AUT Journal of Civil Engineering

AUT J. Civil Eng., 5(4) (2021) 613-624
DOI: 10.22060/ajce.2022.19293.5725

Causes of Delays in Iranian Building Construction Projects

M. Rahmati[1], M. Rojhani[2]*, M. A. Raoof [3]

[1] Graduate School of Management and Economics, Sharif University of Technology, Tehran, Iran.
[2] Department of Civil Engineering, Faculty of Engineering, Shahed University; Tehran, Iran.
[3] Department of Civil Engineering, Sharif University of Technology, Tehran, Iran.

ABSTRACT: Building construction consumes a large percentage of the materials and energy of a country and plays a significant role in the sustainable development of a region. Therefore, any factor affecting construction can have a significant impact on that country. One issue faced by the construction industry as a whole is delayed completion of projects. Poor management practices, such as time management, are pervasive factors. This study investigated and evaluated the causes for delays in the completion of construction projects in order of significance. As applied research, this study examined the causes of delays in building projects in Iran. Library resources were used to extract a set of causes from the literature and these were used to form the items of a questionnaire. The significance of each item was evaluated based on severity and frequency indices. It was then distributed through social media among a society of engineers active in the field of building construction. A total of 216 responses were gathered and formed the basis of our analysis. The results indicated that late financing by the client, demands for kickbacks, non-standard procedures followed by officials, and unrealistic planning and time scheduling of projects were the main causes of delay. The results of this study are a wake-up call for development planners, policymakers, project managers, engineers, experts, clients, contractors, and consulting engineers. Sustainable development can only be achieved by controlling these determinants of construction delays.

Review History:

Received: Nov. 22, 2020
Revised: Dec, 27, 2021
Accepted: Jan. 25, 2022
Available Online: Feb. 19, 2022

Keywords:

Delay
Scheduling
Sustainability
Project management
Building

1- Introduction

Global population growth means an increase in consumption which, in turn, means an increase in demand for materials and energy. Because material and energy resources are finite, manufacturers should efficiently address this increase in demand by implementing standards of sustainable development [1]. One approach to addressing sustainability is by examining the factors impeding its fulfillment [2, 3]. The construction industry, as a major consumer of materials and energy, has a paramount role in sustainable global economic growth [4]. However, this industry continues to suffer from a loss of productivity and efficiency [5]. Thus, determining and addressing the factors affecting the efficiency of building construction can foster sustainable economic development of a region [6, 7].

The millennium development goals of the United Nation Development Program (UNDP) emphasizes the provision of sufficient housing by 2050 across the globe (UNDP website) [8]. According to the UNDP, by 2018, 4.2 billion people comprising 55% of the world's population lived in cities. This is expected to increase to 6.5 billion by 2050. This population increase translates into a significant increase in demand for housing, whether in form of governmental or private construction. Although the budgets for governmental projects may seem huge in contrast to a small building construction project, the aggregation of these small projects can constitute a large proportion of a nation's economy. In Egypt, for example, the construction sector was a major driver of economic growth in 1981, with 45% of national funds allocated for development [9, 10]. As cities produce 80% of a country's GDP, managing this capital can have a significant effect on the economy of a nation [10, 11]. This volume of capital requires proper management to yield reasonable financial returns and maintain the sustainable economic growth of a region. To this end, the time management of a project plays a unique role.

Delays in the completion of a project can impose irrevocable costs which have been reported to aggravate the financial aspect to the extent that a project can become unprofitable and even incur loss [12]. The prevalence of failure in this industry has increased attention on this issue [10, 12-14]. Amusan *et al.* observed a trend in developing economies in which projects are badly affected by the twin variables of cost and time overruns [12]. They reported that projects in Ghana, Cameroun, Togo, Singapore, and Malaysia actually had been abandoned because of cost overruns when the projects became too expensive to maintain, making them unprofitable. Battaineh and Al Momani concluded that delays occur in almost all Jordanian projects [9, 15]. Moreover, the rate of overrun in developing countries is much higher than in developed countries such as the US, UK, and Japan. This emphasizes the importance of research in this area in

*Corresponding author's email: m.rojhani@shahed.ac.ir

Copyrights for this article are retained by the author(s) with publishing rights granted to Amirkabir University Press. The content of this article is subject to the terms and conditions of the Creative Commons Attribution 4.0 International (CC-BY-NC 4.0) License. For more information, please visit https://www.creativecommons.org/licenses/by-nc/4.0/legalcode.

developing countries [12], which clarifies the governing atmosphere in the industry by extracting the roots and causes of delay. Investigation of the causes and factors contributing to delays can increase awareness among investors and practitioners of the significance of time management for project profitability. Moreover, the results of such research can aid the development of novel and practical solutions.

