

Regular Article

Imad Jabbar Gashayyish*, Majid Hameed Yahya and Husam Ghazi Hadi

Identifying the reasons for the prolongation of school construction projects in Najaf

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Abstract: There are several problems facing the construction industry in Iraq. Delays in construction projects affect one of the most important factors in project success, namely time. This delay causes many problems such as increasing the cost of the project, lack of timely operation, and on a larger scale, economic and social impact on the country. As being one of the metropolises of Iraq, the city of Najaf needs a lot of development projects in the development path. Public school construction projects are an example of projects needed in the city, and delays in these projects in recent years have sometimes caused the city's schools to operate on a mixed basis. This study deals with studies and researches related to the delay of construction projects in other countries, and after interviews and surveys of construction industry stakeholders in Iraq, new factors have been obtained and finally, using the opinions of the mentioned experts, prioritizing the factors extracted from both identified the source and the five main causes of project delays, including late payment to the contractor, design errors, construction length errors, problems with neighbors, and inexperience of contractors. In the next step, the amount of delay due to the main factors identified in the projects was analyzed using the official documents of 30 sample projects from the statistical population of completed school construction projects in Najaf city. Statistics on the amount of delay caused by factors and comparing it with some indicators, the need to use contractors with better ratings, skilled manpower, experienced project managers, and the number of sufficient engineers at the project site were presented.

Keywords: project delays, delay factors, school construction projects, Najaf city, construction management

1 Introduction

Given that a significant part of the budget and income of countries is spent on construction and infrastructure, development projects are one of the important indicators of the progress of any country. As a result, delays in construction projects are very important for the following reasons: stagnation of capital and delayed return on investment, increase in current project costs, decrease in project budget due to rising inflation, procrastination, and nonuse of resources in other projects are the loss of relevance of time-dependent projects and the differences between the parties involved in the project due to the imposition of excess costs and the dissatisfaction of the people and stakeholders. For this purpose, it is necessary to identify these factors and classify them based on their importance and frequency in constructions [1,2]. For example, pre-construction delays impact the completion of construction, as shown in Figure 1. Identifying these factors is important in the implementation of projects.

Different researchers have come up with different definitions for project delays. Turner defines delay as doing work longer than expected. Asfaf and Hijji have defined the definition of delay differently from the point of view of the employer and the contractor. According to the contractor, the delay means an increase in overhead costs, inflation in equipment prices, and an increase in manpower wages, and from the employer's point of view, a decrease in revenue and profits. Rahimian et al. have defined delay as the prolongation of work or activity beyond the expected or planned. Yazdi and Hemmati consider delay as one of the most important and frequent phenomena in projects that have negative effects on project success in terms of time, cost, quality, and safety. Delays can be reduced when their causes are identified and analyzed. Delay is also a situation in which the project is not completed on a contract or agreed upon due to reasons that could be attributed to the contractor, employer, employer consultant, or other reasons [3,4].

Iraq is one of the most important countries in the Middle East, but its construction industry is facing many problems.

* Corresponding author: Imad Jabbar Gashayyish, Ministry of Education, Najaf, Iraq, e-mail: e1976@yahoo.com

Majid Hameed Yahya: Ministry of Education, Najaf, Iraq, e-mail: majid.hy22@gmail.com

Husam Ghazi Hadi: Ministry of Education, Najaf, Iraq, e-mail: Hussamghazi179@yahoo.com

