Analyzing Delay Factors in Iraqi Construction Projects: An ANP Approach with Najaf Governorate as a Case Study

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ABSTRACT

Construction projects in Iraq often experience delays owing to various factors, making it challenging to accurately estimate completion times. This study investigates the factors contributing to these delays, focusing on the Najaf Governorate as a case study. The primary objective of this study was to investigate issues related to the construction project completion duration, particularly considering Iraq's current unprecedented reconstruction and building efforts. The most significant factors influencing the completion duration were identified through statistical analysis of the samples and application of the Analytic Network Process (ANP) method. Data were collected and refined using a questionnaire designed according to a five-point Likert scale and administered in two rounds. The first round involved 28 participants, whereas the second round included 5 participants. The analysis revealed that contractor inefficiency, particularly from a financial perspective, is one of the most critical factors affecting construction progress and causing delays. The practice of accepting the lowest bids emerged as the second most crucial aspect leading to project delays in Iraq. Additionally, the study concluded that insufficient cash flow for the employer and the lack of technical expertise within the contractor company were the third and fourth most influential factors affecting the duration of construction projects, respectively. This study also highlighted that legal gaps in Iraq's legislative framework for construction projects are among the most significant causes of delays. Finally, the practice of subcontracting was identified as a significant contributor to both delays and poor work quality in the construction projects in Iraq.

Keywords-construction projects; delay; ANP; Iraq

I. INTRODUCTION

The analysis of the factors influencing the completion of construction projects has attracted significant attention owing to the complexity of these projects in terms of strategy and implementation approaches. The unique nature of construction projects, with their constraints involving numerous variables and challenges as well as the lack of consistency in project actions and behaviors, further contributes to this interest. Each project has its own specific conditions, which impose substantial challenges on implementing organizations and present significant obstacles in managing time-related issues during execution. This often results in the non-completion and non-delivery of construction projects within the specified timeframes, significantly impacting project budgets and quality of the construction [1, 2]. These factors have encouraged numerous researchers to analyze these issues, particularly in developing countries (including Iraq), in an attempt to identify solutions. This research was driven by the negative impact these factors place on the economic development process in these countries, as well as the adverse effects they have on the various parties involved in construction projects.

A brief literature review was conducted to investigate the factors contributing to construction project delays in the Middle East region. The literature indicates that different countries face varying reasons for delays, and the significance of these reasons varies depending on the project type [3]. Numerous studies have been conducted to evaluate the causes of delays in construction projects. Delay factors change over time, differ between countries, and vary from one project to another [4]. For instance, E. Soliman examined the causes of construction project delays in Kuwait, and proposed approaches to prevent their occurrence and reduce their impact [5]. These recommendations included modifying contract terms, revising contract award procedures, limiting documentation phases, and changing agreement support. Authors in [6] reviewed 47 factors contributing to construction project delays and categorized them into four categories: administrative, personal, technical, and technological. The study emphasized the discussion of four elements to address the delays in construction projects. The findings highlight the necessity of implementing effective project management, ensuring timely project delivery, and maintaining control and financial management. Additionally, the study recommended establishing effective communication among project

stakeholders, engaging specialized contractors, prioritizing construction project quality, and leveraging technology to enhance productivity through the utilization of modern software applications. Authors in [4] investigated the causes and effects of construction project delays in Ethiopia using the Relative Importance Index (RII) and association coefficient. Their findings revealed that the primary factors contributing to delays included corruption, unavailability of on-site facilities, rising material costs, scarcity of high-quality materials, delays in issuing policy documents, inefficient material transportation, delays in the approval and delivery of completed work, poor site management and supervision, delayed disbursement of funds, and ineffective project planning and scheduling. In [7], the perspectives of experts and independent parties regarding the relative importance of factors causing delays in the Cambodian construction industry using RII were evaluated. The findings highlight several key issues: insufficient on-site resources, unrealistic project schedules, delayed material deliveries, lack of skilled workers, design complexity, worker absence, delayed payment by owners for completed work, inadequate site management, and subcontractor-related delays. These factors were primarily categorized as on-site issues and were identified as the main contributors to project delays in Cambodia. Alsuliman investigated the factors contributing to interruptions in community construction in Saudi Arabia. The causes of interruptions were classified into four categories: challenges before bid awarding, issues during the bid awarding process, problems following bid awarding, and common issues. The impact of these factors on schedule delays was estimated using a simple formula [8]. Authors in [9] examined the factors contributing to construction project delays in Cyprus. They identified several key reasons for delays, each with a corresponding percentage of impact. The primary causes were found to be modifications requested by the client (70%), mistakes and missing information in expert drawings (55%), reduced productivity (55%), difficulties in external project financing (52%), and inadequate work planning (50%).

