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DELAY OVERRUN IN ROAD MAINTENANCE PROJECTS IN SYRIA

Summary. Road maintenance project delays present serious obstacles to the development of infrastructure, especially in nations where political and economic instability are prevalent. This study focuses on the key reasons why road repair projects in Syria took longer than expected between 2019 and 2022. Insufficient construction material supply and late contractor payments are the most important delay issues identified by the research, which is based on official records overseen by the Public Establishment of Road Communications. The study illustrates the intricate relationship between emergency repairs, fuel shortages, administrative inefficiencies, and governmental requirements through a correlation analysis of several projects. To reduce future delays in Syria's road infrastructure sector, the findings are intended to assist stakeholders in enhancing project planning, resource management, and execution techniques.

Keywords: time overrun, Syria, correlation study, road maintenance, delayed payments

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1. INTRODUCTION

The primary function of roads is to provide mobility and access. Nowadays, improving road networks and connectivity is a priority for developing countries worldwide, as road projects are a critical element of their national budgets, where an efficient road network contributes to economic growth and national expansion. Consequently, it is important to commit to the scheduled time for road projects in order to meet the immediate needs of stakeholders.

Any project to be completed successfully may require additional time or cost. Therefore, the purpose of this study is to analyze and examine the reports taken from the public establishment of road communications in Syria over the years 2019-2022. By understanding the causes of delays in road maintenance work, unnecessary obstacles and delays in both maintenance and construction projects can be avoided. It is worth pointing out that the causes of time overruns mentioned in these projects in this paper were the real causes that occurred and were registered. The ranking system of the factors was identified depending on the importance of the delay factor, and it is defined to classify the major factors influencing time overrun.

2. LITERATURE REVIEW

It is a challenge to complete projects on time and within the planned budget, and it is a persistent problem around the world. Construction projects are subject to unforeseen circumstances due to various factors, such as the existence of varied interest groups, including the project owner, consumers, contractors, consultants, and financiers; the complexity of construction, materials, equipment, the climatic conditions, the political and economic situations, and legal regulations. [1]

The average delay for 49 Saudi Arabian road and bridge projects was 39%. The most significant contributor to delays was land acquisition and ownership. Other factors contributing to delays included contractors' lack of experience, redesigns, and uncontrolled underground utilities (line services).

The common reasons for project delays were caused by the owner contributing 53% of the project delays, based on the study results. [2]

While in Ethiopia, the main source of project delays was attributed to the contractor, with 40% contributing to the project delays. The financial problems, land acquisition, improper planning, design changes, construction delays, shortage in providing materials and equipment by contractors, and unfinished design are the common problems of delay and cost overrun, respectively. [3]

Another study in Jordan shows that topography, weather circumstances, labor supply, and varying demand were the basic reasons for the time and cost overruns. [4]

Ibrahim Mahamid indicates, in a study on the causes of frequent time overruns in road construction in Palestine, that the segmentation of the West Bank, the political circumstances, the absence of efficient machinery, inconvenient site approaches, reasons related to the owner (for example, delayed payments), and reasons related to the contractor (like difficulties in financing the project, personal struggles between workers, conflict between the consultant or the contractor and other parties, and high competition in bids) were the ten most frequently occurring factors. [5]

In Ghana, the causes of road construction delays are divided into contractor-related delays, such as insufficient contractor expertise; client-related delays, like the owner changing the work plan during construction; and problems in financing and payment for completed work by

the owner in addition to delays in site providing and delivering to the contractor. In addition to problems with the payments by the donor, such as providing the project items (donor-related delays). [6]

Aksana Jihad Mohammed shows that the main factors for delays in road construction projects are economic crises, delayed payments, unreasonable project timelines, and underestimating the deadline duration. Factors related to the owner, which can be under control, come first. Then, the external factors that are beyond control come later. [7]

