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Modelling the Boundaries of Fast-tracking in Construction by using Stochastic Model

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ABSTRACT

Fast-tracking a project involves carrying out sequential activities in parallel, partially overriding their original order of precedence, to reduce the overall project duration. In this paper, the regular work schedule of residential post construction work details comparing with fast-tracking method is proposed. Relevant findings highlight the existence of a pseudo-physical barrier that suggests that the possibility of shortening a schedule by more than a quarter of its original duration is highly unlikely. The explicit non-linear relationship between cost and overlap has also been quantified for the first time. Finally, manual calculations using the new model are compared with results from a Genetic Algorithm through a case study.

Keywords: *Fast-tracking; scheduling; schedule compression; activity overlap*

I. INTRODUCTION

Fast-tracking involves performing activities, initially viewed as sequential, in parallel by overlapping their execution. It is considered to be one of the three most common schedule compression or acceleration techniques, along with activity "cost" and activity "duration". However unlike activity crashing and substitution, which generally increase project costs directly, activity overlapping is thought to increase project due to an increase in the potential for change and rework which can lead to increased costs and duration. Fast-track projects are those in which construction begins before all of the architect's drawing and specification are complete.

First, calculating the project completion time through PERT method is stated in this survey. Then computerized discrete event simulation method is presented. Finally, the two methods are compared with each other by solving a numerical example.

II. STRATEGIES OF FAST-TRACK CONSTRUCTION

It is used to achieve shorter project duration. Different types of strategies are affecting the fast-track construction. The strategies of fast-track in construction is followed by,

- Delay management
- Resource management
- Choice of technology

Delay Management

In construction, delay could be defined as the time overruns either beyond completion date specified in a contract, or beyond the date that the

parties agreed upon fir delivery of a project. It is a project slipping over its planned schedule and is considered as common problem in construction projects. They may be complex, demanding high level of co-ordination of permission, people, goods, plant and materials and construction can begin despite many uncertainties, and as a consequence, delays are common.

Resource Management

Construction companies face the challenges of delivering often complex projects to a schedule, within a budget and hopefully with a reasonable profit margin. Resource management is the process of planning the necessary to meet the objectives of the project and to satisfy the client's requirements. Without paper resource management, projects can fall behind schedule, or can become unprofitable. The objective is to ensure the adequate and timely supply of resources, whilst at the same time maximizing the utilization of resources between projects.

The basic resources for a project are follows

- Human resources
- Money
- Machine
- Material

Choice of Technology

An in the development of appropriate alternative for facility design, choices of appropriate technology and methods for construction are often ill-structured yet critical ingredients in the success of the project.

Advantages of using latest technology for the work are follows,

- Faster construction time.
- Saving in materials.
- Building can be more flexible and easy in installation.
- Maximum utilization of resources.

III. Scope and Objective

The objective of this paper to study the different literature about fast-tracking in construction and identify the importance of fast-tracking in construction.

The scope of the paper includes

- To study the design, engineering and implementation complexity, knowledge and experience of owner project group, quality requirement and the cost of packages.
- To study the application of fast-tracking method to reduce the duration of the construction project.

IV. Literature Review

Literature survey aimed to identify the importance of fast-tracking in construction.

1. Thomas A. Roemer (2001), "Time-Cost Trade-offs in overlapped product development"

This paper presents the traditionally, design has followed a sequential pattern where information about the product was slowly accumulated in consecutive stages. A stage commenced only when the preceding stage had terminated and had supplied complete and final information. Overlapping product design differs from the sequential approach in that it allows downstream design stages to start before preceding upstream stages have finalized their specifications. Time-cost trade-offs are extensively discussed in the project scheduling literature where activities can be shortened at additional costs. Because both crashing of activities and overlapping aim at reducing completion times, they can be considered alternatives or complements to each other. However, the underlying mechanisms are quite distinct because the durations of individual activities actually increase through overlapping, while the lead time decreases as a result of working concurrently on different activities.

2. Moonseo Park (2005),"Dynamic Change Management for Fast-tracking Construction Projects"

This article presents the project is fast-tracked without proper planning, those change iterations can cause the disruption of the construction process. For this reason, to effectively handle fast-tracking change iterations involved in fast-tracking need to be identified, and the dynamic behavior of construction resulting from those change iterations must be dealt with in a systematic manner. In addition, a case study of highway and bridge construction projects shows the potential of how fast-tracking construction can benefit from dynamic change management in real world settings. Construction involves a lot of non value adding change iterations due to its structural problems, in particular when construction is performed concurrently.

