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Time, Cost and Quality Predictability in Fast-Track Projects

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Abstract: Fast-Tracking, overlapping and compressing schedules have an impact on project predictability in terms of achieving the planned objectives (time, cost, and quality). Predictability plays an important role in project success; however, no research directly addressed the relationship between fast-tracking and predictability of the project objectives. This paper investigates the relationship between fast-tracking and predictability with regard to success in meeting the project's planned objectives. A significant finding of the study is that fast-tracking can lead to less predictability for the project's outcomes. In addition, the paper gathers and prioritizes effective suggestions to improve predictability. Questionnaires were the main research instrument in this study. 12 suggestions were selected as the most effective practices for improving the predictability of fast-track projects.

1 Introduction

Today, fast tracking as a project delivery system has been widely implemented in several industries. Predictability of fast-track projects plays a significant role in their success. The predictability can be measured with regard to success in meeting the project's essential objectives (cost, time and quality). Many studies have investigated the fast-track projects with focusing on each one of these objectives separately while not directly addressing the relationship between fast tracking and predictability. The lack of research creates a need for more investigation in this area.

The research will investigate the relationship between fast tracking and predictability with respect to meeting project objectives (cost, schedule, and quality). Fast-tracking and predictability principles will be explained. Suggestions to increase predictability of fast-track projects will be presented.

The research methodology consists of a questionnaire analysis. The questionnaire's objectives are 1) to evaluate the predictability indices (cost variance, time variance and quality variance) of fast-track projects in comparison to conventional projects, and 2) to gather and prioritize effective suggestions to improve the predictability of fast-track projects.

2 Background

A simple definition of fast tracking is the process of overlapping sequential activities or phases in parallel to compress the project schedule (PMI 2008). The Fast-Track Manual's (Eastham 2002) broad definition considers fast-tracking as the "reduction of the schedule to the minimum practicable is the principal

driving force for one or more stages of the project". Despite the different definitions, fast-track projects are similar to conventional projects in terms of predictability importance to success. In order to consider a fast track project as a successful project, the project needs to be predictable.

Project predictability, in general, can be measured by the success in meeting the project's essential objectives (Henry et al. 2007, and Alhomadi et. al 2011). In other words, the objectives are employed as indices of predictability to show how near to or far from to the project completion of the planned objectives. These objectives are represented in the iron triangle (cost, time and quality) (Atkinson 1999). The more work done earlier on meeting the project's planned objectives, the more predictable the project is. UK government in 1999 selected time predictability and cost predictability in addition to other measurements (quality, client satisfaction, change orders, business performance, and health and safety) as National Construction Industry Key Performance Indicators (KPIs) (DOE 2000). UK government defined predictability generally as the number of projects completed on time and within budget. In detail, the study expressed time predictability as a measure of how closely the project was delivered to the original schedule, and cost predictability expressed as a measure of how well outturn costs compared with original budget. Martin (2003) added that cost and time overruns are as bad as underruns for predictability. Both reflect variations of predictability for construction economists. In addition, Martin indicated that the specific definition of predictability would be completing the project on target or better or on target or lower. This means achieving the project planned budget or schedule within 5% plus or minus, for example. The existence of cost variances; schedule variances, changes, reworks, defects and deviations are indices of how predictable a project is (Alhomadi et. al 2011).

3 Questionnaire

The questionnaire's objectives were 1) to evaluate the predictability indices (cost, time, and quality variance) of fast-track projects in comparison to conventional projects, and 2) to gather and prioritize effective suggestions to improve the predictability of fast-track projects.

The questionnaire was conducted into two phases. Due to the ability of an electronic survey to collect a large number of responses with ease, time savings, little effort and low cost, an electronic web based questionnaire was created to collect data. The large number of sample responses (62 respondents) increased the sample results quality. The questionnaire in the first phase was designed to 1) collect respondent's demographic information including years of experience, area of expertise, and type of organization; 2) evaluate predictability indices (time, cost, and quality variance); and 3) find suggestions to improve fast-track projects predictability. Respondents' areas of expertise include 15 different specialties such as project managers, project engineers, construction managers, planners/schedulers, and cost estimators. The respondents' range of experience varies from 5 to 35 years with an average of 13 years. A variety of organizations were surveyed: 1) owner organization, 2) consultants, 3) engineering procurement construction (EPC) contractors, 4) educational organizations, and 5) developers.