II. METHODOLOGY OF THE STUDY

This study employed a questionnaire-based approach to identify and evaluate the factors contributing to project delays in Iraq. Subsequently, the Analytic Network Process (ANP) method was used to determine the relative significance of these factors. Approximately sixty factors affecting project completion duration were identified from previous studies and consulting field experts in construction. These factors were incorporated into questionnaires designed using a five-point Likert scale, and a random sampling method was employed to select 28 survey participants for the first round. The participants were professionals in the project construction sector in Iraq, employed in both public and private sectors. In the second round, five participants were selected from among the most experienced experts, each with over 25 years of experience in the construction sector. This two-phase approach aimed to refine and prioritize the most significant factors affecting the project timelines in Iraq.

III. FACTORS AFFECTING PROJECT TIMELINES

To identify the most significant factors contributing to delays in construction projects in Iraq, we employed a five-point Likert scale and developed a questionnaire to determine the causes of the delays. A sample of Iraqi engineers was selected, with the majority having experience ranging from five to ten years. Those with less than five years of experience or more than ten years constituted equal proportions, each representing 32% of the sample. To initiate the statistical analysis of the questionnaire results, it was necessary to ascertain the scientific specializations of the sample population. The results indicated that 64% were civil engineers, overseeing most construction projects, while 36% represented other specializations, such as architecture, electrical engineering, and mechanical engineering. After establishing the characteristics of the surveyed sample, questionnaire results were collected for each proposed delay factor. The Severity Index (S.I) was calculated using equation (1) to identify the factors that significantly impact erection projects in Najaf based on respondents' opinions, as illustrated in Table I.

$$S.I(\%) = \sum a\,(n/N) * 100/5 \quad (1)$$

IV. STATISTICAL ANALYSIS OF THE RESULTS USING THE ANP METHOD

Following the analysis of the five questionnaires that exerted the most significant influence on project implementation duration, it was determined that questionnaires for the ANP technique were essential, based on the severity of the occurrence index. Upon finalizing the preparation of the form, it was distributed to a select group of experts in the field of construction. Interviews were conducted with these experts to elucidate the response mechanism. The process involved addressing and clarifying any issues or questions that the respondents encountered while completing the form. After allowing each participant sufficient time to respond to the questionnaire, the forms were collected for statistical analysis of the results using the Super Decisions software. Figure 1 shows the interface of the Super Decisions software after setting the main goal of delay in Najaf's construction projects and the five more important factors that may cause delays. Table II shows the matrix of the effects of each factor as was constructed in the software. The software estimated the priorities of the five most important factors that causing delays in construction projects in Najaf, as shown in Table III.

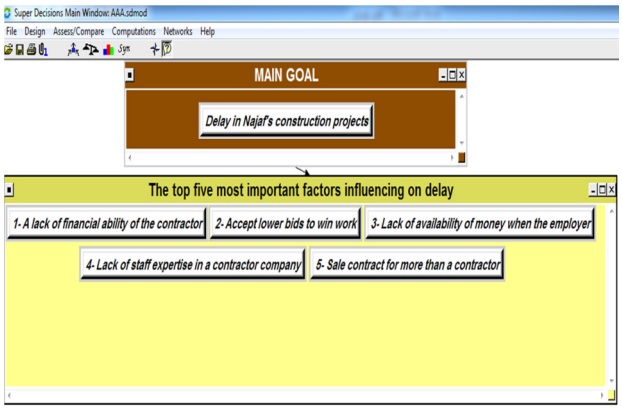

Fig. 1. The software interface after structuring the main and secondary parameters.

