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A REVIEW OF MAJOR CAUSES OF DELAY IN ROAD CONSTRUCTION PROJECTS

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Abstract — *Construction projects contribute to economy growth significantly in any country. However, these projects are faced by delays frequently, especially for roads. This paper aimed at reviewing causes and sources of delay in road construction projects. Furthermore, the most important causes of delay in the literature have been reviewed and listed in their proper groups. The results revealed five major groups causing delay which are: contractor, owner, equipment, material and equipment and sponsor. Furthermore, based on the findings of previous works, one factor placed in first position was contractor-related, three owner-related, three external-related, one resource-related and one shared between project parties.*

Keywords- *Causes of Delay, Risk Management, Road Construction*

I. INTRODUCTION

The construction industry is regarded as one of the main sectors contributing to economic growth in any country. The success of construction projects is usually measured by three key indicators, time, cost and quality [1]. However, failure of satisfying project requirements has been repeatedly occurred, especially when projects are completed beyond contract period. Such case is called delay which is defined as the time exceeded the project duration stated on the contract [2]. These delays have been proven in many countries, for instance, infrastructure projects in both Ethiopia and India have suffered from time delay where 80% and 72% of them were delivered late [3]-[4]. In Saudi Arabia, the average delay among 49 roads and bridges projects was 39%. [5] studied this dilemma in Kenyan roads based on the fact that 70% of these projects were not completed on time. The magnitude of this issue may significantly appear in Jordanian roads since the delay reached to 455% of contract duration observed in one case study [6].

There are many reasons contributing to project delay and vary from country to country. They can be caused by project parties, manpower, machineries and some of them are uncontrollable such as weather effects [1]. Despite of the efforts made by professionals to achieve the project in a timely manner, the responsibility for delay is mainly associated with them in many cases. For example, contractor was responsible for 40% of delay in Ethiopia [7]. While the owner was mainly blamed in Saudi Arabia since the contribution to project delay reached to 53% from his side [8]. In Palestine, delays caused by equipment and material received more importance than those caused by professionals. However, this review presents the factors, groups and their perceived importance according to the findings of previous studies.

II. LITERATURE REVIEW

Santoso and Soeng [1] analyzed delay causes and their relationships with project duration, cost and quality in Cambodian roads. Risk identification was accompanied with grouping risk factors into five categories namely: contractor, owner, consultant, external and project. A questionnaire survey was adopted as a research instrument and the responses were analyzed by importance index technique. It has been observed that rain and flood were the most influencing factors on project duration. The research findings also indicated that several delay factors ranked among the highest ten were linked to contractor and project groups.

Hasan [2] et.al prepared an initial list of delay factors their consequences by reviewing past literature. Subsequently, these factors have been evaluated by expert panels in a purpose of keeping the most relevant ones to road projects in Bahrain. A questionnaire was utilized as a data collection method and the answers were then analyzed by computing the frequency and severity for each risk. It was concluded that the main causes of delay caused by contractor, owner and consultant were inadequate planning, suspension of work and experience of consultant, respectively.

Tesfa [3] explored causes of delay faced by road construction in Ethiopia. Past road projects constructed between the period 2000-2005 were reviewed and a questionnaire survey was distributed to contractors, owners and consultants to examine their perceptions about risk factors. It has been found that 80% of projects were completed late. In addition, six delay factors were determined to be the most affecting factors on project delay.

Patil [4] et.al conducted a questionnaire survey among professionals working in the Indian construction industry. The aim of this survey was to assess the reasons for delay faced by transportation projects. the data were gathered and analyzed by calculating the relative importance index for each delay cause. The study found that land acquisition factor obtained the highest value. Moreover, the most critical causes of delay were to be caused by project professionals.

Seboru [5] investigated the problems led to delay in roads completion in Kenya as a considerable percentage of these projects were delivered behind contract duration. The list of delay factors comprising 141 were taken and categorized into 25 groups. Contractors and consultant were targeted in a purpose of evaluating their opinions about risk factors. Using the relative importance index, the study reported that payment of client, bureaucracy in client office, slow decision making, ineffective scheduling and planning and rain were the most significant factors leading to project delay.

