MAKING VALUE ENGINEERING AS AN EFFECTIVE TOOL FOR PROJECT INTEGRATION USING CONSTRUCTABILITY AND PARTNERING CONCEPTS

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Chang T. Hyun is a professor , who is majoring in construction engineering and management and especially has great concerns in Value Engineering(VE) and partnering, with more than 10 years academic experience in the university. He is a professional engineer with more than 7 years practice experience in both private and public sector. He has been directing and instructing in construction engineering and management including VE, TQC, and computer application in the construction industry and leading VE workshops, for government offices and private construction firms. He is a champion who has been dedicating to activating VE in Korea and wrote several manuals about VE implementation in Korean construction industry as well as many papers related to VE and partnering.

ABSTRACT

This paper presents the way how Value Engineering(VE) techniques could be used as an effective tool for project integration at the design phase and the construction phase in the construction process. Using constructability concept and partnering concept, the methodology, where VE cooperates with those concepts and performs a key role for project's integration, will be pursued. In addition, Analytic Hierarchy Process techniques which is known as a rational decision making process will be applied to VE for objective and quantitative evaluation of several alternatives.

INTRODUCTION

It is generally accepted that project performance can be enhanced when the interaction between designers and builders occurs on a regular basis, beginning at an early stage in the proejct, in an open and trusting environment. Accordingly, researchers and practicing engineers have recently paid considerable attention to alternative approaches to project integration in the construction industry, such as constructability and partnering which may improve project's integration by increasing the quality and/or quantity of interaction.

When the project would be well managed, especially the project planning, design, and construction phases would be treated as integrated tasks, a project of maximum value to the owner is realized in the most economical time frame, as stated by Barrie and Paulson(1992). This kind of approach could unite a multi-party team consisting of owner, designer, builder, and construction manager in a non-adversary relationship. And interactions relating to construction cost, environmental impact, quality, and completion schedule are carefully examined by the team.

The purpose of this paper is to present the way how VE techniques could be used as an effective tool for project integration at the design phase and the construction phase in the construction process, using constructability and partnering concepts and decision-making

techniques.

PRESENT STATUS

The theoretical VE job-plan approach is technically and logically sound and has been shown to be successful when it is applied properly within cooperative environment and at the early stage of project. However, can we say the present application status of VE in the construction industry in our country is satisfactory? Probably, "Not yet!" What are the reasons why we can't say "Yes, of course!" There are so many reasons in relation to the characteristics of the industry and the conditions of our country, and so forth. Above all, followings would be main reasons especially in the construction industry.

Firstly, the adversary relationship among the parties involved in same project more often prohibit submitting and accepting of VE proposals. Anyone who has worked in design or construction is aware of the negative attitudes engineers, architects, and contractors can have toward one another. These attitudes negatively influence communications among the different parties involved in a project. Furthermore, in general, the designer responsible for the original design used to resent any criticism of it. So, he/she is usually very reluctant to accept the VE proposal coming out from the contractor, to some extent, caring design principal or supervisor's criticizing for not producing the right design the first time.

Secondly, the traditional design-bid-build delivery system which is most widely adopted contracting method in Korean construction industry as other countries, keeps designers and builders from interacting especially in the early stage of the project. As illustrated in the following figure(Barrie and Paulson 1992), the level of influence is by far the greatest during engineering and design, while actual expenditures at that stage are relatively small.

Most engineers and architects could benefit from contractor input, but contractors are not usually involved in a project until bidding. They work from completed drawings and specifications without having any input to their contents(BR 1982). Because of the separation between design and construction, we are used to lose the chance to get the greatest cost savings in the early stage of the project. In reality, VE techniques are used mainly at the construction phase in Korea because of several reasons including the above. These are not satisfactory.