In a study on identifying the causes of suspending road projects based on a study conducted in 25 developing countries around the world, the most common reasons were: financial problems with banks, delayed in payments to contractors, and delays making decisions by the owner, lowest bidder selection, lack of equipment; insufficient contractor qualification /shortage of construction materials/ delayed payments by the contractor, underestimating and insufficient planning/scheduling, miscommunication between project parties, inflation, political situation, shortage of fuel, shortage of overseas currency, import of equipment and materials issues, environmental claims, bureaucracy and government change of regulations, economic circumstances, and accidents during the construction. [8]

A study review concluded that the most significant reasons for road project delays are design changes and contractor inefficiencies in management, planning, and scheduling. Therefore, engaging technically qualified employees was a suggested solution to reduce delays. While the contractor should perform comprehensive surveys instead of relying on the report of surveys. [9]

Another study revealed that the lack of engineers in completing comprehensive surveys resulted in an incomplete definition of the project scope before contracting with the contractor. Delays in removing the present public service infrastructure from work sites of the project, problems in issuing instructions by the client to the contractors during the implementation of the projects, and an insufficient supply of required construction materials and equipment are the results of a study in Blantyre, Malawi [10]. Whereas in the Woliso Ambo Road Construction Project, the unpaid increase in the construction materials cost, the lack of construction materials, and the lack of risk assessment and management by consultants, in addition to overestimating or underestimating market conditions based on the construction price indices, were the most important negative reasons for delays, respectively. [11]

In Afghanistan, the delay-causing factors in road projects are 1- security, such as war and theft, and 2- contractors financial situation and insufficiency of equipment and material. 3- territorial acquisition, 4- corruption existing in the process of procurement, 5- delayed partial payments by owners/clients, 6- lack of security hazards in the procurement process, 7- imprecise design and quantity calculations/bills of materials, 8- short contractors' experience, 9- poorly qualified technical staff, and 10- awarding projects to the lowest bids [12]

It is meaningful to find out the critical factors that lead to a successful road maintenance project, as conducted in Maysan province, where the researchers identified three groups of success factors of road maintenance projects: management, technical, and resources. And the outcomes show that the ten most significant factors for the success of road maintenance projects are adequate funds, on-time payments to contractors and employees, materials quality, implementing advanced technology to observe or assess road deficiencies, communication and coordination among the involved parties, accurate budget and time estimation, selection of qualified maintenance contractors, use of modern machinery, adequate materials and equipment, and senior management support. [13]

Due to the circumstances that the country has been exposed to, additional reasons have emerged over the last years that have led to time delays in the implementation of road maintenance projects in Syria.

3. RESEARCH METHODOLOGY

Road project contracts in Syria are divided, according to the relevant directorates within the public establishment of road communications, into projects for implementing new road construction and road maintenance projects, which include periodic and ongoing maintenance, as well as improvement works for the central road network. This research will concern road maintenance project contracts and the reasons for delays.

In the road maintenance sector, about 10 considerable causes were identified as reasons for time overrun through literature in more than 25 projects in Syria in the period of 2019-2022. The reasons that had been documented in paperwork between the contractor and the owner were the original registered causes. The most significant reasons that resulted in time overrun were the insufficient supply of required materials (liquid asphalt or cement to carry out concrete works in the contract due to security and economic problems and an uncompensated increase in the cost of materials, which has 19.8% in the ranking) and payment delays to contractors, which is the second main reason for time overrun, which has 18.5% in the ranking. Delays in decision-making by the owner are considered one of the causes of payment delays to contractors.

These reasons are followed by additional causes of time overrun, such as shortage of fuel, which affects the equipment work (16%); government requirements (13.6%); accidents during the construction and the presence of obstacles not considered during the study (17.3%); site delivery to the contractor (7.4%); and weather conditions (3.7%).

