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Delays Factors for Construction Projects in South of Iraq

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ABSTRACT: This study seeks to identify and categorize the factors responsible for delays in construction projects in southern Iraq. Using a sequential research approach that includes a literature review, interviews, and surveys, data were collected from 115 industry professionals, including clients, consultants, project managers, contractors, and engineers. The analysis utilized both descriptive and conclusive statistical methods, with a specific emphasis on the Spearman rank correlation coefficient to verify the reliability of the delay factor rankings.

The research identified 45 major delay factors, with the most critical being global and local economic crises, bureaucracy and corruption, public holidays, delays in securing municipal permits, and frequent change orders initiated by clients. These factors were further classified into eight categories: inaccuracies in the tendering process, technical performance management, government interference, rework in construction practices, among others.

The results indicate strong consensus among the different respondent groups regarding the main causes of project delays, as demonstrated by high correlation coefficients and a Chi-squared test confirming the agreement's significance. The findings provide valuable insights for practical applications and academic research, supporting the selection of project leaders, anticipating potential delays, and improving project management practices in Iraq. The study suggests future research should focus on strategic economic planning, exploring alternative funding sources, combating corruption, and implementing regulatory reforms to address the identified delay factors.

INTRODUCTION

The construction industry has a profound impact on the economy, society, and the environment, underscoring the need for its sustainability. Sustainable construction seeks to balance economic, social, and environmental considerations. To achieve this balance, it is crucial to develop scientifically-based methods for assessing and quantifying both organizational and technological efficiency in construction enterprises. These methods should also evaluate the industry’s organizational structure and cooperative efforts, particularly in risky and uncertain situations.

In the late 20th and early 21st centuries, Iraq's construction sector was a major economic force, significantly contributing to infrastructure development, including roads, bridges, residential buildings, schools, hospitals, and government facilities. However, economic sanctions imposed in the early 1990s severely impacted the Iraqi economy, leading to a substantial decline in the construction sector. The situation worsened with the military conflict that began in 2003, resulting in widespread destruction of buildings, roads, and industrial facilities.

Years of sanctions further isolated Iraqi construction companies from the global market. Combined with issues like price volatility and a lack of organizational and technical stability, these challenges led to diminished quality of construction projects, delays in implementation, and economic losses for stakeholders involved in investment and construction activities.

LITERATURE REVIEW

The construction industry has substantial impacts on the economy, society, and environment, making sustainability a key concern. Sustainable construction seeks to integrate economic, social, and environmental dimensions, necessitating scientifically grounded methods for evaluating organizational and technological efficiency, as well as assessing the capacity of construction enterprises. These methods should also be capable of diagnosing the optimal parameters for the industry's organizational structure and cooperation, particularly under conditions of risk and uncertainty.

At the turn of the 20th and 21st centuries, Iraq’s construction sector was a major economic contributor, involved in significant infrastructure projects such as roads, bridges, and buildings. However, economic sanctions in the early 1990s and the military conflict starting in 2003 severely impacted the sector, leading to a decline in construction quality and project delays.

Arati Chougule’s study highlights that risk is an inherent part of every project. To mitigate its negative impacts, timely risk assessments and preventive measures are crucial. Chougule’s research identified key delay factors in construction projects through interviews with industry professionals, categorizing risks into technological, construction, socio-political, community, and management types.

Jaber A. Z. (2019) emphasized the pervasive nature of risk, particularly in Iraq, where construction projects frequently face delays and cost overruns. Key risk factors identified include errors in project documentation, low contractor qualifications, inaccurate geological surveys, and delays due to contractor funding shortages.

B. G. Kim, Z. N. Shakir, and others (2020) focused on Baghdad, identifying various risk factors affecting construction projects. Their study categorized risks into financial, political, organizational, technical, and legal groups. Sharma and Goyal further explored cost overruns and project risk evaluation, using fuzzy set theory to model uncertainty and improve cost and duration estimates.