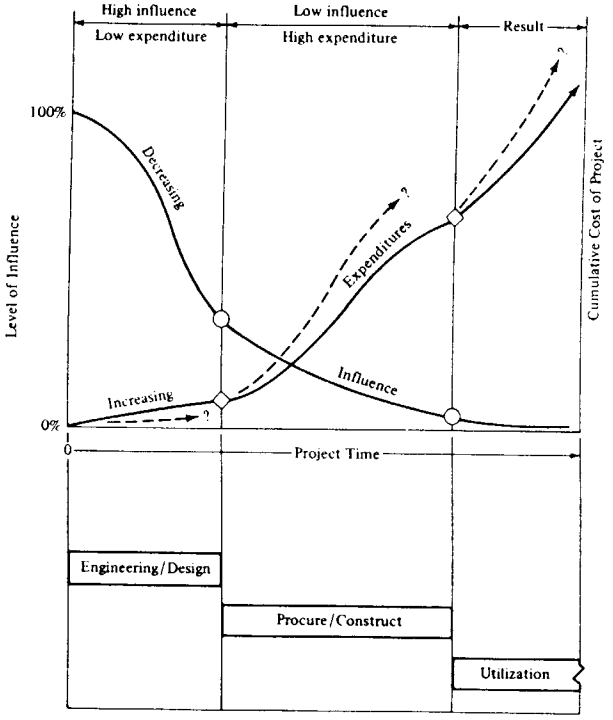

Figure 1. Level of influence on project costs (Barrie and Paulson 1992)

In addition, cumbersome and a little bit difficult aspects of VE process itself sometimes make practicing engineers hesitate to apply VE job plan to their daily work. One of the most cumbersome steps in VE job-plan is the step where several alternatives are evaluated and a optimum alternative is selected.

From these points of view, in this paper, main questions for improvement schemes are settled so that VE could become an effective tool for project integration and decision-making. Those are 'How can the integration of design and construction be achieved more effectively than now?', 'How can the cooperative relationship be made among the parties involved in a project?', and 'How can we evaluate alternatives more objectively, quantitatively, and efficiently?'

PROJECT INTEGRATION

Partnering, design-build, constructability, and combinations of these are alternative approaches to project integration. Each of these approaches helps improve integration in a different way.

Partnering is a non-contractual attempt to change the nature of the often adversarial relationships between owners, contractors, designers, and others involved in a construction project, by getting them to commit to common objectives, formalizing improved communication, and preventing disputes. It would change traditional relationship to a shared culture without regard to organizational boundaries(Warne 1994). The objectives is to build them into a team and maximize the effectiveness of each participant's resources. The expected benefits include improved efficiency and cost effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services (CII 1991).

Design-Build combines the architecture/ engineering firm and contractor into one organization. This sets up an environment in which communication between them can begin early and should be more routine.

The Construction Industry Institute(CII) forming a Constructability Task Force in 1986 to study constructability program, defined constructability as "the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives" (CII 1986). Constructability can take a number of forms, but its aim is to get construction knowledge and experience into the early stages of planning and design. The integration of experienced construction personnel into the earliest stages as full-fledged members of the project team, will greatly improve the chances of achieving a better quality proejct completed in a safe manner, on schedule, and for the least cost(ASCE 1991).

Based on our research results(Pocock et al. 1996), the partnered projects have significantly better interaction score than traditional projects and combinations projects in which constructability and other approach are applied have the highest score of all categories. And, the partnered projects and combinations projects are better than traditional projects in terms of performance indicators such as schedule growth, cost growth, and modifications. Fig. 2 presents this result graphically. From these results, we can assume that the more the interaction occurs, the better the performance becomes. This confirms that constructability and partnering can improve project's integration by increasing the quality and/or quantity of interaction, and eventually give us better performances.

INTEGRATION OF DESIGN AND CONSTRUCTION

Constructability and VE differ in terms of some criteria such as focus, implementation, and timing. This does not mean that they are mutually exclusive. Rather, activities within the two work processes may complement each other in achieving their goals. Constructability implementation can act as a precursor to VE, providing information through constructor input and lessons learned from past projects so that VE may be more effective(Russel et al. 1994).

The constructability implementation roadmap provides an overview of the constructability process by emphasizing following six milestones(CII 1993). In project-level program, milestone 3 through 5 are mainly applied(Radtke and Russell 1993). The steps in those milestones are shown below also.

