

Providing a Model for Reducing the Time of Construction Phases

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ABSTRACT

In construction projects, each type of delay in implementation and lack of exploitation of them is the precise instance of wasting the resources. The most important resource which is wasted in this regard is the element of time which is the most valuable capital of nations in today's fast-paced world. Sometimes, the profit resulting from early completion of the project may tempt the employers and project owners to reduce the time of project. Some other times, macro policies may urge a project to be exploited earlier than its due date. After introducing the time reduction techniques briefly in this paper, the challenges of these techniques were specified through interviewing with the experts. Then three criteria were selected to investigate the techniques. Using the results of the questionnaire, the impact of these techniques on the criteria was then dealt with in different phases of the project in Design and Build contracts.

Key words: Reducing the Time, Increasing the Resources, Concurrent Engineering, Value Engineering, Analyzing the Demands of Employers.

INTRODUCTION

The need for reducing the time of project is observed in the majority of construction projects. This need is caused by the following factors²

Acceleration

The need for acceleration is one of the reasons that time reduction techniques are used in projects. The reasons of acceleration can sometimes be economic. It means that the profits made by exploiting the project may be more than the expenses required for acceleration; therefore, it would be required to accelerate the project. However, other reasons may pertain to politics, military and national interests.

Delay Compensation

Each project may have delays in implementation. Time reduction techniques are used to compensate these techniques and to be back on the original schedule of the project.

Since reducing the time is an essential matter for construction projects, extensive investigations have been conducted on this field in order to create different time reduction techniques. Each of these techniques influences other aspects of the projects such as expenses, as well as the time. Therefore, these aspects should be considered while using such techniques¹.

Using the previous researches, studying the available sources and interviewing with the experts,

four techniques were investigated as the main techniques for reducing the times of projects in this paper. Before introducing the techniques, it should be pointed out that correct project management is considered as a precondition of applying time reduction techniques. Each project requires accuracy and correctness in work; therefore, it is totally essential to follow some principles so that delay would be prevented in each project. Some references stated these principles as time reduction techniques, whereas such techniques should be used in cases in which the project implementation is based on principles. For instance, a project which mismanaged would obviously have some delays resulting from malfunctioning of management. If the management is changed, the project will be naturally progressed well and timing will be improved. However, time reduction cannot be considered as a technique because following the correct management is among the necessary conditions in a project.

The techniques investigated in this paper are as follows:

The techniques which influence the critical path

Time crashing Technique

A common method for reducing the time of projects is to increase the resources which compress and reduce the tasks. Reducing the time through increasing the resources is named crashing [1]. Increasing the resources would have lesser complexities and more certainty in comparison with other methods. Although it may increase the expenses considerably, it has lesser risks which are known. It is one of the most common methods which are used to decrease the time. The resource-increasing technique is actually the same as time-cost trade off^{2,3}.

Concurrent Engineering Technique

Concurrency means that two or more events happen at the same time, a synonym of parallelism. It is a term which is used in performing the tasks or stages of a project in planning and controlling a project². Two tasks are concurrent when all or some of them occur at the same time. Moreover, the parts of the two tasks which are performed simultaneously are called overlapped. Different levels of projects can be done concurrently. This concurrency can be

done among the tasks of a project and also among the working packages and stages of a project^{1,3}.

The techniques which influence the nature of tasks

Value Engineering

Value engineering technique would try to reduce the time and maintain the quality of project through innovation and new ideas. Normally, this technique is exercised at the beginning of the project by the value engineering team which investigates different solutions and hold meetings for brainstorming¹.

Employer's Demands Analysis

Employer's Demands Analysis should be done on the nature of tasks and problems influencing the objective of analysis (reducing the project time). If employer's demands and requirements which are the design principles of project change or decrease properly, the time and cost of project will decrease. The sooner the demands change occur in the project, the higher efficiency and the lower cost it will bring¹. The greatest impact on time-reduction of the project occurs when unnecessary functionalities can be deleted from the project in the stages of conceptual and basic design¹.