The study underscored a gap in theoretical and practical research regarding the impact of risk factors on the performance of construction projects in Iraq. To address this, modern scientific methodologies like structural equation modeling and the Smart PLS program were used to analyze and model these risks.

METHODOLOGY

Data were collected from various construction professionals, including contractors, project managers (PMs), engineers, consultants, and clients. Selection involved reviewing professional profiles on LinkedIn and company websites. Consultants were selected from the Engineering Consultant Bureau at the University of Kufa, while clients were chosen from relevant ministries and agencies. The data collection involved a three-phase approach: literature review, interviews, and questionnaires.

A preliminary literature review identified potential delay causes, followed by interviews with industry professionals to gather context-specific insights. The final stage involved a questionnaire with two sections: one for respondent demographics and the other for rating 45 delay factors on a five-point Likert scale. Data analysis utilized SPSS for calculating the Relative Importance Index (RII), ranking delay causes, and performing factor analysis.

The sample size was calculated using Yamane's formula, resulting in a sample size that ensures a 95% confidence level with a margin of error of 5.61%. This rigorous approach enhances the validity and reliability of the study's findings, which will support both practical and academic advancements in project management and construction industry practices.

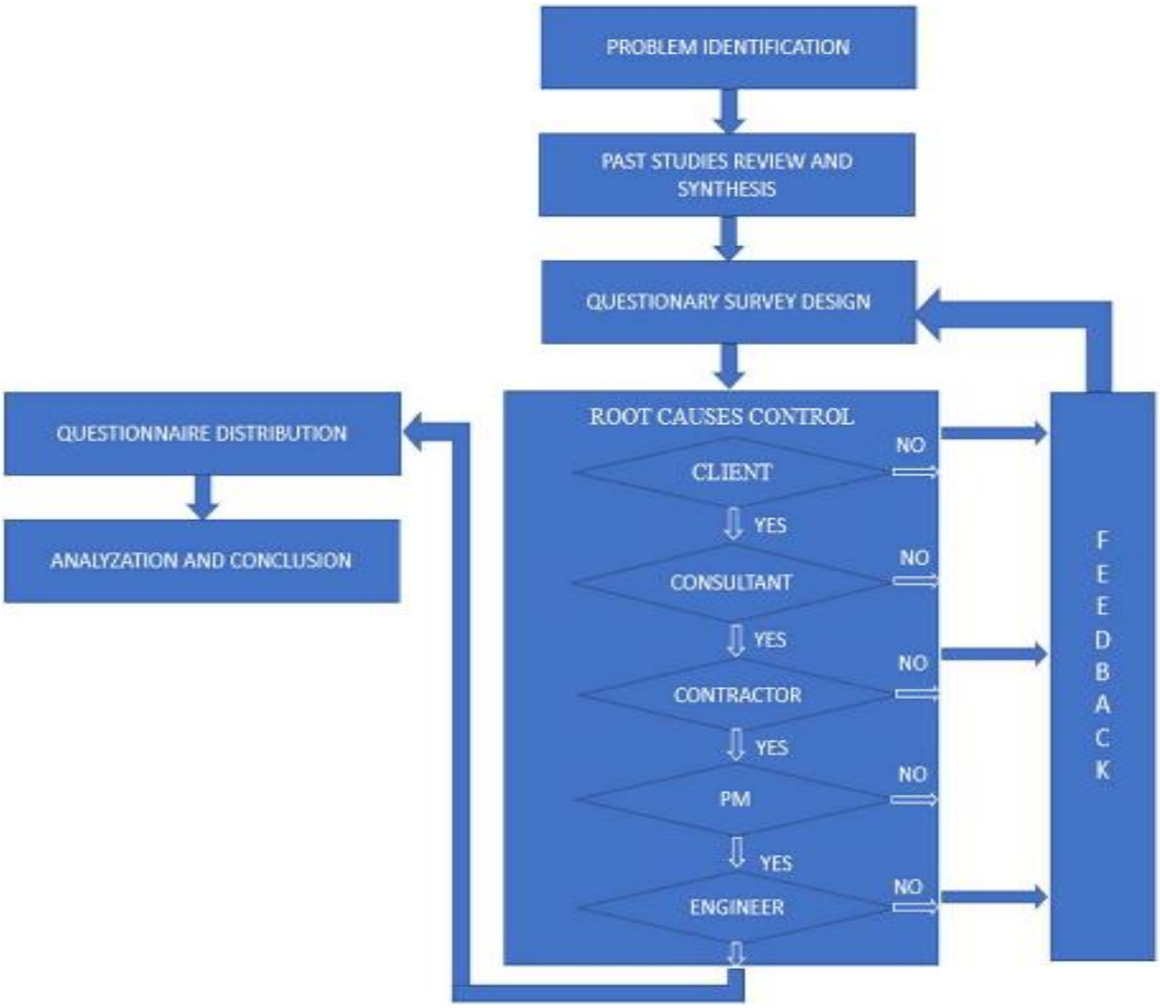

Figure 1

RESULTS

The personal characteristics of 115 respondents who sent back valid questionnaires are included in Table 1.

Table 1: Respondent demographic survey

Variable	Category	Frequency	Percentage
Category of respondents	Client	8	6.96
	Consultant	18	15.65
	PM	15	13
	Contractor	19	16.52
	Engineer	55	47.83