Al-Hazim and Abu salem [6] identified 19 real delay factors and cost overrun documented in 25 Jordanian road projects between the period 2000-2008. The confirmation of these factors has been accompanied with interview sessions with project professionals. The study revealed that the percentage of delay and cost experienced in the considered sample reached to 455% and 600% maximum, respectively. The results also stated that the main reason for delay was terrain conditions.

Amare [7] et.al conducted a study within the same country and type of construction. However, the focus of this study was to assess causes of delay occurring in construction phase only. A total of 65 factors were identified and grouped into three categories. The analysis has shown that the most important group causing delay is contractor. In addition, poor financial control of the project was the highest factor above the remaining.

Elawi [8] et.al preferred to carry out a comparison research between causes of delay in Mecca province in Saudi Arabia and those experienced in the same country and other Gulf ones in the past. A total of 49 bridges and roads projects have been reviewed and the top ten frequent factors were extracted. It has been concluded that the most influencing factor from owner perspective is land acquisition. Additionally, the greatest responsibility for delay was raised from owner since 50% of delay was caused by his side.

Aziz and Abdel-Hakam [9] identified 293 delay causes affecting the completion of roads in Egypt. They have been classified into 15 categories. A total of 500 questionnaire surveys were sent for the sake of evaluating delay factors and determining the most influencing ones on project delay. The researcher found that the first group and cause of delay are equipment and financial problems of owner, respectively.

Akomah and Jackson [10] examined the factors led to delays and the consequences of these delays in Ghana's road construction from contractor's point of view. A total of 32 causes and 9 effects were determined and organized in a form of questionnaire. The answers were received from 115 respondents and analyzed by using the relative importance index method. It has been realized that the first cause and effect of delay are: delay in honoring payment certificates and extension of time, respectively.

Khair [11] et.al similarly, studied the reasons and impacts of delay on Sudanese road construction. A literature-based framework containing 70 delay factors and 9 effects was prepared in a form of questionnaire and filled up by experts working in this field. The study illustrated the importance of each cause within the corresponding category. Furthermore, the researcher has offered some methods that would reduce the impact of delay on the project.

Kamanga and Steyn [12] reported that the majority of contractors in Malawi failed to complete their projects in a timely manner including road projects. Therefore, this research has been carried out to identify the problems behind such delays. A questionnaire survey prepared with 72 delay causes categorized into 6 groups has been designed. The respondents were requested to assess the level of importance for each factor based of five point likert-scale ranging from never occurring to continual occurring. The results indicated that the factor number one causing delay was shortage of fuel.

Kaliba [13] et.al examined the problems exposed by road projects in Zambia in terms of time and cost overruns. Several theoretical factors have been determined based on the literature and the files of similar projects completed in the past. The factors that were relevant to the study then have been confirmed by expert panels in the field. Next, a questionnaire survey was designed and distributed to professionals in road construction. The importance of each factor was calculated using weighted average method. It was found that payment delay and effect of weather were the first factors causing delay and cost overrun, respectively.

Sharaf and Abdelwahab [14] identified 73 causes of delay classified into 12 groups affecting highways projects in Egypt. This process was undertaken in parallel with worldwide research. Considering expert opinions about these factors, the relevant ones have been included in a questionnaire. Based on the respondent's answers, risk matrix including the probability of occurrence and the impact of risks has been established. According to the results, the most responsibility for delay was pointed to owner. Furthermore, highway projects in Egypt were found to be at medium level of risk.

Venkateswaran and Murugasan [15] focused on delay causes faced by roads implemented over bridges in India. A total of 29 risks have been identified, seven of them were suggested by respondents in a form of questionnaire. The responses have been analyzed by computing the frequency index for each factor. In addition to that, factor analysis method was utilized to categorized risks into seven groups. The findings have shown that land acquisition was ranked the highest factor contributing to delay in such type of construction.

Jeyakanthan and Jayawardane [16] described delays associated with road projects implementation in Sri Lanka as inevitable. Thus, a research aiming at investigating such problems has been carried out. A total of 36 risk factors based on previous studies and projects documents have been outlined. Subsequently, the final framework of causes of delay has been validated through interviewing experts and prepared for the next stage. The discussion of the findings resulted from projects files has been made based on the phase of construction. The overall results revealed the importance of construction stage since the delay occurred in the stage was 69%.