M.1. Commit to implementing constructability
M.2. Establish constructability program
M.3. Obtain constructability capabilities
  S.1. Assemble key owner team members
  S.2. Define constructability objectives and measures
  S.3. Select project contracting strategy
  S.4. Secure contractors, vendors, and consultants
M.4. Plan constructability implementation
  S.1. Develop constructability team
  S.2. Identify and address project barriers
  S.3. Consult applications matrix and lessons-learned file
  S.4. Develop constructability procedure and integrate into project activities
M.5. Implement constructability
  S.1. Apply constructability concepts and procedure
  S.2. Monitor and evaluate project program effectiveness
  S.3. Document lessons learned

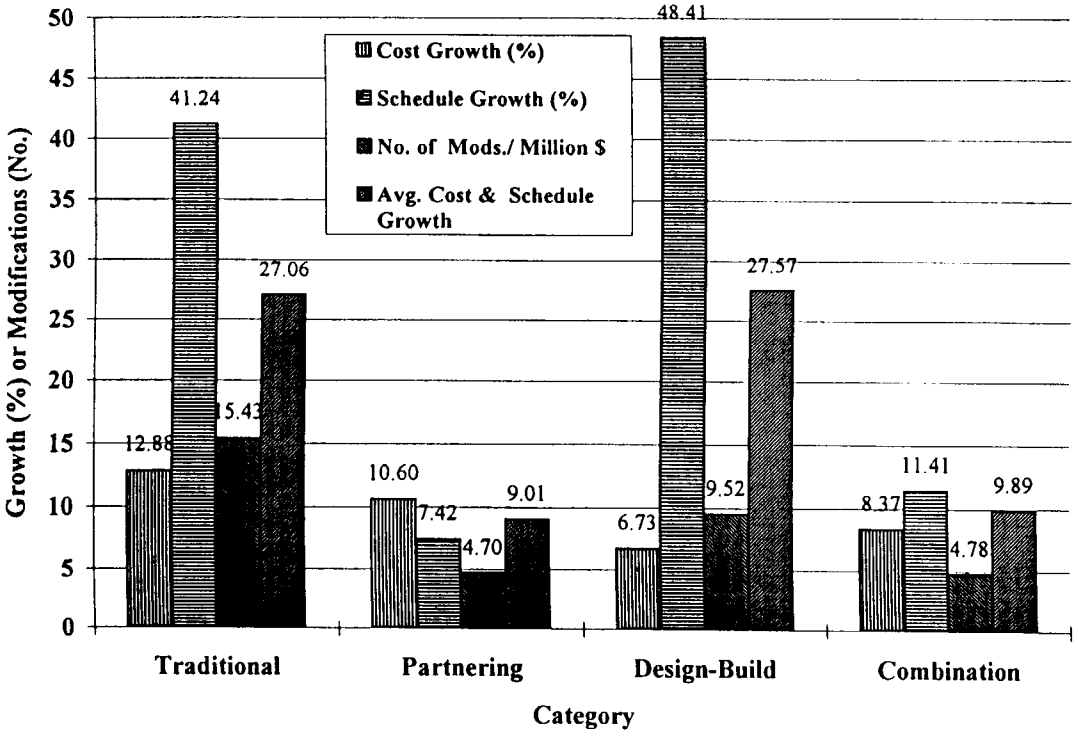

Figure 2. Average Project Performance by Category (Pocock et al. 1996)

M.6. Update corporate program

Most important attribute which we can obtain from constructability concepts, is the integration of project, by getting construction knowledge and experience into the early stages of planning and design. We can apply this basic concept to VE especially for the integration of design and construction, by involving experienced construction personnel into the planning and design stages.

In addition, constructability concepts and techniques such as developing team, defining objectives and measures, identifying and addressing project barriers, consulting applications matrix and lessons-learned file, monitoring and evaluating project program effectiveness, and so forth, could be mainly applied to VE program so that designers and builders interact effectively from the early phase of project and use VE as a powerful tool for the improvement activities including design review. In preparing VE program, using the ideas of constructability, we can select owner project VE manager, establish VE objectives, identify appropriate measures for objectives, consider use of incentive clauses related to VE performance, perform team-building exercises, identify and address barriers present among VE team, screen appropriate lessons-learned file, and so forth. In implementing VE, we can execute VE job-plan, while maintaining records of VE ideas, evaluating and reporting on program's progress, documenting lessons learned, and so forth.

COOPERATIVE ENVIRONMENT

Partnering varies widely from one project to another, yet there is also extensive consistency among most partnering efforts (Ronco and Ronco 1996). These core characteristics of partnering are shown in left column of Table 1. With this consistency, the ways in which partnering efforts may vary are shown in right column of Table 1.

