

## VE STUDY OF THE PROJECT PLANNING AT BUILDING CONSTRUCTION SITES

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### ABSTRACT

This paper proposes a method of planning and developing an optimum construction project plan consistent with on-going changes in the plan, its restrictions, its relevance to the basic intent of design and to the specific site conditions. So far, proving its effectiveness in its company-wide application, the method aims at enabling the construction project staff to maintain a high level of work precision flexibly consistent with the basic construction plan, that should be established from a total view-point.

### INTRODUCTION

As symbolized in the increased number of high-risers, the building construction work nowadays keeps requiring mass and technical development in the construction equipment being used. While the total volume of construction work resulting from the needs created by the high pace of the growth of Japanese economy and industry has become large, the growth of necessary technical manpower has been tardy, mainly because of the trend of increased aging of such technicians' community. Thus, the current situation apparently reflects the need for solving some inherent problems in the construction industry, that are listed below expressed as specific needs.

- \* Need to improve the structure of the on-site production system and its effectiveness.
- \* Need to have such production equipment of better operating efficiency that can be easily assembled, disassembled and/or relocated as required within a preset time-schedule of the construction work.
- \* Need to develop and improve construction methodologies aimed at realizing a higher level of productivity.

To solve these problems, construction work plans should be developed by selectively designing the methodologies with which construction work can be done cheaper and safer to produce high-quality buildings in a limited time.

Construction work plans could be more specifically designed as "to rationally establish the related policies, work methods, procedures, schedules and quality assurance methods so that the quality of design can meet all of user's requirements." Thus, the linkage of construction work and its work management can be illustrated in figure 1.

We have conventionally place project emphasis on A2 — B2. As construction technologies have been advanced and social awareness of "quality responsibility" and "quality assurance" has prevailed, we must pay more attention to the A1 — B1 — C chain of actions<sup>1</sup>.

Being aware of the importance of construction work planning, below is how the VE methodology can be effectively applied to this planning phase of various building construction projects.

### VE APPLICATION TO THE CONSTRUCTION WORK PLANNING

The conventional practice of building construction work planning has been known to be liable to a number of potential problems, as listed below:

- \* Frequent changes in planning may be necessary during the construction unless a well-balanced planning has been made (1) based on the complete understanding of owner's initial design intention and related building site conditions, and (2) matched with the related known conditions or criteria of the construction planning.
- \* Construction work plans may have to be changed when any planning inconsistencies of "unmatching conditions" occur in the actual construction work.
- \* The degree of the precision of construction work is dependent on how much prior thinking has been put in the methodologies of upgrading work precision.

To solve these problems, it is fundamentally necessary for the construction planner to select the best method of planning that would best meet all conditions as required in the problem areas.

I have applied VE to make the construction work planning more effective, that can be named "VE Job Plan for construction Work," as illustrated in Table 1. This paper is to specify how each of the Job Plan steps should be applied to the on-site process of construction work planning. [Table 1]

The person in charge of any construction work-site should be responsible for developing a "team design" to be participated by in-house specialists of various technical backgrounds.

Construction methodologies being considered and/or kept being created for "instant implementation" even after the construction work has been started would only result in changes in work process causing delays and/or confusions.

So that a productive plan for optimizing construction work can be developed, it is important to have accumulated enough experience in VE-projects by familiarizing yourself with the practice of VE planning and by pursuing research for higher productivity in terms of better systems, techniques and methodologies.

It should also be noted that, even with the traditional methods of construction, efforts of method improvement by changing the materials as required by the selected methodologies and by combining the related components and materials to be "unitized" in the process can be a good point of preparation.

Now, there should be a reasonable decision-making process so that the work planning can be effectively and smoothly proceeded, as proposed below by the author in the form of VE Job Plan for Construction Work Planning (Figure 1). It consists steps, in which the first two steps ... Step 1 (Define Functions) and Step 2 (Evaluate Functions) ... are unique in construction work as described under asterisks. The author will elaborate details of these two steps to

emphasize uniqueness of his Details of the remaining Steps 3

through 10 are not shown the standard Job Plan rules

### VE Job Plan for Construction Planning

Phase	Step	Specific decision-making activities
Define Functions	1. Gather information	* Possible restraints of the construction work planning are identified through field researches and VE aspects of the conditions of work planning are listed up by individual work-items.
		* All design documents (drawings, specs, etc.) are checked for planning consideration, and VE aspects of specific planning details are listed.
		* The basic construction contract is checked so as to list VE aspects of the conditions for planning individual work-items.
	2. Select conditions of work planning	* Applicable aspects of the conditions for individual work-items are selected according to detail requirements identified through the field researchers. * Applicable aspects of the conditions of design documents are selected by individual items. * Application aspects of the conditions of the basic construction contracts are selected by individual work-items.
	3. Define specific functions	(details for steps 3 through 10 are not shown)
	4. Select & classify necessary functions	
	5. Analyze costs by functions	Evaluate
Functions	6. Evaluate & prioritize functions	Develop
Alternative Proposals	7. Generate ideas	
	8. Evaluate econo/tech feasibility	
	9. Select workable methods to implement the ideas	
	10 Evaluate econo-tech details and make decision	

#### STEP 1: Collecting information necessary for VE study themes

The purpose of this step is two-fold: 1) To be well familiarized with the themes of the VE application by collecting on-site project-related information so that the operation and work can be smoothly managed; 2) to develop specific work plans through a team-design approach, enabling all the concerned staff and in-house specialists (as team planners) to cooperate "on the same boat."