The Impacts of Techniques in Different Phases of Project

Conducting studies, investigations, and interviews with the experts, several challenges were obtained for time reduction techniques (Table 1). Investigating these challenges and interviewing with the experts in this field, some of the challenges were then combined with each other, and some were deleted due to similarity or unimportance. Finally, three main criteria were selected out of the challenges. They were time reduction, risk increase and cost rise, respectively. After extracting the criteria through interviewing and filling out the tables, the comments of the experts were questioned on the impact of techniques on the criteria in different phases of the project. The statistical population included 28 individuals of university teachers and also the industry experts working on the subject of time reduction techniques.

Given the results of the questionnaire, the impact of techniques on the criteria in different

phases of the project is shown in Table 2 and Figures 1-3. It should be noted that the x axis of the charts indicates the phase of conceptual design in Number 1, the phase of detailed design in Number 2, and construction phase in Number 3.

According to the results obtained in the subject of the impact on time reduction, two techniques of increasing the resources and concurrent engineering had the greatest impact on the construction phase, whereas two techniques of value engineering and employer's demands analysis had the greatest impact on the phases of conceptual and detailed design. This difference can be sought in the classification of these techniques. The first two techniques had the greatest impact on the critical path; therefore, they influenced the construction

phase. Two other techniques influenced the nature of tasks which had impacts on the phase of conceptual construction.

Given the results obtained in the subject of the impact on risk and cost increase, the more the project progresses, the more these two criteria increase in all techniques. It means that the more the project advances toward completion, the more the risk and cost of creating the changes increase. However, it should be noted that the risk and cost of increasing the resources and concurrent engineering should be inevitably borne in order to reduce the time more. Not only do the risk and cost increase for the techniques of value engineering and employer's demand analysis as the project progresses, but also the potential of time reduction decreases.

Table 1: Risk of techniques

Increased direct costs not included
Failure to reduce indirect costs
Loss of efficiency and productivity
Work interference
Increased risk of people's life
Degradation
Lack of resources
Time increased
Rework
No optimization
Non-cooperation
Disputes and claims
Failure to accept changes
Failure to achieve project goals.
No team for Value Engineering

RESULTS AND CONCLUSION

According to the points mentioned in this paper and considering the contract of Design and Build as a method of proper implementation to apply the time-reduction techniques, the optimal way of using the techniques in different phases is as follows:

Conceptual Design Phase

In this phase, it would be better to use value engineering technique. Therefore, the value engineering team comes into action to design and advance the project through creativity and new ideas so that it helps the strategies of achieving the project objectives.

Table 2: The Impacts of Techniques in Different Phases of Project

		Concurrent Engineering	Time Crashing	Value Engineering	Employer's Demands Analysis
Time Reduction	conceptual design	9.73	4.83	38.53	33.54
	detailed design	35.67	15.23	36.89	38.74
	construction	54.6	79.94	24.58	27.72
Risk Increase	conceptual design	11.45	4.27	18.76	8.65
	detailed design	37.18	14.74	22.34	22.37
	construction	51.37	80.99	58.9	68.98
Cost Rise	conceptual design	8.96	2.02	21.46	12.07
	detailed design	12.18	3.96	27.38	15.82
	construction	23.75	94.02	51.16	72.11

However, the value engineering team can apply employer's demand analysis, too. Analyzing the employer's demands and having different meetings

with the employer, it can change or delete some demands which are contradictory to the objectives of the project so that an optimal and definite framework is defined.