Total		115	100
Highest level of education	Doctorate	9	7.83
	Master	25	21.74
	Bachelor	78	67.83
	No degree	3	2.61
Total		115	100
Years of experience	Less than 5	16	13.91
	5–10	20	17.39
	10–20	41	35.65
	20–30	25	21.74
	30–40	8	6.96
	Above 40	5	4.35
Total		115	100

Before advancing to the main calculations, it is crucial to ensure that the study constructs meet the necessary analytical standards. To achieve this, three essential checks were performed: reliability, validity, and normality.

To evaluate the reliability of the questionnaire items, Cronbach's alpha (α) was computed using the formula:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum s_y^2}{s_x^2}\right)$$

where:

- k is the number of items in the survey.
- $\sum s_y^2$ is the sum of the variances of the items.
- s_x^2 is the total score variance.

For the 45 items included in the study, Cronbach's alpha was calculated to be 0.97, significantly exceeding the recommended threshold of 0.7. This high value indicates excellent internal consistency, affirming the reliability of the measurement instrument.

To ensure the questionnaire accurately measures the intended subject, validity was assessed through a review of relevant literature and content analysis. Feedback from clients, consultants, contractors, engineers, and project managers was used to validate the content. Their input confirmed the relevance and appropriateness of the questionnaire items.

The normality of the 45 items was examined using Skewness and Kurtosis tests. As noted by Chan et al., a distribution is considered normal if Skewness and Kurtosis values are close to zero. The results were tested against the null hypothesis of zero and found to be within the acceptable range of -3.29 to

+3.29, indicating that the data are reasonably normally distributed.

These checks confirm that the study constructs meet the necessary standards for reliability, validity, and normality, ensuring that the subsequent analyses will be robust and accurate.