Many researchers have studied the causes of delay and classified them. Ogunlana *et al.* compared the causes of delay in high-rise buildings in Thailand and other countries and categorized them into the major groups of materials, contractors, clients, and consultants [16]. Chan and Kumaraswamy determined and evaluated the causes of delay in Hong Kong concerning their relative importance and divided them into eight groups [17]. Odeh and Battaineh studied causes of delay in Jordan and categorized them into groups comprising clients, contractors, consultants, materials, workforce, contracts, external factors, and contract-based relationships [18]. Similar studies by Rachid *et al.*, Khoshgoftar *et al.*, and Hossain *et al.* have used a global approach [19-21]. Some researchers, such as Lindhard and Wandahl, have focused on scheduled activities and studied the causes of delay in 1450 activities out of 5424 scheduled activities [22]. Assaf and Al-Hejji classified the causes of delay in building construction projects in Saudi Arabia into those related to the client, contractor, and consultant [13].

Le-Hoai *et al.* focused on the causes of delay using field monitoring, library resources, and expert opinion to prepare and distribute a questionnaire among clients, contractors, and consultants in Vietnam [23]. The results of the 87 completed questionnaires revealed 21 important factors that they then divided into the sub-groups of client, contractor, consultant, project, material, workforce, and external factors. Le-Hoai *et al.* compared the results of their study with those in the UAE, Malaysia, North Korea, Jordan, Kuwait, Ghana, and Nigeria and found the top five factors in all of these to be the same [23].

Doloi *et al*. examined the causes of delay in construction projects in India and determined that a lack of commitment was the main driver of delay [10]. Senouci *et al.* studied 122 projects in Qatar from 2000 to 2013 for road, drainage, and building construction [24]. Using statistical analysis, they found that the additional costs were more pronounced in the building construction projects than in the road and drainage construction projects. The projects with the highest rate of additional cost were those with periods of 1 to 2 years, such as building construction projects. They surveyed 15 building construction projects and reported that a positive correlation exists between the initial estimation of the project cost and the added costs because of delays. They also reported a decreasing trend in the added cost throughout the study period, which could be attributed to increased awareness and mitigation efforts employed by the practitioners [24].

Al-Hazim *et al.* studied the final reports on 40 infrastructure projects in Jordan from 2000 to 2008 [25]. Based only on the frequency of each item, they identified 20 of the most important factors contributing to delays in these projects. A closer examination of 14 of the 40 projects indicated that the added cost was 101% to 600% of the initial cost estimation, with an average added cost of 214% per project. The delays were found to encompass 125% to 455% of the original estimate, with an average time delay of 226% per project.

El Sayed *et al.* [26] divided the causes of delay into predictable (thus preventable) and unpredictable (thus unpreventable). The results revealed that the failure to use proper time management software when scheduling tasks was the main cause of delay. Other researchers have studied broader aspects of the causes of delay [26]. Some of these causes were misidentified, as demonstrated in a study in Ghana, where poor management practices attributed to the contractor were brought on by payment difficulties with the client [27]. A comparison of the causes of delay in different countries can be a guide for governmental planning for financial programs [16].

Table 1 lists the top three major factors of delay in projects as obtained from a recent and comprehensive literature review. It was observed that different projects had different causes of delay in different countries. Acknowledging the causes of delay in each project can aid practitioners to rethink their planning and schedules.

Iran is not exempt from delays in such projects. The short-time profitability of these projects has attracted investors to this industry. Because these investors have different backgrounds, many lack the proper management skills for such projects, which will subject their investment profitability to risk. On the other hand, most skilled experts in Iran are engaged in large governmental projects and rarely, if ever, take advantage of such short-term investments. This absence of managerial skill is pronounced in the financial outcomes of projects.

Although many studies have been done around the world, there has been a lack of such studies in Iran, especially in the building industry. As an economic powerhouse and also a developing country in the region, building construction projects have been found to be lucrative practices. Data from 2017 reveals that the funding dedicated to the Iranian construction industry was about US$2 billion. The total area under construction was 134 million m^2, which is equivalent to US$25~30 billion in investment. This is 12~15 times the funding allocated by the government (data from the Statistical Center of Iran and Central Bank of Iran websites) [28, 29]. Implementing managerial skills, e.g. time management, in an industry of this size could significantly foster sustainable economic growth in Iran. Delineating the causes of delay in projects in Iran is thus of vital importance; however, the most recent study suffers from a small sample size, limited study area, and a lack of sophisticated methodology [30].