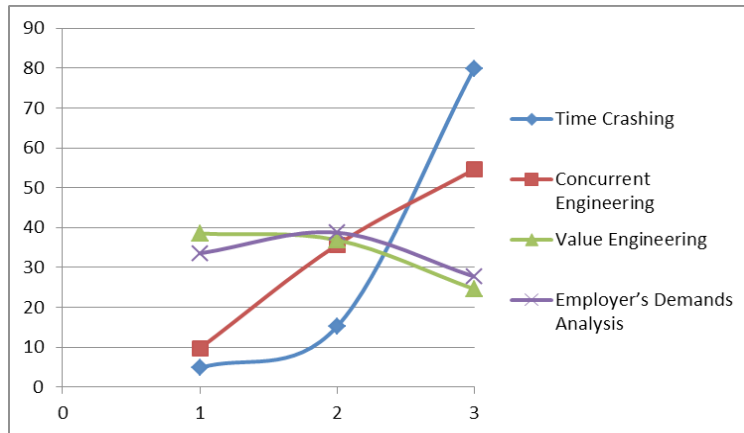


Fig. 1: The Impacts of Techniques on Time Criteria

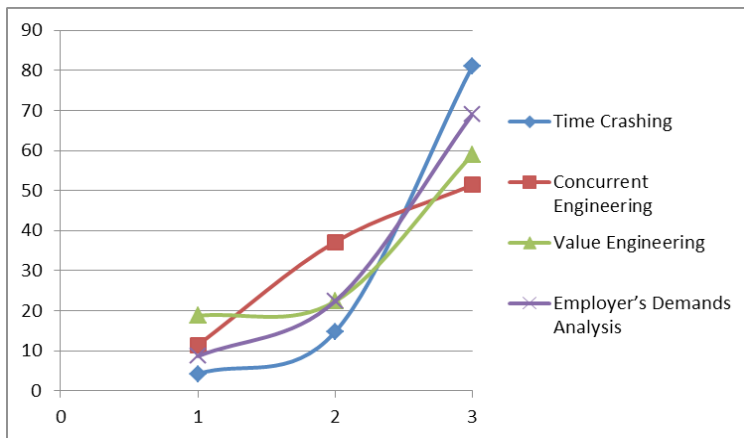


Fig. 2: The Impacts of Techniques on Risk Criteria

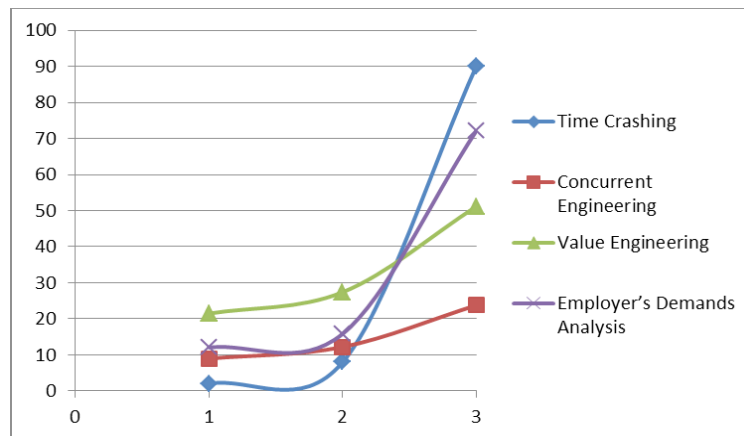


Fig. 3: The Impacts of Techniques on Cost Criteria

Detailed Design Phase

In this phase, the value engineering team continues to keep up with the project to update the information and apply predetermined changes.

Time crashing technique can come into action in this phase. Therefore, it reduces the project time through increasing the resources in three ways (increasing the hours of one shift, increasing

the number of shifts, and increasing the forces). Concurrent engineering technique can also have good impacts on time reduction in this phase. Using this technique according to the type of dependencies, it is tried to make the tasks concurrent. The Fast Track technique which is a subcategory of concurrent engineering technique should also start from this phase so that the design phase and construction phase overlap with each other through overlapping the tasks.