The predictability of each fast-track project objective was evaluated in comparison to conventional project objectives using the "Likert" scale which is a bipolar (balanced between negative and positive) psychometrics scale used in questionnaires to measure the participants' knowledge and attitude toward a specific object (Rossi et al. 1983). Each objective had a scale consisting of seven categories or points. The categories were equally divided by balancing between negative and positive (see Table 1).

Table 1: Predictability evaluation scales categories.

	Extremely "Less Predictable"	Somewhat "Less Predictable"	Slightly "Less Predictable"	The Same	Slightly "More Predictable"	Somewhat "More Predictable"	Extremely "More Predictable"
Cost							
Time							
Quality							

To complete the above scale, the respondents were asked: "Based on your experience, please score each one of the following objectives according to their predictability in fast-track projects in comparison to conventional projects". To identify suggestions, an open-ended question asked the respondents to suggest the three most effective items in relation to cost, time, and quality that could increase the predictability of fast-track projects.

The second phase of the questionnaire, as in the first phase, collected demographic data and evaluated predictability indices as explained earlier. However, a significant change in the second phase was a revision of the open-ended question. The revised question included a list of twenty suggestions and respondents were asked to select the five most effective suggestions based on their experience. The suggestions were generated from the first phase survey and the literature review. Initially 41 suggestions were identified and then the list was reduced from 41 to 20 suggestions by confirming them with the literature, merging similar suggestions, and eliminating irrelevant suggestions. In the second phase questionnaire, the respondents also were given the chance to suggest extra items. Respondents made other suggestions but only one was considered.

4 Results and Discussion

This section presents and discusses the results of the analysis of 62 survey responses. The surveys results are summarized into two areas: 1) project predictability indices evaluation; and 2) most effective suggestions to improve fast tracking predictability in term of cost, time, and quality.

4.1 Predictability Indices

Predictability has been evaluated according to Likert scale for cost, time and quality as explained in Section 4. To evaluate the respondents' opinions about the predictability of cost, time and quality of fast-track projects compared to conventional projects, the mean and the sample standard deviation were used.

According to the central theorem limit a reasonable sample size is n≥30. This tends to create a normal distribution (Rossi et al. 1983). There were 62 responses for the predictability ranking scales. The mean and the sample standard deviation were calculated based on the normal distribution assumption to quantify the sample data. The mean is important to reflect the center of the tendency (the centre of a

distribution) of each scale response by calculating the arithmetic average (arithmetic mean). Standard deviation is also another important indicator of the response variation around the mean, which is calculated by the square root of the variances from the mean. A high value for the standard deviation means more variation or disagreement about the average value while a small value means more agreement between the respondents on the mean value. To calculate the values of the mean and standard deviation, each index has a scale consisting of seven categories or points. The categories were previously quantified to weighted values. Categories weights were assigned equally to differentiate clearly between the categories as follows:

- Extremely “Less Predictable”= -3
- Somewhat “Less Predictable”= -2
- Slightly “Less Predictable”= -1
- The Same = 0
- Slightly ”More Predictable”= 1
- Somewhat ”More Predictable”= 2
- Extremely ”More Predictable”= 3

The equations used to calculate the mean (see Eq. 1) and standard deviation (see Eq. 2) values are explained below:

The mean (Arithmetic Average)

$$\bar{x} = \frac{1}{n} \cdot \sum_{i=1}^{n} x_i \quad [1]$$

Where:

$\bar{x}$= arithmetic mean

n= number of observations in a sample

x_i= response value

The sample standard deviation

$$s = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (x_i - \overline{x})^2}, \quad [2]$$

Where:

s=the sample standard deviation

xi= { x1,……xn} the sample variables

$\bar{x}$= arithmetic mean

(n-1)=sample correction for standard deviation biasness to be an unbiased estimator, which is used to reduce the errors and build a more accurate estimate with less variance between the estimated value and the real value (Montgomery et. al 2007).

The cost predictability scale center of tendency was assessed based on the arithmetic average (the mean, equation 1). The mean ($\bar{x}$) value of cost predictability scale is (-0.370) which locates between the two categories ("The Same" = 0 and "Slightly Less Predictable"= -1). The mean value reflects that the cost predictability in fast track projects is almost the same as conventional projects. The high standard deviation value (1.90) indicates a relatively large variation between respondents' opinions about cost predictability around the average value (see Figure 1). This may be due to different understandings, practices and experiences.