Table 1. Partnering Core Characteristics (Ronco and Ronco 1996)

Core characteristics	Areas of variation
Communications focus	Built in / or add-on features
Inclusive	Execution
Public	Emphasis
Proactive	Time
Cooperative	Structure

The partnering process will vary according to the type, size, uniqueness, etc. of the project. The following process is only a model(Hellard 1995), but generally adopted one (Hyun and Doh 1996).

M.1. Preparation Phase
  S.1. Educate own organization
  S.2. Make intentions clear
  S.3. Commit top management
M.2. Workshop Phase
  S.1. Develop resolution process
  S.2. Develop joint evaluation process
  S.3. Discuss individual roles/concerns
  S.4. Create charter
M.3. Implementation Phase
  S.1. Periodic evaluation
  S.2. Final evaluation and celebration

Most important attribute which we can get from partnering concepts, is making cooperative environment without regard to organizational boundaries. By building all parties, that is, owner, designer, builder, and others involved in VE program into a team, we can change traditional relationship to a shared culture and maximize the effectiveness of each participant's resources.

In addition, partnering concepts and techniques such as partnering workshops, creating charter, developing resolution process, developing joint evaluation process, and so forth, could be mainly applied to VE program so that designers and builders interact effectively and use VE as a useful tool for the improvement activities. In particular, the partnering workshop provides an excellent opportunity for initial discussions of VE ideas. So, the workshop combining VE and partnering is strongly recommended. And VE within partnering needs to be modified to make it consistent with one-team approach. From this standpoint, preparing VE joint proposal(VEJP) which is made by all participants instead of solely contractor's idea, is also strongly recommended.

HYBRID VE MODEL

Considering that constructability program is especially effective in the early stages of the project and partnering usually is applied in the construction phase, a Hybrid VE model could be proposed as in following Fig. 3. Here, Ph-Ⅰ is the hybrid of constructability and VE for pre-construction phase, and Ph-Ⅱ is the hybrid of partnering and VE for construction phase. VE program of each phase, that is, Ph-Ⅰ and Ph-Ⅱ, of course, could adopt both constructability concepts and techniques and partnering concepts and techniques from necessity. The dotted box in this figure indicates that those milestones or steps could be extended if necessary. For example, because VE is usually performed as a reactive process to design, it is assumed that Ph-Ⅰ would be implemented at the detailed design phase. However, it could be also applied at the conceptual design phase or even before.

MUCH MORE

In addition, Analytic Hierarchy Process (AHP) techniques which is known as a rational decision-making process will be applied to VE so that owners, contractors, designers, and others involved in a construction project evaluate several alternatives objectively and quantitatively. In general, AHP decision-making process is used as follows(Skibniewski 1988):

1. A complex problem is structured by decomposing it into a hierarchy with enough levels to include all attribute elements to reflect the goals and concerns.
2. Elements are compared in a systematic manner using the same scale to measure their relative importance, and the overall priorities among the elements within the hierarchy are established.
3. The relative standing of each alternative with respect to each criterion element in the hierarchy is determined using same scale.