The current study focused on identifying the causes of delays in Iranian building construction projects. The data was collected using a carefully designed questionnaire that extracted information from the clients, contractors, and consultants involved. The goal has been to determine the severity and frequency of the identified causes and grade them in order of significance. The main groups of causes were those stemming from the contractors, clients, and consultants. Delineating the absolute and relative importance of each factor allows them to be kept in mind by those involved in the industry when planning projects.

An innovation of this study is that it was conducted in Iran and features an in-depth literature review that includes rarely investigated items as the causes of delay in building projects in Iran. It also reviews and compares the results with those of other relevant countries that are similar to Iran.

Table 1. Comparison of delay factors in different countries.

Reference	Country	Field	Top Three major factors of delay
Shaikh (2020) [31]	Pakistan (PK)	Construction	Financial problems faced by the contractor Fluctuation in the price of materials Poor supervision
Tshidavhu & Khatleli (2020) [32]	South Africa (ZA)	Energy	Shortage of skilled labor Slow client decision-making Poor planning and scheduling
Khan *et al.* (2019) [33]	India (IN)	Building	Change in scope of work Political / Public opposition Rework due to inadequate quality
Bin Seddeeq *et al.* (2019) [34]	Saudi Arabian (SA)	Oil & Gas	Changing of design and scope by the client during construction Poor planning and scheduling of project Design errors
Rachid *et al.* (2019) [19]	Algeria (AL)	Construction	Slow change orders Unrealistic contract duration Slow variation orders in extra quantities
Golabchi & Ghazimahalleh (2017) [35]	Iran (IR)	Building	Performing all activities on the site Supervisor delay Rework
Al-Hazim *et al.* (2017) [25]	Jordan (JO)	Infrastructure	Terrain conditions Weather conditions Variation orders
Samarghandi *et al.* (2016) [36]	Iran (IR)	Construction	Lack of attention to inflation and inefficient budgeting schedule Inaccurate budgeting and resource planning Inaccurate first draft and inaccuracies in technical documents
Koushki *et al.* (2014) [37]	Kuwait (KU)	Building	Changing orders Financial constraints Lack of experience in the construction business
Fallahnejad (2013) [38]	Iran (IR)	Oil & Gas	Imported materials Unrealistic project duration Client-related materials,
Doloi *et al.* (2012) [10]	India (IN)	Construction	Lack of commitment Inefficient site management Poor site coordination
Khoshgoftar *et al.* (2010) [20]	Iran (IR)	Construction	Finance and payments of completed work Improper planning Site management
El-Razek *et al.* (2008) [39]	Egypt (EG)	Building	Financing by the contractor during construction Delays in contractor payment by the owner Design changes by owner or agent during construction
Assaf & Al-Hejji (2006) [13]	Saudi Arabian (SA)	Construction	Change orders by the owner during construction Delay in progress payments Ineffective planning and scheduling by the contractor
Faridi & El-Sayegh (2006) [11]	UAE (UA)	Construction	Approval of drawings Inadequate early planning The slowness of the owner's decision-making process
Frimpong (2003) [27]	Ghana (GH)	Groundwater	Monthly payment difficulties from agencies Poor contractor management Material procurement
Chan & Kumaraswamy (1997) [17]	Hong Kong (HK)	Construction	Poor site management and supervision Unforeseen ground conditions Slow decision making involving all project teams
Kaming *et al.* (1997) [40]	Indonesia (ID)	Building	Design changes Poor labor productivity Inadequate planning

