005)	Inception	Establish need and outcome	Value Engineering contribution to the project may be continuous or focused on the listed stages
	Concept	Improve strategy	
	Feasibility	Enhance viability	
	Implementation	Maximise cost effectiveness	
	Use	Improve product/ process	
(3)The Australian Standards (2002)	Suggests applying Value Engineering as early as possible. A number of discrete Value Engineering studies are conducted at various points in the lifecycle	To achieve best value or best value for money	E.g. two-day workshop, or for the time needed to achieve the study objectives
(4) Male et al (1990)	Pre-brief (the strategic brief)	To structure information in a clear form to take a decision to build	One-half to one day
	Briefing (the project brief)	To restate the strategic brief and translate it to a performance specification in constructional terms	1-2days
	Charette (brief review)	To combine the stages of the previous two workshops	1-3 days
	Concept design (outline sketch design)	To review and improve the concept design	2-3 days
	Detailed design (final sketch design)	To define and detail the construction components	2-3 days
	The operational study (construction)	To convert the design into component and construction operational sequences	A day or more
(5) CIRIA (Connaughton and Green, 1992)	Concept stage	To analyse the need for a project before taking the decision to build, and to structure project objectives and constraints	1-2 days
	Feasibility	To select an outline design proposal that best achieves value for money	1-2 days
	Scheme design	To evaluate developing design proposals	1-3 days

	Detail design	To evaluate detailed design proposals	1-3 days
(6) BSRIA (Hayden &Parsloe, 1990)	Inception	To identify the need for a project and project objectives and constraints	Depends on the nature, circumstances and the scale of the project
	Outline proposal	To evaluate the broad project approach and design criteria	
	Scheme design	To appraise developing design proposals	
	Detail design	To evaluate detailed design proposals and installation methods	

Figure 3 summarizes Table 1 and shows the distribution of Value Engineering opportunities to the project stages. If the intervention points, as suggested by the literature, are summed up for each project stage, it can be seen that the majority of the intervention points are allocated for the briefing stage and the concept design, equally by 6 points, then the pre-brief and the

detailed design stages, equally by 4, then the site operation stage by 3, and finally at the use stage by 1. This gives an indication of the importance of carrying out Value Engineering in the early stages Royal Institute of British Architects plan of work.



Royal Institute of British Architects (RIBA) plan of work

Figure 3: Intervention opportunities according to a variety of Value Engineering approaches

It can be achieved that, in order to achieve client satisfaction, Value Engineering should be carried out sequentially and successfully at the following stages of the project lifecycle:

1. Value engineering at the pre-design stage: to structure the problem in hand, to ensure that the building decision is the best solution for this problem and to structure the strategic brief.
2. Value Engineering at the briefing stage: to identify client requirements, needs and wants and to structure the project brief.
3. Value Management at the design stage: to optimize designs and to ensure that these designs are aligned with the stakeholders' requirements and project objectives. This study can be carried out more than once, at various phases of the design stage depending on the project size and complexity.
4. Value Management at the construction stage: to discuss the contractors' inputs and build ability issues and to realign client and contractor value systems.

Figure 4 takes the above and illustrates subsequently, and is used by the authors to depict the sequential processes that

should be taken to reach the top of client satisfaction. Each step should be well laid, structured and tested before constructing the next one. Doing that perfectly achieves the peak of client satisfaction. Additionally, as shown in the figure, those steps build the client value pyramid. However, the ability to influence the project decreases with the increase of the project lifecycle. Therefore, the ability to form and change the client's requirements and the client value system can be effectively managed at the start of the project, in other words at the project's early stages. As the project lifecycle passes, the ability to change decreases and the cost of change increases. This demonstrates the concern of the decisions taken at the early stages of the project lifecycle. Thus, it is crucial at the outset to structure the problem and test whether the project is the best solution for it, then establish the client value system and embed it in the project briefs, transfer it to the designs, and then finally include it in the project constructed. This is reflected in the value pyramid, where its base is bigger, and more important, than the following layer and so on. However, this does not diminish the importance of the following decisions or stages, as the client value system should be managed from the outset of the project and throughout its lifecycle to its end, as discussed previously.