Table 2: Analysis outputs of delay causes of construction projects

Variables	Mean	SD	Skewness		Kurtosis	
			Statistic	Std. error	Statistic	Std. error
DPPC	3.23	1.39	−0.235−0.235	0.226	−1.25−1.25	0.447
DDCSC	2.75	1.337	0.273	0.226	−1.197−1.197	0.447
IMCOC	3.43	0.965	−0.318−0.318	0.226	−0.536−0.536	0.447
PCCCOP	2.95	1.375	0.013	0.226	−1.352−1.352	0.447
SMD	3.25	1.498	−0.314−0.314	0.226	−1.411−1.411	0.447
WSC	3.05	1.123	−0.066−0.066	0.226	−0.777−0.777	0.447
TPBA	3.38	1.387	−0.315−0.315	0.226	−1.237−1.237	0.447
PASD	2.67	1.09	0.361	0.226	−0.361−0.361	0.447
MIDD	3.1	1.489	−0.166−0.166	0.226	−1.435−1.435	0.447
DIDD	2.97	1.357	−0.022−0.022	0.226	−1.335−1.335	0.447
CSSPQ	3.02	1.481	−0.03−0.03	0.226	−1.491−1.491	0.447
ITPC	3.05	1.572	−0.115−0.115	0.226	−1.591−1.591	0.447
CPD	3.3	1.044	−0.594−0.594	0.226	−0.274−0.274	0.447
DPFC	3.28	1.478	−0.327−0.327	0.226	−1.343−1.343	0.447
REC	3.43	1.093	−0.875−0.875	0.226	−0.001−0.001	0.447
ISMSC	3	1.331	−0.068−0.068	0.226	−1.32−1.32	0.447
PPSPC	3.14	1.344	−0.104−0.104	0.226	−1.322−1.322	0.447
ICM	2.93	1.336	−0.028−0.028	0.226	−1.292−1.292	0.447
FCSIW	3.34	1.22	−0.532−0.532	0.226	−0.55−0.55	0.447
CTSIQ	2.94	1.434	−0.091−0.091	0.226	−1.468−1.468	0.447
DPFLTC	2.59	1.206	0.438	0.226	−0.77−0.77	0.447
MLSM	2.5	1.18	0.625	0.226	−0.362−0.362	0.447
LDM	2.7	1.251	0.242	0.226	−1.095−1.095	0.447
CTSMC	2.93	1.153	−0.107−0.107	0.226	−1.014−1.014	0.447

SFMSANTM	**2.79**	**0.996**	**0.161**	**0.226**	**−0.642−0.642**	**0.447**
CMP	**3.2**	**1.179**	**−0.103−0.103**	**0.226**	**−0.744−0.744**	**0.447**
DL	**2.53**	**1.126**	**0.56**	**0.226**	**−0.476−0.476**	**0.447**
UW	**2.93**	**1.381**	**−0.016−0.016**	**0.226**	**−1.356−1.356**	**0.447**
LPL	**3.09**	**1.341**	**−0.228−0.228**	**0.226**	**−1.19−1.19**	**0.447**
CLP	**2.61**	**1.282**	**0.364**	**0.226**	**−0.875−0.875**	**0.447**
DWWSSC	**3.22**	**1.066**	**−0.093−0.093**	**0.226**	**−0.582−0.582**	**0.447**
EB	**2.57**	**1.068**	**0.397**	**0.226**	**−0.512−0.512**	**0.447**
EOPS	**2.32**	**1.031**	**0.638**	**0.226**	**−0.198−0.198**	**0.447**
IEPE	**2.47**	**1.02**	**0.26**	**0.226**	**−0.867−0.867**	**0.447**
SE	**2.54**	**1.062**	**0.209**	**0.226**	**−1.077−1.077**	**0.447**
ISC	**2.96**	**1.046**	**−0.052−0.052**	**0.226**	**−0.376−0.376**	**0.447**
IWC	**2.97**	**0.912**	**−0.089−0.089**	**0.226**	**−0.229−0.229**	**0.447**
DGPM	**3.5**	**1.334**	**−0.54−0.54**	**0.226**	**−0.939−0.939**	**0.447**
TCRJS	**2.98**	**1.108**	**0.114**	**0.226**	**−0.744−0.744**	**0.447**
AC	**2.82**	**1.048**	**0.095**	**0.226**	**−0.559−0.559**	**0.447**
CGRL	**3.18**	**1.189**	**−0.074−0.074**	**0.226**	**−1.032−1.032**	**0.447**
PH	**3.57**	**1.14**	**−0.547−0.547**	**0.226**	**−0.489−0.489**	**0.447**
BC	**3.68**	**1.536**	**−0.757−0.757**	**0.226**	**−0.981−0.981**	**0.447**
GLED	**3.7**	**1.061**	**−0.483−0.483**	**0.226**	**−0.454−0.454**	**0.447**
DILTR	**2.9**	**1.235**	**−0.071−0.071**	**0.226**	**−1.16−1.16**	**0.447**