3. K.B. Kasim (2005)," Improving materials management practices on fast-track construction projects"

The paper presents the many factors can cause delays on such projects. If the main reasons for project delays on housing projects in Thailand were incomplete drawings, material management problems, deficiencies in organization, shortages of

construction materials, and inefficiencies in site workers. They also suggested that delays in materials supply was a major cause of time overrun. Thus, it would seem that materials delays are a major cause of delays in projects. This paper reviews current materials management practices on fast-track projects and explores the Information and Communications Technology (ICT) tools and techniques implemented. Faster construction can be achieved through the preparation of appropriate designs and the selection of the right methods and material. For instance, the fast-track design/build delivery method can significantly reduce total project time-up to 50%, depending on the job.

4. Valentin,Vanessa (2001), "A Synthesis of Fast-Track Highway Construction Delivery in the U.S. "

This paper presents the Highway construction projects in the past were procured by way of qualifications-based submissions design and competitive low-bidding construction. Unfortunately, this division limits innovations, results in increased cost and time growth, and promotes hostility between owner, design and construction personnel. The transition from the traditional Design-Bid-Build process to the more fast-tracked methods of Design-Build and Construction-Manager-as-General-Contractor has been a steady one. The decreased time and cost growth associated with both of these delivery methods has garnered popularity among transportation agencies that are progressively in search of ways to increase innovation and teamwork.

5. Refaat H. Abd El Razek (2010),"Time-Cost-Quality Trade-off Software by using Simplified Genetic Algorithm for Typical repetitive Construction Projects"

Time-Cost Optimization "TCO" is one of the greatest challenges in construction project planning and control, since the optimization of either time or cost, would usually be at the expense of the other. Since there is a hidden trade-off relationship between project and cost, it might be difficult to predict whether the total cost would increase or decrease as a result of the schedule compression. It was declared the three classic design and construction objectives are quality, cost, and time for project construction. It was developed to facilitate the optimization of resource utilization in typical construction projects in order to simultaneously minimize project cost and duration while maximizing its quality.

6. A. A. Alhomadi (2011),"The Predictability of Fast-Track Projects"

This article presents the Fast-Tracking to accelerate, overlap or compress schedules has an impact on project predictability in terms of achieving the planned objectives (time, cost, and quality). As stated earlier, the predictability of the fast-track projects can be measured by the ability to achieve the project's planned objectives. Cost variance, time variance and quality variance are used to evaluate the predictability as indices by comparing the completion against the project's original objectives. In this section research addressing such indices is presented. This paper investigated the relationship between fast-tracking and predictability through an extensive literature review. It revealed that schedule compression, accelerating or overlapping has an impact on projects in terms of achieving the original objectives and sometimes may lead to unexpected outcomes. However, a fast-track project's original objectives can be successfully achieved by avoiding unrealistic goals.

7. P. Fazio (2001),"Fast-tracking of construction projects: a case study"

This paper presents the objectives, phased construction and fast-tracking management techniques have been developed as part of the professional construction management (PCM) approach. The PCM unites a three-party team consisting of owner, designer, and construction manager in a non adversary relationship, and it provides the owner with an opportunity to participate fully in the construction process. This paper establishes the differences between the fast-tracking technique and the phased construction approach. It further illustrates, through a project study, the impact of compressing and overlapping design activities in a fast-track program in order to expedite project delivery. The management decision to recuperate the initial 5 months of vendor delays by accelerating both design and construction activities, awarding work packages on incomplete design, and demanding extensive trade overlaps gave rise to a totally opposing result; i.e., the project was further delayed.

8. M. Moazzami (2011),"Contractual Risks in Fast-Track Projects"

This article presents the Fast-tracking strategies are used to achieve shorter project duration; however, these strategies may negatively impact project performance by imposing additional risks, uncertainties, and costs. Rework, change orders and site modifications are almost inevitable in

fast-tracked projects. The results of this investigation will help to develop effective contract documents and strategies fit for fast-tracking. The identified legal risk were inaccurate cost estimating and cost overrun risk liability, liability for design errors and omissions, delay damages, change orders, construction rework and modifications, as well as risk liability for overlooked work. In addition, the contractual aspects of the fast-track projects have been reviewed at three levels: contract language; contract type; and project delivery method.

9. Y Khoueiry (2013),"An optimization-based model for maximizing the benefits of fast-track construction activities"

This paper presents the method is, while relatively risk-free, cannot necessarily meet the obligation of sharp deadlines. Fast tracking, through the overlapping of activities, is a replacement to the sequential approach and has been adopted. A practical example of rework is in residential building projects, where end users tend to modify the interior design of their apartments to suit their expectations and needs, which are often different from the engineer's specifications. The model, in its current form, requires data from multiple sources. These include activity durations that are pulled from the project baseline schedule, and progress data that are solicited from field personnel.