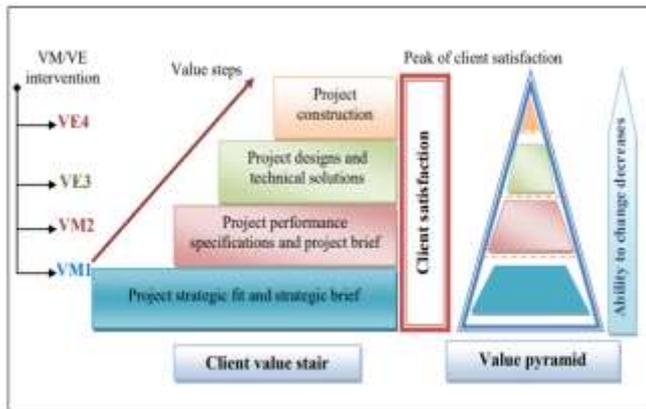


Figure 4: The concept of value steps

It was debated above that the use of Value Engineering / Value Management interferences is a strong method for ensuring the transformation of the client value system from one stage to another. Therefore, Value Engineering / Value Management studies can be used to test the previous step to ensure that it was laid properly, before transferring to the following step. However, Figure 4 shows the main opportunities for Value Engineering / Value Management interventions to achieve this purpose. In other words, more opportunities than these can be identified in each stage. For example, Value Engineering can be carried out more than once during the design stage, e.g. to check and approve the outline proposals and another time to optimise scheme designs.

V. CONCEPTUALISED APPROACH CHARACTERISTICS

The literature revealed that Value Engineering is a strong methodology that can be used at an early stage for structuring the problem, obtaining a consensus about project objectives and understanding client requirements and the value system.

Additionally, it was highlighted that Value Engineering in Saudi Arabia is carried out by employing an external team at the schematic stage or later to optimize project designs, in order to reduce project cost without sacrificing quality and project functionality. However, employing an external team to conduct a Value Engineering study causes an adversarial stance between the design team and the Value Engineering team. Therefore, because of this adversarial position, the design team might resist change and portray a bad impression about Value Engineering to the project sponsor, in order to avoid redesign works caused by the Value Engineering proposals. Furthermore, as addressed above, the external team may not have sufficient background knowledge about the risks and details of the project environment and context, compared with the design team which has been involved from an early stage in the process, taken the brief and understood the client requirements well. Additionally, employing an external team consumes more time and money. In contrast, employing an external Value Engineering team may add new perspectives about achieving project functions. Consequently, it can be supposed that the best practice for Value Engineering in the Saudi Public Sector is by employing external experts to help the design team to conduct Value Engineering at an early stage, to overcome these problems.

Value Engineering is carried out once during the project lifecycle, during the design stage in the Saudi Public Sector to optimize in-hand designs, which means that this study is carried out depending on the given assumptions about the project concept, which could be wrong in some cases. Therefore, the following Value Engineering / Value Management studies, as illustrated in Figure 4, are needed:

A) Value Engineering 1 at the project pre-brief stage

Public sector projects are often distinguished by the multiple perspectives about their objectives; as there are many stakeholders, everyone has a different background and, consequently, has his own viewpoint about the project objectives. Therefore, it is essential to structure a mutual understanding and gain a consensus about the problem at hand and its best solution. The literature illustrated that Value Engineering has an effective role when it is conducted at an early stage of the project lifecycle in structuring the problem, and helps the stakeholders to decide the best solution for the

problem. Moreover, it helps to identify the need for investment and the risk with which it may coincide. Having decided to proceed with the project, the next stage is gaining a consensus amongst project stakeholders about the project's strategic objectives, and then preparing the strategic brief, to ensure that the project fits with the organization strategy and to check the business case of the project.