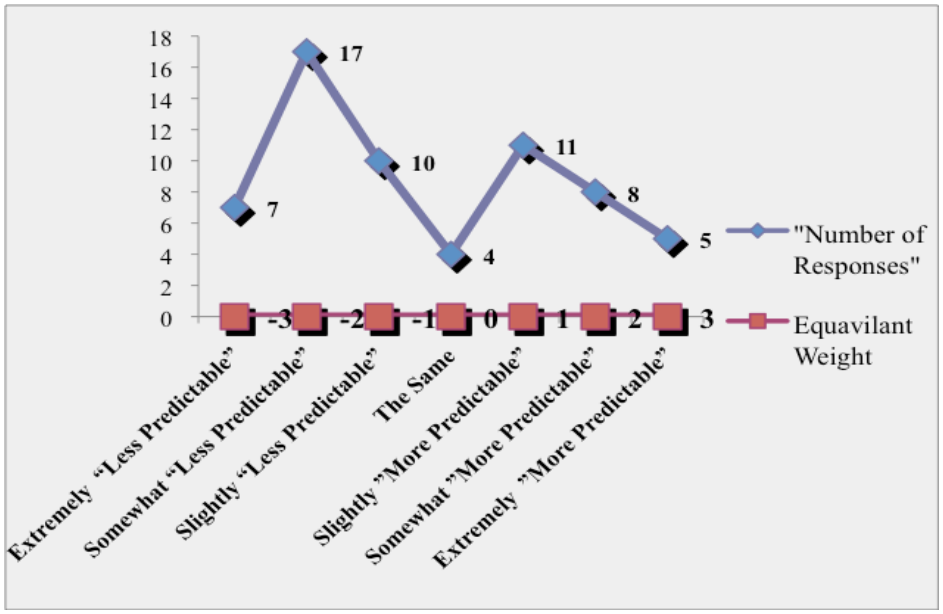

Figure 1. Fast-track cost predictability evaluation

Likewise, the time predictability of fast-track projects has also fallen under the interval "The same" and "Slightly Less Predictable" with $\bar{x}$ equals to (-0.048). This value is very close to the value 0, which means that the time predictability in fast-track projects tends to be the same as conventional projects. Another significance of assessing time predictability is the standard deviation, which is (1.712) and shows high variation between the answers; see Figure 2 for a summary of the responses.

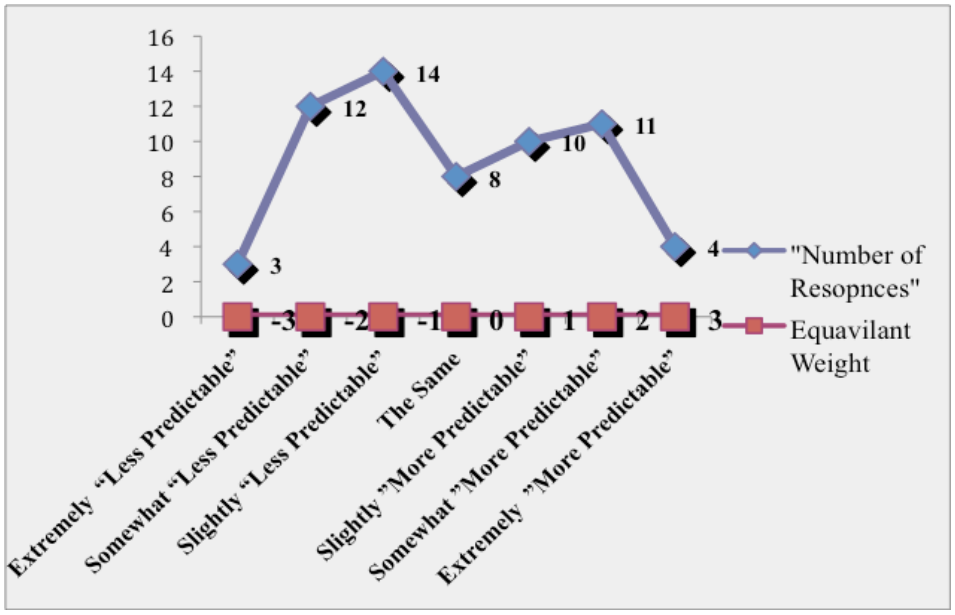

Figure 2: Fast-track time predictability evaluation

Quality predictability mean value falls between the two categories ("The Same"=0 and "Slightly Less Predictable"=-1) with $\bar{x}$ value equals to (-0.451). The variation in the answers is also expressed by the relatively high value of standard deviation, which is (1.646) (see Figure 3).