Al Hadithi [17] studied delay-related factors affecting the completion of road projects in Iraq. The researcher identified 64 causes of delay grouped into seven major categories namely: contractor, owner, consultant, material, external, equipment and labor and project. These factors have been evaluated by conducting a questionnaire survey and analyzed by their frequency which was assessed by respondents. According to the analysis, political situation was assessed as the most factor causing delay in Iraqi highways.

Regarding Palestinian roads, Mahamid [18]-[19]-[20] explored the factors responsible for delivering these projects late from different perspectives. the causes of delay have been determined based on the literature and categorized between 5 to 6 groups in these studies. A questionnaire survey with well-organized delay factors has been sent to contractors, owners and consultants separately. The data were obtained, and risk matrix then has been established. it has been recognized that 7, 8 and 13 factors were located in the high-risk range according to contractor's, owner's and consultant's opinions, respectively.

Mahamid [21] et.al investigated similar problems existed in the same location and type of construction. Literature-based causes of delay have been highlighted and divided into 8 major groups according to the source of delay. The list of causes was sent to contractors and consultants in a form of questionnaire to assess these causes according to their severity. the causes and their groups were then ranked using the above-mentioned data analysis method. It has been observed that political situation is the most influential cause of delay in road construction. Moreover, material and equipment group was of great importance since many critical factors related to this group.

III. GROUPS CAUSING DELAY IN ROAD CONSTRUCTION PROJECTS

Different numbers of delay groups and sources were recognized in the literature. The majority of studies have classified delay causes into 3 to 7 groups. The highest number was observed in Kenyan roads accounting for 25 groups. Normally, the name of the groups reflects the factors involved in each as the same factor can be placed in different groups. For instance, labor productivity factor can be placed in contractor and labor groups, shortage of material cause can be placed in material and contractor groups, equipment failure cause can be placed in equipment and resource groups. More than 30 different groups of delay were found in the literature. The most frequent groups utilized for categorization were: contractor, owner, consultant, material, equipment, external, project, labor and design. Based on the results of previous works, the most contributing groups to project delay occupied the first position were: contractor [7], owner [4], equipment [9], material and equipment [21] and sponsor [14]. Sponsor group was mentioned only once through literature and contained risks that are beyond control.

IV. CAUSES OF DELAY IN ROAD CONSTRUCTION PROJECTS

Several studies have discussed causes of delay in construction projects in different countries. However, delay factors affecting road projects have been considered in this review. A variety of reasons have been studied in this type of construction ranging from 10 in Saudi Arabia and Ethiopia to 293 in Egypt. Most researches identified less than 80 factors. Due to the high number of causes, the most important fifteen causes of delay in each study have been highlighted. They have been addressed into the groups which are commonly utilized for categorization. It has been observed that contractor, consultant and owner were the main contributors to project delay based on top-fifteen-rang. In fact, more than 27, 35 and 20 factors were among the top fifteen in contractor, owner and consultant groups, respectively. So, for these groups, only top 10 high ranked causes of delay have been taken.

A. Causes of delay related to contractor

In this category, the most important factors causing delay are: difficulties in financing project [7]-[12]-[17], poor site management and supervision [7]-[1]-[4], lack of high- technology mechanical equipment [12]-[7]-[4], ineffective scheduling and planning [5]-[7]-[21], poor qualifications of technical staff of contractor [7]-[1]-[12], low productivity of labor [7]-[1]-[21] inadequate contractors experience [9]-[8]-[2], inaccurate cost estimation [17]-[6]-[10], delay in honoring payment certificates [10] and Poor communication between contractor and other project parties [4]-[21]-[2].

B. Causes of delay related to owner/ client

Causes of delay for owner group comprise the following: award the project to the lowest bidder [7]-[1]-[21], delay progress payments [13]-[3]-[21], owner financial difficulties [9]-[13]-[2], delay in payment to contractor [17]-[5]-[18], slow decision making [11]-[5]-[21], bureaucracy in client organization [11]-[5], land acquisition [8]-[4]-[15], variation order [5]-[6], change order [4] and inadequate feasibility studies [17]-[16].