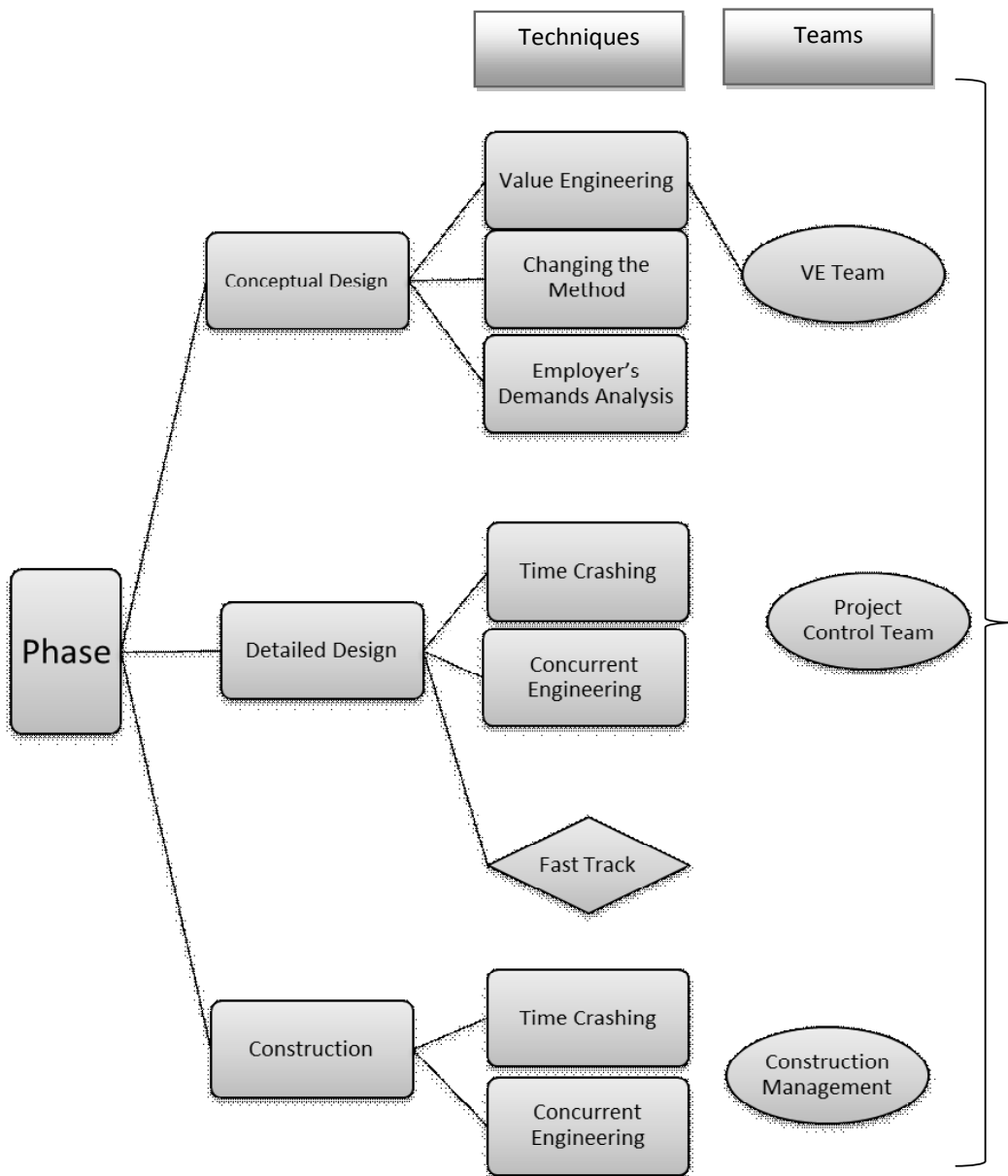


Fig. 4: Approach to the use of techniques in DB contracts

For instance, instead of the case in which one individual performs all the tasks to design a steel structure, one individual is responsible for modeling the structure, another one is responsible for designing the foundation, someone is responsible for designing the connections, and two individuals are responsible for drawing the maps. Here, two techniques of time crashing and concurrent engineering are used. It means that two planners are used instead of one so that the planning time decreases through the time crashing technique. Moreover, concurrent engineering is used through dividing one task into several tasks and overlapping them. Now if it is asked to use the fast track, too, the data can be given to the designer of the foundation so that it is done faster through initial modeling and before the complete design of the structure and connections is performed. Therefore, the implementation team can execute the foundation at the same time as designing the structure. Here, the role of management is of high importance. The management should have the necessary control over the objectives and procedure of the project to meet the following needs:

- Strong Relationships between the Factors
- Speeding up the Data Transfer

- Strong Management of Changes and Rapid Creation of Reworkings
- Risk Taking
- Management of Conflicts Caused by the Risks and Delays

Implementation Phase

In this phase, the value engineering team continues to keep up with the project to announce and monitor the predetermined changes. However, the responsibility of construction management team becomes sensitive in this case because the construction stage has more importance than the rewordings and interventions. Generally, the risks have more impact on time and cost increase.

In this phase, two techniques of concurrent engineering and time crashing can have proper impacts on the time reduction of the project. Accordingly, the activities on the critical path are investigated. Given the two criteria of cost and risk, the most optimal technique is selected. This optimal selection may be a combination of the two techniques of concurrent engineering and time crashing. The explanations which are indicated as a model are presented in Figure 4.

REFERENCES

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