Tab. 1

Factors Ranking Arranged Per Their Importance and Symbol

Factor	Rank	Symbol
1- Failure to provide required materials	19.8%	C
2- Delay in payments	18.5%	B
3- Emergency works	17.3%	E
4- shortage of fuel	16%	G
5- Government requirements	13.6%	A
6- site delivering to the contractor	7.4%	F
7- weather conditions	3.7%	H
8- Security conditions prevailing in the area	1.2%	D
9- Delay by the contractor in receiving the work sites	1.2%	I
10- Land acquisition	1.2%	J

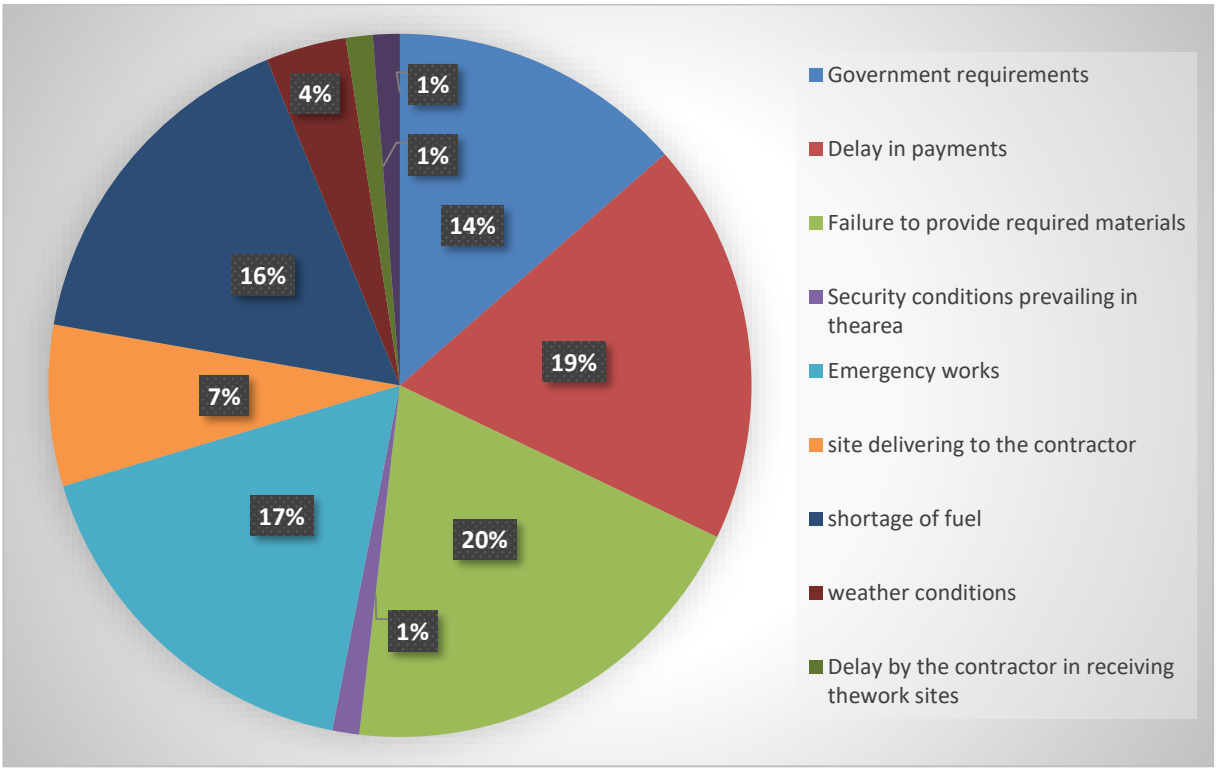

Fig. 1. Factors ranked in order of their importance

4. RESULTS AND DISCUSSION

While Figure 1 depicts the graphical representation, Table 1 lists the factors in order of significance. Table 2, comparing the actual and planned times for a sample of 15 projects, shows that the average percentage overrun time is 305%. While Table 3 shows the variables affecting delays in projects of the study, Table 4 indicates the correlation study for the variables affecting delays in projects.

As shown in yellow in Table 4, the most significant factors that were associated with these projects were A-C (-0.53433), B-C (-0.45699), E-G (-0.40319), and A-E (-0.35671). It is possible that greater "government requirements" reduced "failure to provide required materials" based on the negative association (-0.53433).

With values ranging from -1 to 1, correlation table 4 displays the direction and strength of linear correlations between pairs of variables. The degree of relationship between two variables is indicated by the correlation coefficient (r). +1 perfect positive correlation (one variable rises proportionately when the other rises), -1 perfect negative correlation (one variable falls proportionately when the other rises), and 0 0 to ±0.3 weak correlation, ±0.3 to ±0.7 moderate correlation, ±0.7 to ±1 strong correlation and no linear relationship.