TABLE I. THE NUMBER OF OCCURRENCES OF EACH FACTOR ALONG WITH THE LEVEL OF SIGNIFICANCE

	Degree of influence					Level of significance
Influencing factors	**Very high**	**High**	**Moderate**	**Weak**	**Rare**	**S.I (%)**
The contractor's financial inefficiency	20	8	0	0	0	94.28
Lack of cash flow at the employer	22	4	1	1	0	93.57
Selling the contract to more than one contractor	18	8	2	0	0	91.42
Lack of employees with technical expertise in the contractor company	17	10	0	1	0	90.71
Accept the lowest bids submitted to win business	13	13	2	0	0	87.85
Ineffective oversight of the project progress stages by the contractor	14	9	5	0	0	86.42
The employer is late in paying the contractor's financial dues	10	16	2	0	0	85.71
The contractor's miscalculation of the construction project time	11	11	5	1	0	82.85
The period allocated for completing the work and estimated by the employer is not sufficient at all	11	11	5	0	1	82.14
Design error	13	11	0	1	3	81.42
Lack of skilled labor in the market	7	14	4	3	0	77.85
Needy contact between the consultant and other groups	7	13	6	2	0	77.85
Needy contractor contacts with other groups in the project	7	13	5	3	0	77.14
Needy contact between the owner and other groups of the project	7	13	5	3	0	77.14
Needy coordination between the consultant and other groups	7	12	7	2	0	77.14
Lack of skill of workers at the work site	7	10	10	1	0	76.42
Needy contractor management with other groups in the project	7	12	6	3	0	76.42
Failure to inspect the work site and conduct the necessary inspection before submitting the bid	7	10	10	1	0	76.42
Poor coordination of the owner with other parties of the project	7	12	6	3	0	76.42
Lack of required equipment	8	7	11	1	1	74.28
Permanent shortage of site workers	6	11	7	3	1	72.85
Weak contractor control over the subcontractor	5	10	11	2	0	72.85
The contractor relies on a newly graduated engineer	6	10	8	4	0	72.85
Delays in payments to material suppliers	6	8	12	2	0	72.85
Lack of experience among the contractor person	5	11	10	0	2	72.14
Market instability and price fluctuations from time to time	4	16	3	3	2	72.14
Amendment to the contract by the owner (change in specifications, and works)	6	8	12	1	1	72.14
Equipment failure on site	7	8	9	2	2	71.42
Suspension of work by the owner	5	10	10	2	1	71.42
Delay in carrying out the inspection and testing process by the engineer	5	10	10	2	1	71.42
Lack of required materials	5	9	10	3	1	70
Delays in payments to subcontractors	6	4	16	2	0	70
Changes in project scope	2	10	12	6	0	70
Change in material specifications	6	6	10	6	0	68.57
Inadequate selection of equipment	5	7	12	3	1	68.57
The owner was late in submitting change requests	3	10	11	4		68.57
Extreme weather conditions on the job site	3	10	10	5	0	67.85
Delay in delivering materials to the work site	5	8	9	4	2	67.14
Lack of clarity of specifications	3	9	11	5	0	67.14
Lack of administrative staff at the contractor	3	8	12	3	2	65
Lack of consultants for the owner	2	9	11	6	0	65
Traffic restrictions on the work site	4	7	11	4	2	65
The owner was late in approving the contractor's requests	5	6	8	8	1	64.28
Low equipment productivity	0	12	10	5	1	63.57
Assigning the contractor to additional work during the work	3	5	14	6	0	63.57
Ineffective quality control by the contractor	3	5	12	6	2	60.71
Spending much time finding subcontractors	3	7	10	4	4	60.71
The consultant was late in approving the contractor's requests	4	6	6	11	1	60.71
Early planning and design	0	5	17	5	1	58.57
Shortage of equipment spare parts	3	5	8	10	2	57.85
Low technical level of the consulting engineering team supervising the project	3	5	8	10	2	57.85
The existence of previous disputes between the consultant and the contractor	2	5	10	10	1	57.85
Ineffective project planning and scheduling	3	5	8	8	4	56.42
The consultant was late in approving materials for the contractor	1	3	12	10	2	53.57
Delay in approving the contractor's receivables by the consultant	0	6	9	10	3	52.85
Failure of the consultant staff to adhere to official working hours	1	3	6	16	2	49.28
Personal disagreement between workers and the management team	0	3	7	15	5	48.57

TABLE II. MATRIX OF THE EFFECTS OF EACH FACTOR

	Financial inefficiency of contractor	**Lack of cash flow by employer**	**Selling contracts to multiple contractors**	**Insufficient technical expertise**	**Accepting the lowest bids**
Financial inefficiency of contractor	1	3	3	2	3
Lack of cash flow by employer	0.333	1	1	1	3
Selling contracts to multiple contractors	0.333	1	1	1	2
Insufficient technical expertise	0.5	1	1	1	1
Accepting the lowest bids	0.333	0.333	0.5	1	1

TABLE III. CALCULATING THE PRECEDENCE FOR EACH IDENTIFIED FACTOR

Factors causing delays in Najaf's construction projects	**Normalized by cluster**	**Limiting**
1- A lack of financial ability of the contractor	0.39706	0.39706
2- Accepting lower bids	0.1823	0.182302
3- Lack of availability of money with the employer	0.16234	0.162335
4- Lack of staff expertise in a contractor company	0.15518	0.155182
5- Sale contract for more than a contractor	0.10312	0.103121

V. CONCLUSIONS

Based on Table II, we conclude that most of the factors identified are aspects affecting the construction project duration and should be considered to avoid schedule delays and their negative impacts on the project and involved parties. Table III indicates that financial considerations significantly impact construction projects. Statistical analysis using the ANP method reveals that the contractor's financial inefficiency is one of the most significant factors affecting construction projects and causing delays. Additionally, accepting the lowest bids is identified as the second most crucial factor leading to delays in Najaf Al-Ashraf construction projects, according to respondents' opinions extracted from the software and displayed in Table III.

It was also determined that the employer's lack of cash flow and the contractor company's insufficient technical expertise are the third and fourth most influential factors affecting the duration of the construction project, respectively. Furthermore, gaps in Iraq's legislative framework for construction projects are among the most critical causes of delays. The practice of selling contracts to multiple contractors has been identified as a key factor contributing to delays and poor work quality in construction projects in Iraq. We recommend reconsidering project allocation based solely on lowest prices, and instead applying criteria such as technical and financial efficiency, previous experience, and a balance between offered prices and required completion time. Moreover, the contractor's financial capacity and ability to implement the project should be thoroughly evaluated before project allocation. Lastly, we propose establishing an accurate timetable for work progress using based on scientific formulas derived from work productivity or previous experience and requiring contractors to adhere to it strictly to avoid project delays.

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