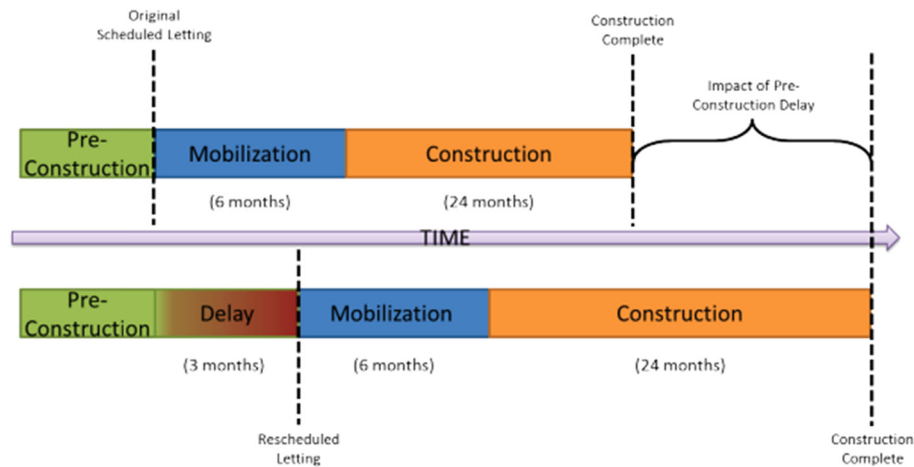


Figure 1: Preconstruction delays impact the completion of construction [1].

Meanwhile, delays in construction projects affect one of the most important factors of project success, namely time. This delay will cause many problems such as increasing the cost of the project, lack of timely operation, and on a larger scale, economic and social impact on the country. The city of Najaf, as one of the major cities in Iraq, needs a lot of development projects in the development path. Public school construction projects are an example of projects needed in the city, and delays in these projects in recent years have sometimes caused the city's schools to operate on a mixed basis. Therefore, identifying the reasons for the prolongation of construction projects in Najaf can be important research. In other words, with a careful case study and by achieving the results of the causes of delays in the construction of schools, it is possible to reduce the existing causes provide the ground for reducing delays and better progress for this Iraqi metropolis.

2 Literature review

In this section, we review some related works. Project delays generally increase the associated costs of time, financial claims, suspension, or early termination of the project. According to the definition provided by Keivani and Ramezani, in construction projects, the delay means the time between operation and completion of the project according to the plan, and the actual time of completion and operation, in other words, delay, action, or event performing a specific action on a construction project takes longer and appears as prolonging the duration of the activity or delaying its start date. From these definitions, it seems that although the delay has been expressed from

different researchers' perspectives, in general, its negative impact on project scheduling and the resulting project costs have been pointed out [5,6].

Successful development plan background: A development plan includes various projects with a common goal when related projects meet the desired goals to be successfully implemented. A successful project is one in which the employer, the contractor, and the operator are satisfied. The employer is usually satisfied when the projected budget and cost should not increase, the project completion date is on time, and the quality of the projects is within expectations [6,7].

Importance of time factor in construction projects: Delay is an event that increases the schedule; in other words, the delay is the interval between planned time and the actual time of project activities. Today, due to the sharp and sudden changes in prices and the rapid acceleration of countries in order to achieve the indicators of development and progress, timely implementation, and operation of major national and regional projects are of great importance. Especially when these projects are parent and infrastructure projects, the daily implementation of this can cause huge and irreversible damage to the country's economy [8,9].

Consequences of project delays: Hajivand and Kazemnejad, delays increase costs, reduce effectiveness, reduce the quality of work, spend double budget, pay adjustments, compensation for delays, customer dissatisfaction, failure to use project revenue in a timely manner, failure to return capital on time as a result of project uneconomic, project inefficiency, and ultimately creating political and social tensions [10].

Delays caused by the employer: Prolonged implementation of construction projects by the employer is very common.

As some of the factors of external delays are related to the employer, such as not having a building permit or inconsistency in the use of the building based on the municipal permit or lack of trusted supervision according to urban planning instructions and laws, start the project with difficulty and cause compensation to the contractor and ultimately terminates the contract [11,12].

Inadequacy of project management: Successful project manager must have expertise and impartiality in project decisions and be committed to the subject of the project. The weak project manager does not see the contractor as his executive arm but looks at him as a claimant who deserves a lot of flexibility. These managers consider postponing statements and confusing contractor claims as part of their managerial capabilities. They cause projects that have to be completed within a certain time to be completed later and at a higher cost [12].

Delays caused by the contractor: It can be seen that many delays are related to the contractor. There are many factors involved in this delay, which can be the necessary instability in the economic situation and the sudden increase of effective factors in the plan, the existence of inefficient manpower and expertise in the contractor system, and lack of proper management in the contractor system [13].