The noteworthy patterns and correlations (with an emphasis on moderate to strong associations, $|r| \geq 0.3$). Variable A has a -0.53433 moderately negative association with C. C tends to moderately decline as A rises, indicating an inverse relationship. With B (-0.2254), E (-0.35671), F (-0.24703), and H (-0.23857), there are weak negative correlations: A has very weak correlations with D (0.094114) and G (-0.04012): A has nearly no linear link with these variables, and A has tiny inverse relationships with them.

Variable B has a moderately negative correlation with C (-0.45699), indicating a discernible inverse association between the two variables. Weak correlations with other people: B has weak positive correlations with E (0.061465) and F (0.105445) and weak negative correlations with A (-0.2254), D (-0.21466), G (-0.20456), and H (-0.00369, almost zero).

Variable C has a moderately negative correlation with both A (-0.53433) and B (-0.45699); as A or B rises, C tends to fall. Weak correlations with others: C has a weak negative correlation (-0.23536) with F and a weak positive correlation (0.049588) with D, E, and H. There is hardly any correlation between C and G (0.004088).

Weak correlations with all: The largest association (0.21466) has a weak negative correlation with B, and D has very weak correlations with all other variables. This implies that D is mostly unaffected by the other variables.

Variable E has a moderately negative correlation with A (-0.35671), meaning that when A rises, E tends to fall. E and G have a discernible inverse association, with a moderately negative correlation with G (-0.40319). Weak correlations with other people: E has weak negative correlations with D (-0.11194) and H (-0.05148) and weak positive correlations with B (0.061465), C (0.04506), and F (0.090582).

Variable F: Weak correlations with all: F exhibits weak positive correlations with B (0.105445) and E (0.090582) and weak negative correlations with A (-0.24703), C (-0.23536), D (-0.09579), and G (-0.22316). F is comparatively self-sufficient.

Variable G has a moderately negative correlation with E (-0.40319), indicating a clear inverse association between the two variables. Weak correlations with others: G has extremely weak positive correlations with C (0.004088) and H (0.023873) and weak negative correlations with A (-0.04012), B (-0.20456), D (-0.18256), and F (-0.22316).

The variable H shows very weak correlations with all other variables. The highest correlation is a weak negative correlation with A (-0.23857). H seems to be quite self-sufficient.

A and C have the strongest association (-0.53433, moderately negative). E and G (-0.40319) and B and C (-0.45699) have other moderate relationships.

Many variables do not have significant linear associations with one another, as evidenced by the table's weak correlations ($|r| < 0.3$). Particularly weak correlations between variables, such as D and H, imply that they may be independent or impacted by variables not included in this set.

The significant pattern of the study indicates that most connections are negative. Particularly for A, C, E, and G, most correlations are negative, meaning that when one variable rises, the others typically fall. C is involved in several moderate connections. C is an important variable in the dataset since it has a moderately negative correlation with both A and B. Despite being isolated, D and H exhibit continuously low correlations, indicating that they might not have a significant linear relationship with the other variables.

The context of the variables (i.e., what A, B, etc., represent) would enable a more meaningful interpretation of these correlations. If A is temperature and C is ice cream sales, for instance, the negative correlation (-0.53433) may indicate that ice cream sales are decreased by higher temperatures (perhaps because of melting or seasonal impacts).

This indicates that the factors "government requirements" and "failure to provide required materials" are correlated and have a largely negative impact on each other. "Delay in payments" and "failure to provide required materials" are correlated and have the second-highest impact on each other, followed by "emergency works" and "shortage of fuel," which are correlated and have the third-highest impact on each other. Finally, "government requirements" are correlated and have the fourth-highest impact on the factor "emergency works," all of which contribute to

the study's project delays. The correlation study indicates that the other factors have their own effects on the delay, mostly as individuals, and are not related to or correlated with one another.