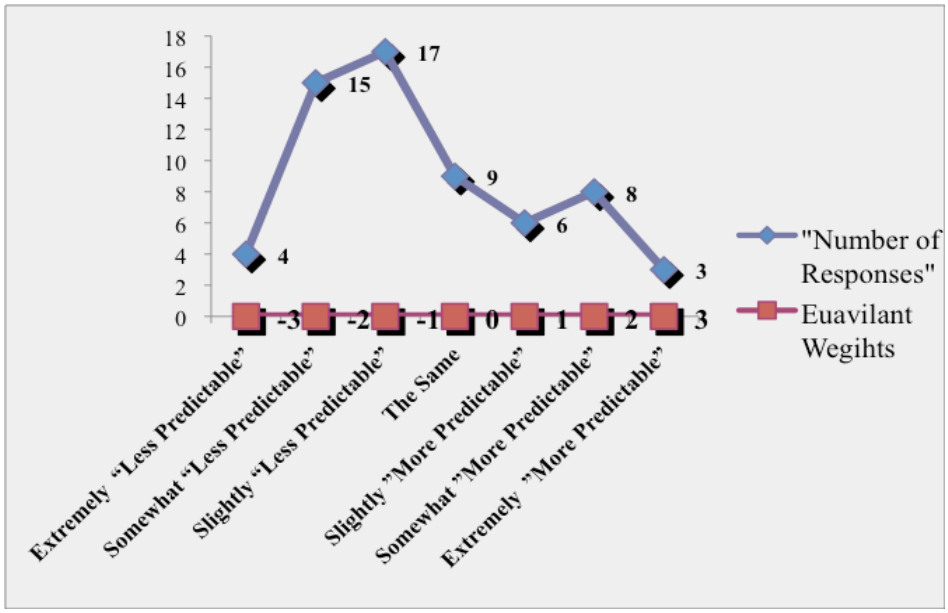

Figure 3: Fast-track quality predictability evaluation

The above mean values for cost, time, and quality show that time is more predictable than cost and quality in fast-track projects. The lowest predictable objective is quality. However, quality and cost predictability are very close together. Basically, time in fast-track projects is usually driving other objectives and determined first. Fast-track projects adhere to time frame while quality suffers and cost changes.

4.2 Suggestions to Improve Fast-Track Projects Predictability

The suggestions for improving fast-track predictability were selected, short-listed and prioritized according to the Pareto analysis (which relates 80% of the outcomes to 20% of the causes) to focus attention on fixing the most important problems. (Novack et. al 1993). A list of 12 out of 21 suggestions has been identified using the chart methodology. The analysis used 47 responses, which is the total number of responses in the second phase. The suggested items and their responses' frequency, weight percentages, and cumulative percentages were used to plot the Pareto chart. The criterion for selection of the most effective suggestions was to choose those, which had 80% cumulative effect among all suggestions. The suggestions were highlighted in a dark-blue color on Figure 4 chart left side.