Weakness of project management in the contracting system: The traditional management methods are among the existing problems. Therefore, the need to implement new management, especially the existence of project management system in project-based organizations, is obvious. Today, contractors in developing countries suffer more from managerial weakness, and technical weakness is secondary. Management of time, cost, quality, risk, project scope, procurement, communications, and human resources is among the categories that must be considered in the project management system [14].

Delays caused by the consultant: The inability of feasibility studies by the team of consulting engineers in the construction industry today and in domestic projects; unfortunately, the specialized aspect of feasibility studies has been reduced and has become more of an orderly aspect. In addition to the involvement of employers, the inexperience of consultants can also be the cause; therefore, most of the projects are generally prepared based on the information of the type and adaptation of the studies of previous projects and are implemented without any economic justification, and the country's financial resources are wasted [15].

Delays due to materials: Factors that lead to project delays and are derived from materials are quality of materials, lack of materials, delays in the supply of materials,

and changes in the type or specifications of materials during construction [15].

Labor force: The existence of a labor force is necessary for the physical progress of the project. Occasionally there are issues with the workforce that include manpower supply, manpower efficiency, and manpower expertise and skills [16].

Equipment and machinery: In the case of machinery, the following factors lead to project delays: lack of access to equipment and machinery or problems in the supply of spare parts, machinery failure, and status and efficiency of existing machinery [16].

External factors: There are always a number of other factors for delay in articles that are outside the above classification, the most common of these factors are inflation and rising prices, changes in laws or standards, problems with neighbors and residents of the region, and political issues of the social and cultural situation of the region [17].

The role of environmental factors in delay: The background of experimental research conducted abroad based on studies based on research and in a general classification, environmental factors that cause delays in construction projects can be classified into seven groups: the role of factors geographical, culture in the community and project organization, technical and technical factors, managerial factors, factors related to the contract, factors related to manpower, and the existence of civil disputes [17].

As it is clear from the above, so far, a little research has been done on the causes of delays in the implementation of construction projects in the Middle East region, which statistically analyzes the delay time and the factors affecting the delay. So this field needs more research. However, this problem has not been raised in the form of an academic study in Iraq. The significant number of construction projects in Iraq and the delays in them, the contingency review of delays, the lack of accurate and up-to-date databases of delays, the lack of unity and consistency of procedures, etc., all emphasize the need for Iraqi projects in a systematic way to manage delays. In this study, we try to identify the causes that lead to the prolongation of the implementation of construction projects in Iraq, and after determining the effectiveness of each cause from the perspective of project management agents (employer, consultant, and contractor), then statistically be analyzed. Finally, it is summarized and concluded, and effective points are provided to solve or reduce the existing problems. Table 1 lists the extent to which the researcher has used them to investigate and find delays in Iraq. Examining this research, it can be

Table 1: Factors time delay factors

Papers	Factors
[18]	<ul style="list-style-type: none"> • Design errors and differences • Delay of the employer in making decisions • Prolonged approval of work plans • Inadequate contractor planning • Lack of manpower • Unexpected ground and basement conditions
[19]	<ul style="list-style-type: none"> • Employer delays in decision making • Mistakes during construction • Lack of manpower • Lack of equipment • Contractor inexperience • Unexpected ground and basement conditions • Lack of motivation of the contractor to complete the work
[20]	<ul style="list-style-type: none"> • Weak management and supervision • Design errors and differences • Contractors' financial problems • Mistakes during construction • Delays in payment to the contractor • Lack of equipment • Inexperience of workers

concluded that a case study for schools in the city of Najaf in Iraq can have practical results.

Therefore, by reviewing studies and research related to the delay of construction projects in other countries, as examined, factors have been identified, and after interviews and surveys of construction industry experts in Iraq, new factors have been obtained and finally using the opinions of these experts, prioritization of factors extracted from both sources and the five main factors of project delays including delay in payment to the contractor, design errors, construction length errors, problems with neighbors, and inexperience of contractors were obtained.

3 Research methodology

In the present study, according to library studies, including the use of articles and research on the factors affecting the delay of construction projects, we obtained 12 important factors causing delays in construction projects and then used questionnaire methods and interviews with 40 construction engineers. In addition to prioritizing the existing 12 factors, Iraq obtained 44 new factors influencing the delay, according to experts. Then, by prioritizing 5 factors out of 12 factors of library resources and 5 factors out of 44 factors desired by experts, the researcher

achieved 10 factors. At this stage, 10 factors were re-surveyed and questioned by experts to obtain the final 5 factors as follows: delays in payment to the contractor for completed work, design problems, problems during construction, problems with neighbors, use inexperienced contractors.