In public sector organizations, there are usually political issues that should be considered; therefore, employing an external Value Engineering manager is beneficial in avoiding political influence. Additionally, senior managers affected by the project should attend this workshop in order to check the strategic fit of the project with the strategic directions of the organization. However, as suggested by Connaughton and Green (1990), if the problem is well structured, objectives are clear and soft issues are sorted out already, there is no need for this study.

B) Value Engineering 2 at the briefing stage

Value Engineering is applied in the interface between the brief phase and the design phase, and aims to communicate the client's requirements, needs and wishes to the design team. In this Value Engineering workshop, the strategic brief is re-stated and is converted into a performance specification in constructional terms. Therefore, Value Engineering 2 is supposed to be conducted at the briefing stage to help in translating the strategic brief into design and construction terms and specifying performance requirements for each of the project elements. Furthermore, it includes collecting information about the client's needs and requirements and project objectives, in order to recognize clearly the functions required, and then identifying elements, components and engineering systems design criteria. The main output of this study is the project brief, which will be handed to the design team to articulate it into design solutions.

It is expected that the workshop be coordinated by an external Value Engineering manager, because this is important from a team control perspective, as the external Value Engineering manager can, for example, invite every team member to contribute and clearly address his opinion about the project. The Value Engineering team consists of representatives of various organization groups, a project manager and the design team or at least an architect, because the design team is the best party to write the project brief. At the end of this study, the project brief should be submitted to the client so that he can approve it and return it to the design team to start the designs accordingly.

C) Value Management 3 study during the design stage

With the problem clearly structured and project objectives and client requirements identified during the pre-design stage, utilising Value Engineering 1 and Value Engineering 2 studies, the next stage is to create technical solutions for the specified problem – the design. It was reported by Mendelsohn (1992) that 85% of the problems faced in the field are produced at the design phase. Therefore, designs should be tested and compared against strategic and project briefs. It is proposed in this research that the VE3 study is conducted during the design stage, but no later than the scheme design to save time and effort and to mitigate the design team change resistance. It aims to optimize designs and to check that the design achieves the agreed project objectives and client's requirements effectively. Alternative designs that achieve the requisite level of performance should be compared on the basis of the lifecycle cost at this stage, while the risks associated with these alternatives should be analyzed and considered. Additionally, quality requirements should be assessed during this Value Management study.

Besides the Value Management manager, the literature showed that Value Management is conducted by a multidisciplinary team, to cover all aspects of the design. Additionally, operations and maintenance managers should contribute in this workshop to discuss lifecycle cost and maintenance and operation issues. The attendance of the end-users' representative is crucial to include their inputs in the design. The project manager's contribution is vital, as he is the main person responsible for the project, and his inclusion from the outset of the project is essential to follow the transition of the client value system successfully from stage to stage. The client's representatives should attend to discuss with the team any changes needed and to agree them.

In order to avoid commotion and change resistance, it is better to employ the design team, besides experts from outside the design team, to conduct this workshop. This will facilitate the change for two reasons. Firstly, the design team will learn from the experience of the external experts, and secondly the design team will be involved in the change process. As the design team contributes in the Value Management study and in the decision-making process, change resistance will reduce, because, as stated by Robbins (2012), participation can be used to reduce resistance to change.

D) Value Management for study at the construction stage

The acquisition strategy utilized in the Saudi Public Sector is the classic procurement system, which influences the project value chain and does not involve contractor inputs by separating design from the construction and produces a

confrontational attitude between the design and construction teams.

Therefore, a Value Management intervention is required at the construction stage to overcome these problems, to realign the client and the contractor value systems, if required, and to communicate the client value system and the project objectives to the contractor and supply chain parties.