Tab. 2
Planned and actual times for 15 projects.
(The average percentage overrun time is 305%)

Project	Planned Time (day)	Actual Time (day)	Delay period (day)	Time overrun %
1	120	940	820	683
2	120	545	425	354
3	120	725	605	504
4	75	210	135	180
5	180	300	120	67
6	120	390	270	225
7	250	1160	910	364
8	150	725	575	383
9	150	560	410	273
10	120	725	605	504
11	120	270	150	125
12	180	845	665	369
13	120	665	545	454
14	150	240	90	60
15	120	155	35	29

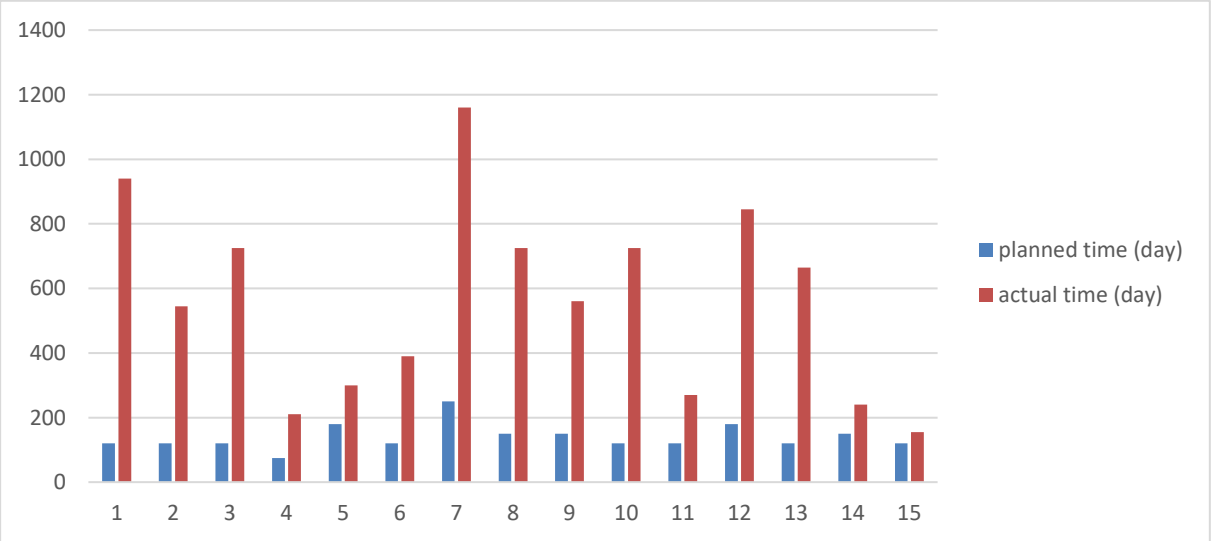

Fig. 2. The planned time and actual time for the examined projects

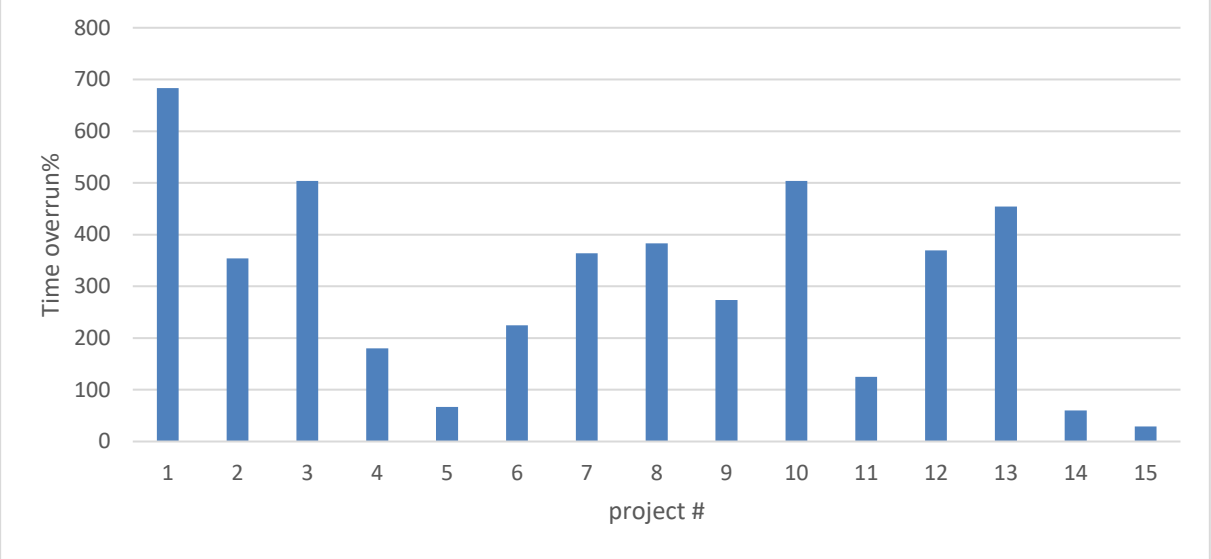

Fig. 3. Time overrun for the examined projects

Tab. 3

Variables Affecting Delays in Projects of the Study

Variable / Project	A	B	C	D	E	F	G	H	I	J
1	60	40	0	0	0	0	0	0	0	0
2	30	0	40	30	0	0	0	0	0	0
3	20	20	30	0	5	20	15	0	0	0
4	50	30	0	0	0	0	20	0	0	0
5	0	70	0	0	30	0	0	0	0	0
6	0	40	0	0	0	60	0	0	0	0
7	25	25	30	0	0	0	20	0	0	0
8	0	0	80	0	20	0	0	0	0	0
9	0	20	25	0	15	10	20	10	0	0
10	0	20	60	0	0	0	20	0	0	0
11	0	20	60	0	0	0	20	0	0	0
12	0	20	60	0	0	0	20	0	0	0
13	0	20	30	0	0	10	20	20	0	0
14	0	60	40	0	0	0	0	0	0	0
15	0	0	60	0	40	0	0	0	0	0
16	0	30	40	0	0	0	30	0	0	0
17	0	30	10	0	40	20	0	0	0	0
18	30	40	15	0	0	0	15	0	0	0
19	100	0	0	0	0	0	0	0	0	0
20	0	0	60	0	0	0	40	0	0	0
21	20	0	50	0	0	10	20	0	0	0
22	0	20	60	0	5	0	0	15	0	0
23	60	0	40	0	0	0	0	0	0	0
24	0	0	60	0	15	25	0	0	0	0
25	50	0	0	0	0	0	50	0	0	0

Tab. 4

Correlation study for the variables affecting delays in projects

Variables	A	B	C	D	E	F	G	H
A	1							
B	-0.2254	1						
C	-0.53433	-0.45699	1					
D	0.094114	-0.21466	0.049588	1				
E	-0.35671	0.061465	0.04506	-0.11194	1			
F	-0.24703	0.105445	-0.23536	-0.09579	0.090582	1		
G	-0.04012	-0.20456	0.004088	-0.18256	-0.40319	-0.22316	1	
H	-0.23857	-0.00369	0.070201	-0.07239	-0.05148	0.012527	0.023873	1

5. CONCLUSIONS

Most road maintenance projects in Syria are characterized as delayed, particularly in the past ten years, according to an analysis of reports and documents for multiple projects.

The results show that the critical factors are failure to provide required materials due to the political, economic, and security conditions that affected the country; delay in payments; accidents during the construction; and the presence of obstacles not considered during the study. In addition to the shortage of fuel and government requirements. It is illustrated that between the estimated and final time, there is a critical discrepancy, from 29% to 683%, with an average of 305%.

The factors "government requirements" and "failure to provide required materials" are correlated and have a largely negative impact on each other. "Delay in payments" and "failure to provide required materials" are correlated and have the second-highest impact on each other, followed by "emergency works" and "shortage of fuel," which are correlated and have the third-highest impact on each other. Finally, "government requirements" are correlated and have the fourth-highest impact on the factor "emergency works," all of which contribute to the study's project delays. The correlation study indicates that the other factors have their own effects on the delay, mostly as individuals, and are not related to or correlated with one another.

The findings of this study show similarities with the reviewed literature, particularly in developing nations.

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