10. Kyuman Cho (2013),"Time and Cost–Optimized Decision Support Model for Fast-Track Projects"

This paper presents the scheduling and cost estimating module were developed based on the concept and methodology of the fast-track construction method. Then, the optimization module, which aims to analyze the trade-off relationship between project duration and cost. Once the position of the work packages through the previous two steps has been established. It is develop a computer-based application adopting several decision criteria for convenient usage, and high levels of engineering and construction management skill are required for the successful implementation of a fast-track project in its engineering and construction phase

11. Ahmad Jafarnejad (2013),"Calculation of Project Scheduling in Stochastic Networks"

This paper is presents to calculate the completion time of various network paths according to which project completion time could be calculated. Critical Path Method (CPM) is used to determine project completion time if the time to conduct activities is definite. But if time of conducting activities is probable, Program Evaluation and Review Technique (PERT) method must be used and if occurring activities is possible. First, calculating the project completion time through PERT method is stated in this survey. Then computerized discrete event simulation method is presented. Finally, the two methods are compared with each other by solving a numerical example. Comparing the results of the numerical example under study indicates responses of both methods are close to each other. Of course the time for each path could be stated as interval estimation given that average and variance of each path are determined.

12.Vignesh.K (2016),"A Study on the Existing Networking Systems Followed in Construction Project and Evaluating a Module for Implementing Fast Track System for Adoption"

This paper presents the one of the most challenging jobs that any managers can take on is the management of large-scale projects that requires coordinating numerous activities throughout the organization. A particular activity of a project cannot be started until all its immediate preceding activities are completed. There are various advantages using CPM are valid management tools 17%,dispute resolution 50%, contract requirement 33%,improves communication among parties 50%. Delays in final completion can result in an erosion of profits, or even losses. As discussed previously, there are numerous ways to compress the time needed for project execution and completion. Efforts on the part of all parties involved throughout each phase of the construction process were presented.

13.S.KALIRAJAN (2016),"Fast Track Construction – The Need Of The Hour"

This paper presents the traditional construction methods have proved to be ineffective in achieving this goal. Use of Pre-Engineered Structures, decking concrete (left-in shutter) would help a lot in fast track construction though the use of steel would be more in these options. Fast track construction is usually defined as the overlapping of functions and development stages to reduce the amount of time needed to complete a Project. Paradoxically, while the decision to fast track a project is nearly always an economic one, the final costs are generally unknown during the process. For commercial owners, the potential for profit is worth the risk; whereas, for many not for-profit and government owners it is essential to know the total cost going in, so that they do not pay too much for any one item.

14. Fang Fu (2016),"A New Model for Solving Time-Cost-Quality Trade-Off Problems in Construction"

This paper presents the construct a new non-linear programming model based on the classic multi-mode resource constrained project scheduling problem considering repair works. The time-cost-quality trade-off problem has received increasing attention recently due to the significance of quality. Objective functions are often involved with project quality, which is expressed as the average or minimum activity quality. A binary normal distribution function is adopted and evaluated to describe activity quality under the assumption that the activity duration is dependent of its direct cost. The non-independent relationship is presented by the multiple modes of each activity.

15. Jannu Saibabu (2017),"Reliability of implementing primavera p6 in fast-track planning of residential building"

This article presents the fast-track planning is to set the major milestones. What's more, the line directors trust that they can meet them. On the off chance that the line director can't confer in light of the fact that the breakthroughs are seen as farfetched, the task administrator may need to create choices, one of which might be to move the points of reference. Planning of resources in primavera p6 can be done by using resource calendar and scheduling activity; specifically, labour, non-labour, and material. Proper planning of resources are important key to success of project. Arranging engineer has a standout amongst the most critical parts in development ventures. Arranging specialists are in charge of guaranteeing that the venture will be finished according to venture administration arrangement due dates.

V. CONCLUSION

This paper presents a model of project fast-tracking. The way this model is stated has several advantages, namely it can be using for explicitly estimating the costs due to activity overlaps and it reduces the subjectivity of the input information comparing the previous models. The findings of the analysis indicate that on average, it is very difficult for any schedule to be fast-tracked with shortening in excess of 25% of the original project duration. A number of factors that might prevent this maximum compression threshold from being achieved have also been discussed with data's.

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