To investigate the effect of these factors on the delay of 12-grade school construction projects in the city of Najaf, findings related to 30 completed projects in this city as a sample of the statistical community of 12-grade school construction projects have been obtained from the official documents of existing projects; noting that the mentioned projects are similar in various aspects such as construction, type of contract, government and dimensions, and this can lead to more credibility of the sample taken from the statistical community.

We came to the point that the amount of delay due to the inexperience of the contractor is not mentioned in the project documentation. Therefore, no significant relationship can be found between this factor and the delay in construction projects, and based on this, its analysis has been omitted, and as a result, the studied factors have been reduced to four factors and are introduced under the title of four factors. However, there have been delays in each project for no apparent reason or may be related to the inexperience of the contractor, but it is not possible to prove such a thing and it is only under the heading of delay caused by other factors. We also obtained findings from project documentation on indicators such as contractor rankings, project managers' experience, number of engineers working on the project, and number of skilled workers working on the project.

4 Results

The results of the delay period due to five influencing factors show that in relatively existing projects, the delay due to one factor is high or low, the delay due to other factors will be similar. Regarding the delay due to the delay in payment to the contractor, it can be said that it was mainly due to the delays in the projects, but this factor could be due to the negligence of the employer system or the inexperience of the contractor. Among other factors, problems with neighbors are among the problems that depend on the location of the project and depend on specific cases, and therefore in some projects, the delay due to this factor has been zero, and of course, in some projects, there is a long delay due to this factor. We are the one who causes the high dispersion of the

data caused by the agent and makes in such conditions the average is not a suitable criterion for displaying and representing the data, and as a result, similar criteria can be used between the middle and the box diagram.

The results of the duration of the delay due to the delay in payment to the contractor and the problems with the neighbors show that the scatter due to the delay of these two factors is more than other existing factors. However, the median in the box chart for problems with neighbors is lower than the other four factors, and it can be claimed that 50% of the delay data due to problems with neighbors are small. Evidence of this is that the lower limit of the box diagram related to problems with neighbors is equal to the first quarter; this means that 25% of the projects have zero time delays due to problems with their neighbors. Meanwhile, the middle of the box chart of delays due to late payment to the contractor has the highest number and according to Figures (2 and 3) in the box chart of this factor after the middle and in the upper half of the box due to the elongation of the data are more scattered. In other words, in some projects, the delay due to late payment to the contractor has been a significant amount and has contributed significantly to the overall delay of the project. Among the four factors studied, design errors and differences have the least scatter of latency data in 30 projects. In other words, the delay data due to design problems in the projects under consideration are not far apart. From this phenomenon, it can be inferred that the problems in the design did not have much dependence on the conditions of project implementation by different contractors, and the resulting delay occurred in all projects on a relatively approximate scale.

Bar charts related to the history of the contractor and employer management team and the ranking of the contractor company show that the delay caused by five factors is significantly related to these cases; in other words, with the improvement of the contractor rank or increasing the history of the contractor project management team, the delay due to these factors is less. It should be

noted that the relationship between the company's ranking and the rate of delays due to problems with neighbors is that problems with neighbors generally occur in rural development projects in rural areas (where tribes are affected), and companies with favorable ratings mainly in these areas are not active and companies with 5th or 4th ranks in these areas face more problems from the neighbors. Also, experienced managers do not work in companies with poor rankings and thus will communicate with neighbors with delays due to problems. In relation to the number of engineers present in the project in general, such a judgment cannot be made, and the reason is the lack of appropriate numerical criteria in the number of engineers. Predicted engineers in the rate of latency. However, it can be seen that in cases with more than one engineer in both teams, the latency has also decreased. Regarding the number of skilled workers, it can be noted that increasing these forces will have a significant positive effect on the delays caused by construction length errors; however, not much effect has been observed on problems with neighbors and other factors in this regard.