Table 3: Abbreviations list

Abbreviation	Variables
DPPC	Delay in progress payments by clients
DDCSC	Delay in delivering the construction sites to contractors
IMCOC	Issuing many change orders by clients
PCCCOP	Poor communication and coordination between clients and other parties
SMD	Slowness in making decisions
WSC	Work suspension by clients
TPBA	Type of project bidding and award
PASD	Project award with short duration

MIDD	Mistakes and inconsistencies in the design documents
DIDD	Delays in issuing design documents
CSSPQ	Clients’ supervision staff with poor qualification
ITPC	Inaccuracy in tender preparation by clients
CPD	Changing in the project design
DPFC	Difficulties in projects financing by contractors
REC	Rework due to error during construction
ISMSC	Inferior site management and supervision by contractors
PPSPC	Poor planning and scheduling of projects by contractors
ICM	Inappropriate construction methods
FCSIW	Frequent changes for subcontractors due to their incompetent work
CTSIQ	Contractors technical staff with inferior qualification
DPFLTC	Delay in performing field and laboratory tests by contractors
MLSM	Materials lack on site or market
LDM	Late delivery of materials
CTSMC	Changes in the types and specifications of materials during construction
SFMSANTM	Slowness in finishing materials selection due to the availability of numerous types in markets
CMP	Changes in the materials prices
DL	Deficiency of labors
UW	Unqualified workforce
LPL	Low productivity of labor
CLP	Conflicts among labor personnel
DWWSSC	Difficulties of workforce to work in some sites due to security conditions
EB	Equipment breakdown
EOPS	Equipment operators with poor skills
IEPE	Inferior efficiency and productivity of equipment
SE	Shortage of equipment
ISC	Impacts of subsurface conditions
IWC	Influences of weather conditions
DGPM	Delays in getting permits from municipality
TCRJS	Traffic control and restriction at job site
AC	Accidents during construction
CGRL	Changes in governmental regulations and laws
PH	Public holidays
BC	Bureaucracy and Corruption
GLED	Global and local economic disaster
DILTR	Delay in Issuing laboratorial test results

Ranking of public project delay causes

The study identified and ranked key causes of delays in construction projects based on the responses from various participant categories: clients, consultants, project managers (PMs), contractors, and engineers. The rankings reveal the most critical delay factors from different professional perspectives:

- Clients:

Global and local economic crises were identified as the most significant cause of delays.

Slowness in making decisions ranked second.

Poor communication and coordination between clients and other parties and Delays in getting permits from the municipality were both ranked third.

- Consultants:

Type of project bidding and award (the lowest bidder) was the highest- ranked cause of delays.

Difficulties in projects financing by contractors followed as the second most crucial factor.

The third position was shared by Frequent changes for subcontractors due to their incompetent work, Slowness in making decisions, and Bureaucracy and corruption.

- Project Managers (PMs):

Both Global and local economic crises and Bureaucracy and corruption were ranked first.
Public holidays was considered the second most critical factor.
Difficulties in projects financing by contractors and Frequent changes for subcontractors due to their incompetent work were tied for third place.
- Contractors:
Bureaucracy and corruption was ranked as the most critical delay cause.
Global and local economic crises was seen as the second most important factor.
Public holidays was the third most significant cause of delays.
- Engineers:
Global and local economic crises were identified as the most severe cause of delays.
Rework due to errors during construction was ranked second.
Public holidays were considered the third most significant delay factor. These rankings underscore those economic factors, bureaucratic challenges, and issues related to decision-making and communications are consistently viewed as critical causes of delays across different respondent categories. However, the specific rankings of these causes vary by professional perspective, highlighting the complexity and multifaceted nature of delay factors in construction projects.