It should be noted here that results from improvement efforts could be larger if VE application is focused on areas of larger potential improvement effect, as clarified through such information-gathering processes. This Step 1 should consist of the following

"sub-steps," that specify how decision-making actions can be effectively taken by the team members.

#### Sub-step 1-1: Determining specific information needs

First, what kinds of information are needed should be clarified. Information needs in this regard can be largely classified into the following three categories:

1) Need for collecting field research data from which to select and determine necessary types of production equipment most suitable to the on-site conditions.

2) Need for specific information from various design documents (drawings, specs, etc.) so as to have a grip on conditions of construction planning in such terms as building quality, work precision, schedule, economy and safety.

3) Need for information from contract documents so as to establish and cross-check detail schedules for construction.

4) Need for information from monetary data of all related contracts so as to preestablish target costs that must be attained during the management process of construction work.

#### Sub-step 1-2: Planning for collecting information

With all information needs satisfied, you now must plan for the right steps by which needed information can be effectively collected.

#### Sub-step 1-3: Actually collecting necessary information

Based on the specific plans for collecting information, the concerned in house staff and specialists will execute the task to collect needed information. Based on their accumulated job knowledge and experiences, the team members must accomplish the tasks by using various methods such as field observation, document search and analysis, etc. and completing a set of information sheets and forms according to preestablished survey schedules.

#### Sub-step 1-4: Screening and classifying the collected data

Information so far collected should serve as the principal data at each step of the VE Job Plan being applied to construction work planning. Table 1 partially illustrates the consecutive steps that should be followed here.

It is necessary that data collected be exchanged with each among the team members so that everybody comes to have grips of a total profile of the required planning conditions. Data thus collected and classified must then be computerized as a central data base so that needed information can be most effectively used in the ensuing steps of the Job Plan. The author feels it necessary to elaborate on further details of how the collected data can be effectively screened and classified.

#### Field research of VE aspects of planning conditions and their selection

Largely, there are five sectors that build up the research data, by which specific requirements for construction work planning can be summed up (ref. Table 1).

- 1) Research of construction site conditions: Land space, borderlines, physical obstacles (surface and sub-surface) and other restrictive conditions.
- 2) Research of community situation and conditions: Restricting conditions such as typical jobs held by community people, building-&-borderline distances, types of building use, and other factors that must be considered in preventing/avoiding potential human social troubles.

Also, consideration must cover community customs and events for public relations possibilities.

- 3) Research of legal conditions: Laws and other government regulations and related policy guidance affecting the construction projects must be analyzed.
- 4) Research of ground conditions: Seismological and other ground characteristics and conditions and local restraints so as to prevent landslides, loosening earth, and other natural accidents.
- 5) Research of climatic conditions: Tendencies of rains, snows and temperature characteristics must be checked with the local weather bureaus, scientific statistics and those community people who are well versed in such conditions. Special emphasis is necessary on obtaining data of winds so that possible wind hazards can be reduced and/or eliminated.

#### Review of drawings and determining required conditions for planning

There should be no inconsistencies among all design documents such as building designs and sketches, structural drawings and equipment layouts since these data should serve as the basic guides for the construction work.

Also, the drawings should help the planners in determining work requirements, related drawings must be analyzed so as to select areas of importance where specific requirements can be pin-pointed in the same format as used in Table 1.

#### Review of design specs to determine required conditions for planning

As in the case of 1-4-2 above, design specifications (both "general" and "particular" specs), on-site orientation records and question-&-answer sheets for the planned projects should determine specific requirements for construction work.

By determining such requirements, related spec documents must be analyzed so as to select areas of importance where specific requirements can be pin-pointed.

#### Review of structural calculation records to determine required planning conditions

Conditions for work planning can be determined by the structural calculation data. By determining such requirements, related data must be analyzed so as to select areas of importance where specific requirements can be pin-pointed.

#### Review of the documents of construction contracts to determine required planning conditions

The traditional practice in construction work planning has been largely based on (1) the contracted monetary value, within which pertinent target costs of work were determined and the related work methods planned to meet such targets; (2) the contracted schedule of construction work, within which target dates for all work projects were scheduled and the work methods planned to meet such targets.