Diagrams of the number of delays due to delays in payment to the contractor, design errors and differences, errors during construction, and problems with neighbors are presented. The first set of diagrams linearly shows the amount of delay caused by each factor. It should be noted that the projects are numbered from 1 to 30 according to the order of visits. In the next section, data will be presented using box plot diagrams to get a better picture of the scatter of delayed data caused by factors. It should be noted that, as mentioned in the previous section, other factors include factors that the researcher does not know about and does not need to analyze.

The diagrams in Figures 2 and 3 show that from the 44 factors suggested by elite people and engineers, five factors with the highest number of repetitions were selected, which are listed in the table below. The method was that first the delay factors were collected from the experts and then 44 designated factors were sent back to these people to select 5 important factors from among

Table 2: Comparison of delay due to five factors with line chart

Parameter factors	Delay in payment to the contractor	Design errors and differences	Constructor length errors	Problems with neighbors	Other factors
Low limit	2	2	0	0	0
The first quarter	25/9	7	25/6	0	25/5
Middle	14	10	5/11	5/7	5/9
The third quarter	75/26	12	18	75/20	75/17
Upper line	37	28	29	37	30

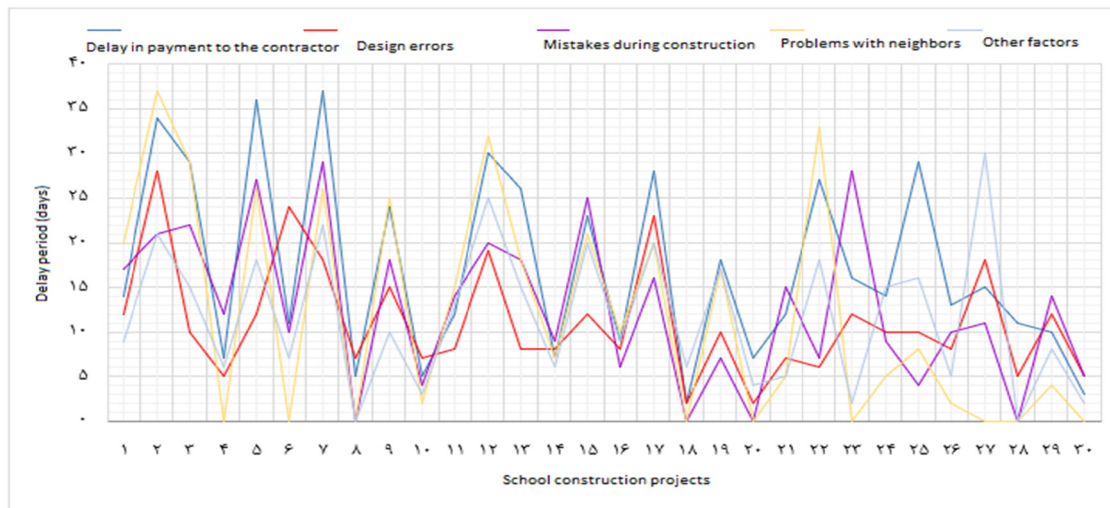


Figure 2: Comparison of the amount of delay caused by four factors with a line chart.



Figure 3: Line chart of the total delay due to five factors in 30 projects.

them and finally among the 5 factors from among all factors with the highest repetition rate. It is as follows: (1) problems with neighbors; (2) changes by the employer in the implementation phase; (3) use of inexperienced contractors; (4) security problems; and (5) irrational contract period.

5 Conclusion

Finally, we conclude that first, in projects that are well organized, the latency caused by each factor can be less, regardless of the circumstances, and as a result, the overall project latency is reduced. They are imposed on the project, and as mentioned, the delay caused by this

factor has no significant and tangible relationship with any of the indicators of project managers' experience, number of active engineers and skilled labor, and the contractor company's rating. Because design errors are related to the background and quality of work of project design consultants, none of the above indicators directly refer to the ranking of consultants and the background of this group. Some factors such as problems with neighbors are less likely to occur and at the same time have a high potential for impact. In general, a strong project team, including experienced project managers, a strong and experienced contracting team, and the use of skilled personnel in the project can reduce delays due to the factors mentioned in the research.

Conflict of interest: Authors state no conflict of interest.

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