Fruitful Value Engineering Change Proposals can be produced by controlling Value Management at the construction stage, led by the contractor, because he is in the best position to decide the most suitable construction methods. Therefore, Value Management Change Proposals can be introduced by the contractor, along with the traditional procurement system, to decrease the project cost, time and risks. However, there should be an incentive clause in the contract to entitle the contractor to share the savings achieved by this study with the client and protect his intellectual rights. Kelly et al. (2014) stated that this clause allows the contractor to be proactive and to use his knowledge and experience in engineering/ construction to enhance the facility during the construction stage. The disadvantage of this clause, however, is that the project could be delayed during the viability investigation of the change by the design team. As a result, changes tend, to some extent, to be superficial.

Arian et al. (2012) concluded that the communication gap between the constructor and the designer, and lack of coordination between project parties, are considered amongst the main causes of inconsistencies between the design and construction of large building projects in Saudi Arabia. This asserts the need for a Value Management study at this stage to sort out the problem by filling the gap and enhancing communication between project parties. Additionally, this study mitigates the confrontational attitude between project parties and encourages communication and collaborative work between them. Any question about the design can be raised and discussed during this workshop. However, Saudi Public Sector contracts should be modified to accommodate this study, by including an incentive clause, which encourages the contractor to carry out Value Management and share the savings achieved.

Participants include the client's representatives, who are present in order to discuss changes on behalf of the client, the project manager, the design team, suppliers and subcontractors' representatives, with a view to enhancing communications between those parties and sharing a mutual understanding about the client value system.

A one- to two-day workshop is suitable for VE1 and VE2, two to three days for VM3 and a one- to three-day workshop

for VM4, as suggested by the literature and summarized in Table 1. These time frames can be changed depending on project size and complexity.

VI. CONCLUSIONS

The research determined that the traditional procurement system is the route utilized in the Saudi Public Sector. Additionally, it revealed that Value Engineering is conducted once during the project lifecycle at the schematic design stage or later, and no evidence from the literature indicates that the Value Engineering approach has been contextualized to fit the situation in the Saudi Public Sector. This paper set out to synthesize the literature in order to propose a Value Engineering approach for the Saudi Arabia that fits the traditional procurement system. It has been argued that Value Engineering / Value Management studies are carried out at transition points or when the client needs to take informed decisions.

This paper has shown that the traditional procurement system affects the project value chain at transition points between parties' value systems. Moreover, Value Engineering / Value Management studies can be effectively utilized to realign the client's and other parties' value systems. It has been argued that a Value Engineering intervention (Value Engineering 1) should be introduced at the pre-brief stage to help the client in structuring the problem at hand, getting consensus amongst project stakeholders about the project's strategic objectives and taking an informed decision to build after ensuring that the project is the best solution for the given problem. Additionally, this study aims at structuring the strategic brief. Furthermore, it has been discussed that another Value Engineering study (Value Engineering 2) is required at the briefing stage. This study aims at translating the strategic brief into design and construction terms, specifying performance requirements. Moreover, this study is needed to prioritize the client's needs and wants and project objectives. It aims to identify the functions required, thereby setting the criteria for the elements, components and engineering systems. The project brief is supposed to be discussed, agreed and communicated to the design team in this study.

It was also shown that a third intervention study (VM3) should be carried out at the scheme design stage to test it against the strategic and project brief and, furthermore, to test alternatives and choose the best design that satisfies the function effectively and efficiently. Finally, it has been discussed that a value engineering study (VM4) needs to be carried out after awarding the contract, to ensure that the construction team understands the client value system and to get the project parties in one place to discuss the project. As the contractor is the most likely party to understand any

construction and build ability issues, value engineering change proposals are introduced by him to accomplish the project efficiently.

This paper has gone some way towards enhancing our understanding by comparing intervention opportunities amongst Value Engineering approaches and developing an appropriate Value Engineering approach to fit the traditional procurement route used in the Saudi Public Sector. It has also contributed to the knowledge by the concept of value steps, which helps to achieve client satisfaction, as illustrated in Figure 4.

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