Agreement analysis

To verify that the delay rankings provided by clients, consultants, project managers, contractors, and engineers accurately reflect the true causes of delays in construction projects in Iraq and are not influenced by chance or b ias, two statistical methods were employed: Spearman's rank correlation

Coefficient and Kendall's coefficient of concordance.

1. **Spearman's Rank Correlation Coefficient**

This method measures the strength and direction of the association between the rankings of two respondent categories. The formula used is:

$$
\rho = 1 - \frac{6 \sum_{i=1}^{n} d_i^2}{n(n^2 - 1)}
$$

- d_i denotes the difference between the rankings of any two respondent categories for a specific delay factor.
- n is the total number of delay factors, which in this study is 45. This coefficient helps to determine whether the rankings from different respondent categories are consistent with one another. High Spearman's correlation values (close to 1) would indicate that the rankings are similar, suggesting agreement among respondents about the causes of delays. Low or negative values would indicate a lack of consensus.

2. **Kendall's Coefficient of Concordance (W)**

This method assesses the degree of agreement among multiple rankings provided by different respondent categories. The formula for Kendall's W is:

$$
W = \frac{12 \sum_{j=1}^{k} R_j^2 - 3n(n+1)^2}{k^2(n^2 - 1)}
$$

- R_j represents the sum of the ranks for each delay factor.

- k is the number of respondent categories.

- n is the number of delay factors.

A W value close to 1 indicates strong agreement among the rankings, while a value closer to 0 suggests minimal agreement. This coefficient helps to validate whether the consensus on delay factors is robust across different respondent perspectives.
By analyzing these two metrics, the study assesses the consistency and reliability of the rankings provided by different respondent categories. High correlation coefficients and a strong Kendall's W value would confirm that the identified delay factors are genuinely representative and that there is significant agreement among the respondents regarding the causes of delays in Iraqi construction projects.

Table 4: Spearman rank correlation coefficients of overall categories of respondents

Respondent category	Values of Spearman rank correlation coefficient
Client-Consultant	**0.891**
Client-PM	**0.918**
Client-Contractor	**0.849**
Client-Engineer	**0.359**
Consultant-PM	**0.932**
Consultant-Contractor	**0.882**
Consultant-Engineer	**0.593**
PM-Contractor	**0.849**
PM-Engineer	**0.527**
Contractor-Engineer	**0.739**

From the analysis of Table 4, it is evident that the calculated coefficients are strong and positive, indicating high harmonization between the rankings provided by all respondent categories. The strongest harmonization is observed between the following pairs: "consultant-PM," "client-PM," and "client-consultant."

To establish a unified measure of agreement between the respondent categories, Kendall's coefficient of concordance (W) provides a useful additional check. Kendall's coefficient is directly related to Spearman's rank correlation coefficient, as highlighted by Legendre [13]. It is computed by averaging the Spearman correlation coefficients pairwise, using the following formula [14]:

$$W = \frac{(m-1)P + 1}{m}$$

Where:

- m is the number of respondent categories.
- P represents the mean of the pairwise Spearman correlations, which is 0.754 in this study.

The computed Kendall's coefficient (W) is 0.803, indicating a high degree of agreement among all respondent categories regarding the causes of construction project delays in Iraq. This high value of Kendall's W further confirms the consistency and reliability of the identified delay factors across different respondent perspectives.

CONCLUSION

The study used a combination of literature review, interviews, and questionnaires to identify and classify delay factors in construction projects in Iraq.

Strong agreement was found between the rankings provided by different respondent categories, with the highest agreement between consultants and project managers, clients and project managers, and clients and consultants.

The Chi-squared test showed a high degree of agreement among all five respondent categories on the 45 delay causes.

The findings will help in the selection of project leaders, identifying potential delay points, and predicting performance demands. Academically, the study contributes to project management literature, particularly concerning project delays.

RECOMMENDATIONS

Developing an economic plan free from political interference

- Securing alternative funding sources
- Combating corruption through supervisory programs
- Reducing the number of public holidays through new regulations.

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