#### STEP 2: Selection of conditions for construction work planning

##### Sub-step 2-1: Evaluation of collected information to select applicable conditions for construction work planning

Not all of the data collected in Step 1 may be usable as objective data for the work planning. Thus, such data must first be analyzed so as to determine which elements of the data can be taken as necessary conditions. What is considered unnecessary can be eliminated and anything that is thought to be missing can be added at this stage.

Thus, the author selected five factors for the evaluation of the collected data, that is, quality, precision, work schedule, economy and safety. Using these factors, specific needs for evaluation can be detected by appropriately posting circle-marks in the columns of these five factors, as shown in Table 2.

##### Sub-step 2-2: Use of VE worksheet for construction work planning

Analysis of the conventional planning practice for various construction projects indicates that there are frequent repetitions and/or similarities. Therefore, the author computerized the data of such repetitions and similarities so as to develop a "data-base" designed for their effective and wider uses. Given below are descriptions of the aspects of the data-base as partially shown in Table 3.

The "Basic" column: Functions of construction work planning can be defined by clarifying a number of required conditions. For that purpose, the project under VE study must be divided into individual work-items so that each item can be expressed as a "verb-&-noun" function. By reviewing and selecting such functional definitions, functions which are essential to be accomplished can be identified.

In this process of analysis, each work-item, as divided, should be expressed as a "basic or primary function" as known in VE application. Then, all necessary conditions, including those of related sub-items, must be identified, resulting in functional definitions for review and selection of essential functions. The black circle, marked in the column, is to show where the primary function is to be found.

Now, the process is to evaluate these functions as to how they should be linked with each other in the relationship between work-items and the entire construction project. The evaluation should result in determining priorities of planning. Selection of work methods for effectively accomplishing the selected functions should be done according to or in the order of the established priorities.

The "Conditions for construction work planning" column: The result of evaluation on Table 2 enables you to list up all necessary conditions for construction work planning, as indicated by A, B, C ... in Table 3.

The "Primary/secondary functions" column - Determination of primary & secondary functions: By dividing the entire construction projects into specific work-items, each item would usually represent one primary function, or often, more than one. Some thinking is needed in this step so that each function can be defined as a combination of a verb-phrase expressing a concept of needed action and a noun phrase suggesting the planning image of the work-item.

With a primary function established on this table, all the planning conditions required by all work-items in terms of their functions must be further analyzed so as to specify their respective purposes and roles to perform.

Since this procedure should clearly explain how the specified work-items can be done, method-wise, the functional definitions here should be very specific, for instance, "determine the method of pile-building," "adjust diameters of piles," etc.

It should be noted that the task of discovering any "missing" conditions for work planning can be made more easily and logically through this process where all necessary functions have been screened and organized for evaluation.

The "VE ideas & hints for improvement" column: Here, the team will brainstorm ideas of better accomplishing each of the determined functions. The order of picking the function follows the priorities as set forth in column 7 of Table 3. The specific VE case examples being dealt here should best be illustrated as visible sketches and/or photos. The resultant data of VE cases can now be maintained as "data bases" classified under such categories as "building uses," "structures" and "scale dimensions."

The "Construction work costs" column: The cost of each work-item must be calculated from the total monetary value of the basic construction contract. Also, expenses required by the necessary planning conditions should be prorated.

The "Target costs" column: In order to enable the company to secure a reasonable amount of profit, target costs are established by reviewing the cost of each work-item, based on the monetary value

of the basic construction contract, and such targets are to be fulfilled during the process of construction work management.

The "VE priorities" column: Functional areas where the value of the work item cost against its target cost is low, and where the potential balance between the work-item cost and its target cost is large for a long working period reflect highly cost-saving potential. Thus, such functional areas must be prioritized in planning construction work.

When the process of idea creation is completed, the collected ideas altogether must be visually specified in the form of rough sketches.

From Step 3 of Table 1 and on, the standard VE Job Plan steps are to be followed in charting out specific planning activities. At Step 10, "detail evaluation," all sketches of work-planning are compared with each other and evaluated based on the data of their techno-economic evaluation.

Thus, plans indicating the highest priorities in the techno-economic evaluation should represent plans of highest values. However, the result of evaluation may not always be of the highest evaluation of both technical and economic conditions. If that is the case, decisions may have to be mainly based on the technical side of conditions, considering a balanced execution of the entire construction project and the contracted scheduling conditions. Figure 2 is a case of the proposed VE application.

## CONCLUSION

I believe that the proposed application of VE Job Plan and functional definition to the planning phase of the construction work-planning procedure could satisfy owner's requirements as well as to realize easier management of construction work in terms of product quality and precision, costs and safety.

My approach, based on the accepted VE methodologies, will prevent waste of time and cost of poor planning resulting in unnecessary "post construction" repairs and make-overs which should have been predicted in the planning National VE Conference. Thus, better planning should benefit not only owners and contractors but also building groups and the company as well. This process has been implemented in Fujita and is proving highly beneficial.

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