C. Causes of delay related to consultant

The most important delay factors attributed to consultant are: insufficient data collection and survey for consultant [17]-[7], incomplete drawings or documents from consultant [3]-[11], Consultant initiated variations [10]-[11], delay in instructions from consultants [10], design changes [8]-[5]-[2], delay in response to other parties [11]-[4], delay in approving major changes in the scope of work [2], Insufficient experience [2], late approval [18]-[20]-[19] and insufficient inspectors [18]-[20]-[19].

D. Causes of delay related to equipment

Potential factors caused by equipment category found in the literature are: slow equipment movement [3], shortage of equipment [9]-[12]-[14], equipment failure (breakdowns) [9]-[10], lack of skilled operators for specialized equipment [9]-[1]-[21], quality of equipment [6], lack of equipment efficiency [21], equipment maintenance [14] and late delivery of equipment [7]-[12].

E. Causes of delay related to material

As far as material group is concerned, low number of causes have been addressed in this category. They account for the following: quality of material [3]-[6], shortage of materials [9]-[10]-[12], material price fluctuation [6]-[14], delays in materials test and obtaining their results [17] and late delivery of materials [7]-[12].

F. Causes of delay related to labor

Four labor-related factors were ranked among the highest fifteen causes of delay through reviewed publications. These factors are: low productivity of labor [17]-[1]-[21], shortage of labor [6]-[2], shortage of skilled labor [10] and labor disputes [13].

G. Causes of delay related to design

Design group contributed to project delay by observing the following factors: design errors [9]-[6]-[16], rework due to change of design or deviation order [9]-[5]-[14], wrong or improper (poor) (inappropriate) design[17]-[9], conflicting design information [5], shortage of information [14]-[17] and improper feasibility study [14]-[17]-[16].

H. Causes of delay related to external

The most critical factors recognized within this group are: bad weather conditions [10]-[1]-[6], accidents during construction [10], terrain conditions [6], political situation [17]-[6]-[21], different site conditions [4]-[10]-[5], effect of social and cultural factors [4], the economic crisis of the country [17] and delay in paying compensations (land-owners) [12], closure [20].

I. Causes of delay related to project

The most significant delay factors in this category were found in tow studies. Impact on people's land along the road construction project, poor ground condition and terrain and long distance to borrow pits were found in Cambodia [1], and inconvenient site access, disturbance to public activities and limited construction area were realized in Palestine [18].

V. MAJOR FINDINGS

According to the reviewed publications, contractor group seems to be the most important since the largest number of causes was involved in this category. This result was revealed based on the review of the highest fifteen causes of delay resulted from each study. Furthermore, causes of delay that have been ranked first in each study are: poor financial control of the project [7], delay in honoring payment certificates by contractor [10], owner financial problems [9]-[13], delay in payment to contractor by owner [5], land acquisition [8]-[4]-[15], rain effect of construction activities [1], terrain conditions [6], political situation [17]-[21] and shortage of fuel [12]. Owner financial problems was the first cause of delay in both Egypt and Zambia. While land acquisition was the most important factor in Saudi Arabia and India. Furthermore, political situation obtained the highest ranking in tow Arabic countries, Iraq and Palestine. In principle, one of the major causes was attributed to contractor group, three to owner group, three to external group, one to resource group and one was shared between project parties.

VI. CONCLUSION

Delays are one of the major problems faced by road construction projects. Thus, the review of causes of delay and their sources in this these types of projects has been carried out. In addition, the top important fifteen factors in each study have been considered based on the overall ranking and addressed in the corresponding groups.

This review revealed that the most frequent groups used for categorization which are: contractor, owner, consultant, material, equipment, external, labor, design and project. The most contributing ones to project delay are: contractor, owner, equipment, material and equipment and sponsor. This observation is subjected to the available groups ranking. The similarity was found in Egyptian roads where equipment and sponsor groups contribute considerably to project delay.

The first cause of delay found in each study is: poor financial control of the project, delay in honoring payment certificates by contractor, owner financial problems, delay in payment to contractor by owner, land acquisition, rain effect of construction activities, terrain conditions, political situation and shortage of fuel. Based on that, the highest percentage of the major causes went to owner and external categories since three main factors are attributed to them equally.

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