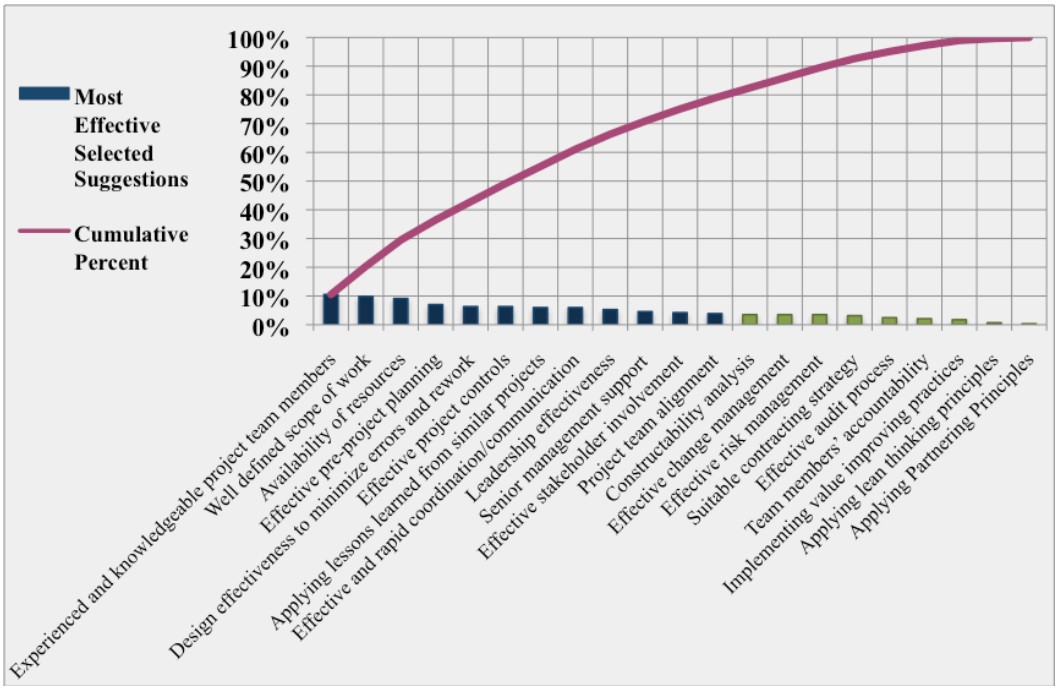

Figure 4. Pareto chart analysis of suggestions effectiveness

Below, the most effective suggestions are listed in descending order of effectiveness:

(i) experienced and knowledgeable project team members

(ii) well-defined scope of work

(iii) availability of resources

(iv) effective pre-project planning

(v) design effectiveness to minimize errors and rework

(vi) effective project controls

(vii) applying lessons learned from similar projects

(viii) effective and rapid coordination/ communication

(ix) leadership effectiveness

(x) senior management support

(xi) effective stakeholder involvement

(xii) project team alignment

5 Conclusion

This paper investigated the relationship between fast-track projects and predictability by measuring the variance in project's planned objectives (cost, time and quality) against the completion, and introduced suggestions to improve the predictability of fast-track projects. The relationship was examined through questionnaires. The research found that the predictability of cost and quality for fast-track projects are very slightly less than those for conventional projects, while time predictability is almost the same. However, the relatively high standard deviation values reflected a large disagreement between the participants about the predictabilities. Another significant finding involved 12 suggestions to improve the predictability of fast-track projects.

Additional research into the relationship between predictability and fast-tracking to improve fast-track project predictability is necessary. Further studies are needed to continue to evaluate the predictability indices based on actual data of completed fast-track projects. The use of actual data would increase the accuracy of the evaluation. Also, investigating the causes that lead to variances in actual project predictability is important.

References

Alhomadi, A. A., Dehghan, R., and Ruwanpura, J. Y. 2011. The Predictability of Fast-Track Projects. The Twelfth East Asia-Pacific Conference on Structural Engineering and Construction, Procedia Engineering, Hong Kong, 14:1966–1972. doi: 10.1016/j.proeng.2011.07.247.

Atkinson, R. 1999. Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. International Journal of Project Management, 17: 337-342.

Eastham, G. 2002. *The fast track manual: a guide to schedule reduction for clients and contractors on engineering and construction projects*. European Construction Institute, Loughborough, Great Britain.

Fazio, P., Moselhi, O., Thberge, S., and Revay, S. 1988. Design impact of construction fast-track. *Construction Management and Economics*, 6:195-208.

Henry, R., Mccray, G., Purvis, R., and Roberts, T. 2007. Exploiting organizational knowledge in developing IS project cost and schedule estimates: An empirical study. *Information & Management*, 44: 598-612.

Loch, C., and Terweisch, C. 1998. Communication and Uncertainty in Concurrent Engineering. *Operations Research Society of America and The Institute of Management Sciences*, 44: 1032.

Martin, J. 2003. Performance Measurement of Time and Cost Predictability. *Current Developments in Construction Economics*, Paris, France.

Montgomery, D., Runger, G. C., and Hubele, N. F. 2007. *Engineering Statistics*, John Wiley, Hoboken NJ.

Novack, R. A., Grenoble, W. L., and Goodbread, N. J. 1993. Teaching Quality in Logistics. *Journal of Business Logistics*, 2: 41.

Park, M. 1999. *Robust Control of Cost Impact on Fast-Tracking Building Construction Projects*. Master of Science in Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Park, M. 2002. Dynamic Change Management for Fast-Tracking Construction Projects. *National Institute of Standards and Technology*, Gaithersburg, Maryland, 81-89.

PMI. 2008. *A guide to the project management body of knowledge: PMBOK guide*. 3rd ed., Project Management Institute Inc., Newtown Square PA.

Rossi, P., Wright, J. D., and Anderson, A. B. 1983. *Handbook of Survey Research*. Academic Press, New York.

The KPI Working Group. 2000. *KPI Report for The Minister for Construction*. Department of the Environment, Transport and the Regions, London.