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Analyzing delay causes in Egyptian construction projects

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ABSTRACT

Construction delays are common problems in civil engineering projects in Egypt. These problems occur frequently during project life-time leading to disputes and litigation. Therefore, it is essential to study and analyze causes of construction delays. This research presents a list of construction delay causes retrieved from literature. The feedback of construction experts was obtained through interviews. Subsequently, a questionnaire survey was prepared. The questionnaire survey was distributed to thirty-three construction experts who represent owners, consultants, and contractor's organizations. Frequency Index, Severity Index, and Importance Index are calculated and according to the highest values of them the top ten delay causes of construction projects in Egypt are determined. A case study is analyzed and compared to the most important delay causes in the research. Statistical analysis is carried out using analysis of variance ANOVA method to test delay causes, obtained from the survey. The test results reveal good correlation between groups while there is significant difference between them for some delay causes and finally roadmap for prioritizing delay causes groups is presented.

Introduction

Construction delay means a time overrun either beyond the contract date or beyond the date that the parties have agreed upon for the delivery of the project. In both cases, a delay is usually a costly situation [1]. Delay was also defined as an act or event which extends required time to perform or complete work of the contract manifests itself as additional days of work [2]. Poor site management can cause project delay and affect productivity [3]. A lot of research efforts have been made to study delay causes in different countries [4–15]. For example, material-related delay is the main cause of project delays in Saudi Arabia [16]. Bordoli and Baldwin [17] examined the causes of delays in building projects in the United States. Weather, labor supply, and sub-contractors were found to be the major causes of delays. Poor risk management, poor supervision, unforeseen site conditions, slow decision making involving variation, and necessary variation works are the principle delay factors in Hong Kong [18]. Unforeseen soil condition, poor site supervision, low speed of decision making involving all project teams, client initiated variations, necessary variations of work, and inadequate contractor experience are the six significant factors contributing to delays in building and civil engineering works [19]. Materials-, equipment-, and labor-related delays were identified as major causes of contractors' performance delays [20]. Design changes, poor labor

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productivity, and inadequate planning and resources were found to be responsible for delays in Indonesia [21]. In Saudi Arabia, contractor performance, owner's administration, early planning and design, government regulation, site and environment conditions, and site supervision were found to be the important causes of delay [22]. Whereas, the financing and payment for completed works, poor contract management, change in site conditions, and shortages of materials were found the most important items of delay causes in Nigeria [23]. Odeyinka and Yusif [24] studied client-, contractor-, and consultant-caused delays in housing projects in Nigeria. Variation orders, slow decision making, and cash flow problems were found as client-caused delays. Financial difficulties, material management problems, planning and scheduling problems, inadequate site inspection, equipment management problems and shortage of manpower were found as contractor-caused delays. Incomplete drawing, slow response by consultant, variation orders, late issuance of instruction, and poor communications were classified as consultant-caused delays. Inclement weather, act of God, labor dispute, and strikes were found to be extraneous factors responsible for delays. Bramble and Callahan [25] studied owner-, designed-, contractor-, and others-related delays in U.S.A. Late release of site to the contractor, late approval, financial difficulties, contract administration responsibilities, change orders, and interference were found to be owner-caused delays. Design defects, slow correction of design errors, tardy shop drawings review, and delays due to test and inspection were considered to be designed-caused delay. Failure to evaluate the site and design, construction defects, contractor management problems, and inadequate resources were found to be contractor-related delays. Weather, act of God, strikes, and labor disputes were found to be delays not caused by the design and construction parties. In Egypt, Amer [26] studied the major delay causes for construction projects which they are: poor contract management, unrealistic scheduling, lack of owner's financing/payment for completed work, design modifications during construction, and shortages in materials such as cement and steel. Abd El-Razek et al. [27] considered several delay causes in construction projects in Egypt which are: financing by contractor during construction, delays in contractor's payment by owner, design changes by owner or his agent during construction, partial payments during construction, and non-utilization of professional construction/contractual management. Marzouk et. al. [28] studied delays that are related to engineering factors which arise due to design development, workshop drawings, and change then he developed a knowledge based expert system for assessing the engineering related delay claims. Kazaz et al. [29] conducted a study on the causes oof time extensions in the Turkish construction industry and levels of their importance, considering 34 factors. A questionnaire survey was conducted with 71 construction companies in Turkey, and the outcomes were evaluated by means of statistical analyses.

Methodology

Delay causes survey

The questionnaire designed for use in the survey comprised demographic information about respondents and 43 delay causes which were grouped to seven categories: owner related, consultant related, contractor related, material related, labor and equipment related, project related, and external related (see Table 1). The respondents were requested to choose one degree of frequency for each delay cause which is rarely, sometimes, often, or always. Also they were requested to choose one degree of severity which is low, moderate, high, or extreme.

The questionnaire was distributed only to owners who are representatives of large investment projects and affiliated to first class of consultants who are classified as house of expertise in the Egyptian Syndicate of Engineers as well as to contractors who are representatives to high class companies registered in the Egyptian Federation for Construction and Building Contractors (EFCBC). Total of 33 experts responded. The experts were divided into three groups each group consists of eleven experts the first group represents owners and the second represents consultants while the third represents contractors. All respondents hold senior positions with related working experience and the majority of them had practiced in the field for 20–30 years.

The size of the sample required from the targeted population, i.e. 33 respondents was determined statistically [30]. The results suggested that the minimum sample size required was:

$$n_0 = \frac{p * q}{v^2} \quad (1)$$

$$n = \frac{n_0}{1 + \frac{n_0}{N}} \quad (2)$$

where n_0 is the first estimate of sample size. p the proportion of the characteristic being measured in the target population. q the complement of p or 1-p. v the maximum standard error allowed. N the population size. n is the sample size.

The total number of contractors registered the Egyptian Federation for Construction and Building Contractor (EFCBC) in 2011 are 58991 and the first class contractors are 1716. Then, N is 58991 and p is 1716/58991 = 0.0291. To account for the possible error in the qualitative answers from the questionnaire, the maximum standard error V was set as 10%. Substituting in Eqs. (1) and (2), the minimum sample required is $2.8 \approx 3$.

It is obvious that this number of required sample is less than the number of respondents who provided their feedback (i.e., 33 respondents). Since the number of contractor companies in Egypt is more than the number of consultant companies and owner representatives, therefore, it is sufficient to utilize the same sample size for owner and consultant representatives as for contractor. A detailed questionnaire comprises 43 delay causes were prepared and presented to construction experts. The respondents were asked to determine the frequency of occurrence of each cause as follows: *Rarely* (R) = 1, *Sometimes* (S) = 2, *Often* (O) = 3, *Always* (A) = 4. To determine the degree of severity of that cause, the following levels are considered: *Low* (L) = 1, *Moderate* (M) = 2, *High* (H) = 3, *Extreme* (E) = 4.

The Frequency Index (F.I), Severity Index (S.I), and Importance Index (IMP.I) are calculated using Eqs. (3)–(5) respectively as stated in Assaf and Al-Hejji [31].

$$\text{Frequency Index (F.I)}(\%) = \sum_{i=1}^{4} \frac{a_{if} * n_{if}}{4 * N} \times 100 \quad (3)$$

$$\text{Severity Index (S.I)}(\%) = \sum_{i=1}^{4} \frac{a_{is} * n_{is}}{4 * N} \times 100 \quad (4)$$