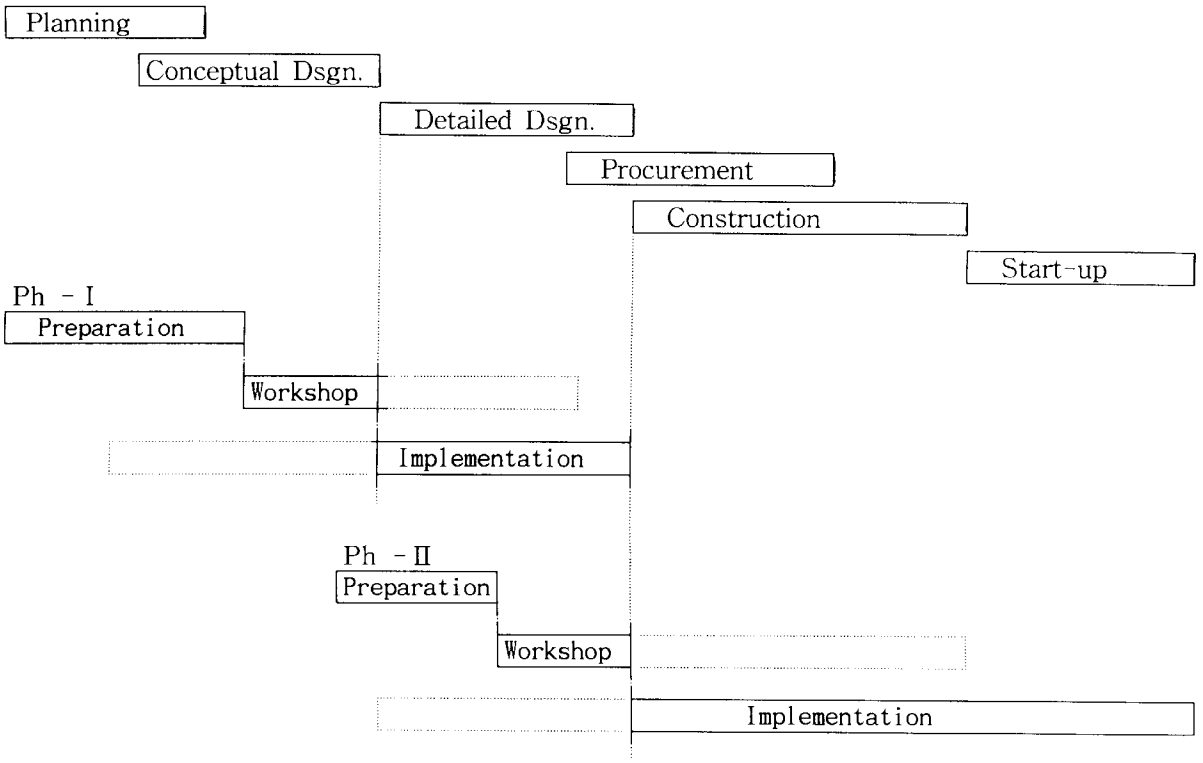

Figure 3. Flow-chart of Hybrid VE model

4. The overall score for each alternative can then be aggregated, and the consistency of comparison can be measured using a consistency index.

Table 2 lists the comparison scale used in pairwise comparisons.

Table 2. Comparison Scale [Adapted from Saaty(1980)]

Intensity of Importance	Definition
1	Equal importance
3	Weak importance of one over another
5	Essential or strong importance
7	Very strong or demonstrated importance
9	Absolute importance
2, 4, 6, 8	Intermediate values between adjacent scale values

The computerization of AHP process (Hyun and Kim 1995) can make the practical application more efficient.

SUMMARY

Though the theoretical VE job-plan approach is technically sound and has been shown to be successful when it is applied properly, the present application status of VE in the construction industry is not satisfactory. Main reasons include the adversary relationship among the parties, the traditional design-bid-build delivery system, and cumbersome aspects of VE process itself.

Our recent research reveals that constructability and partnering can improve project's integration by increasing the quality and/or quantity of interaction, and eventually give us better performances. The activities within VE, constructability, and partnering work processes may complement each other in achieving their goals.

We can apply the important attribute of constructability concepts to VE program especially for the integration of design and construction, by involving experienced construction personnel into the planning and design stages. Other constructability ideas and techniques could be mainly applied to VE program so that designers and builders interact effectively from the early phase of project and use VE as a powerful tool for the improvement activities including design review.

Most important attribute of partnering concepts is making cooperative environment without regard to organizational boundaries. Other partnering ideas and techniques such as partnering workshops, creating charter, developing resolution process, developing joint evaluation process, and so forth, could be mainly applied to VE program. The workshop combining VE and partnering, and the preparation VE joint proposal(VEJP) are strongly recommended.

A Hybrid VE model, in which Ph.-I is the hybrid of constructability and VE for pre-construction phase, and Ph.-II is the hybrid of partnering and VE for construction phase, could be proposed as in Figure 3.

The computerized AHP techniques helps VE members evaluate several alternatives objectively, quantitatively, and efficiently.

Using the new VE program suggested in this paper, designers, engineers, and builders can interact effectively and evaluate several alternatives objectively and quantitatively. Eventually, with this VE program we can produce projects more cost-effectively and the performance of those projects will be improved.

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