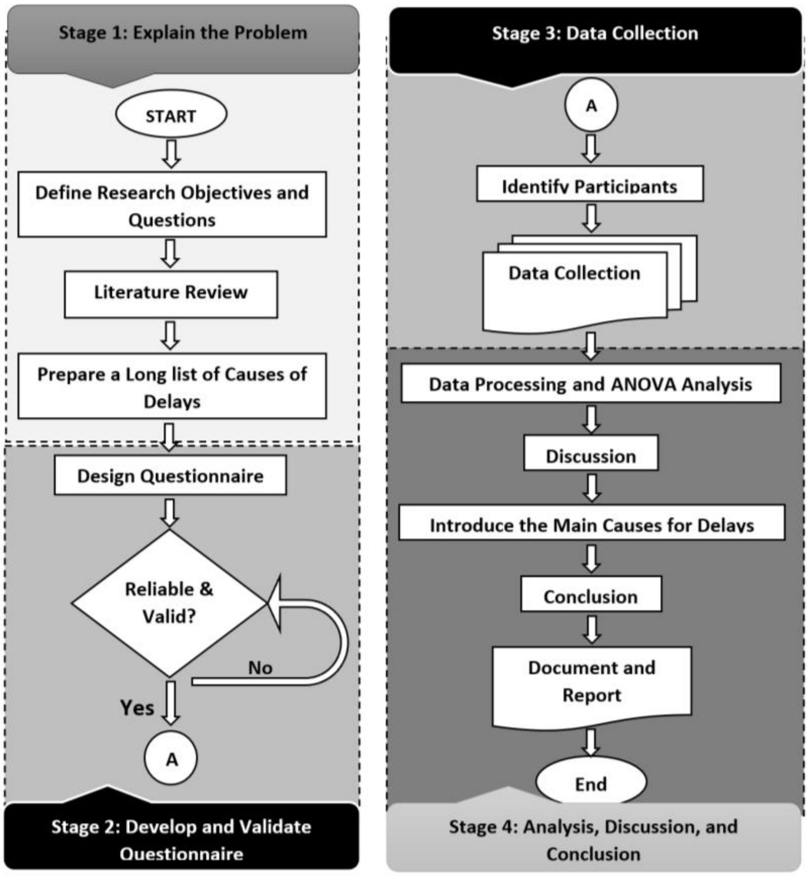

Fig. 1. Schematic of study workflow.

2- Methodology

The goal of this study was to uncover the concept behind the reality of the construction delay phenomenon. This has been addressed differently in social and qualitative studies and requires precise and objective accumulation of data. Subjective data can divert a researcher from actual circumstances; thus, an objective gathering of the data is essential for such studies. When pursuing the causes of delay in building projects in Iran, first a set of effective criteria was gathered from different countries and researchers during an in-depth literature review [9, 10, 12-18, 23-27, 39, 41, 42]. The studies which were most pertinent to the case study were selected and 23 items were chosen and clustered into seven major groups (client, contractor, consultant, material, workforce, project-related, and external factors) to be included in the design of the questionnaire. To collect the data in as impartial and objective a manner as possible, respondents were not aware of the grouping structure for the factors. The questionnaire was designed and its validity and reliability were confirmed by a panel of experts and a Cronbach's alpha of 0.938.

As a cross-sectional study, this questionnaire was implemented in Google Forms and was distributed randomly among about 6000 relevant experts. There were no limitations or restrictions, such as those relating to age, geographic location, and educational status, to contact them in person or remotely through email and Linked-in. Of the total of 6000 experts, only 216 responses were received. The data was compiled in Microsoft Excel and preprocessed and prepared for statistical analysis using SPSS statistical tool kits. Fig. 1 depicts a concise schematic of the workflow for the stages of this study.

The questionnaire was composed of an introductory note, demographic questions, and research-specific questions. The respondents were asked to evaluate each item that affects delays using a severity index (SI) and frequency index (FI) on a discrete four-step scale (rarely = 1; sometimes = 2; often = 3; always = 4, low = 1; moderate = 2; high = 3; extreme = 4). These measures were used to calculate the SI and FI indices in a normalized format as presented in Eqs. (1) and (2). The importance index (IMPI) was implemented to merge SI and FI and to reveal their importance as a convolution. This index is calculated as in Eq. (3).

$$\mathrm{SI}(\%) = \sum_{i=1}^{4} \frac{a_{is} \times n_{is}}{4 \times N} \times 100 \qquad (1)$$

Table 2. Items used in questionnaire (α = 0.938).

Client-related (α = 0.763)	I-1: Late financing by client
	I-2: Late decision-making and confirmation by the client
	I-3: Frequent changes in client requests
	I-4: Lack of incentives for avoiding delays and deterrents to delays
Contractor-related (α = 0.863)	I-5: Adjustments to unclear contracts and conflicting terms
	I-6: Contractor inexperience leads to the need to redo or correct defective work
	I-7: Unfamiliarity with project management
	I-8: Unrealistic and inappropriate planning and time-scheduling of projects
	I-9: Poor site management
	I-10: Inadequate financial versatility of contractor
Consultant-related (α = 0.899)	I-11: Impractical designs that lack an implementation prospectus or complete design
	I-12: Insufficient details or ambiguity about design
	I-13: Lack of consideration of interface among structural and service designs, which then require mitigatory measures in practice
Material-related	I-14: Material deficits in the market
Work force-related (α = 0.815)	I-15: Workforce deficits and/or absence of motivation
	I-16: Non-professional, unskilled, and inefficient workforce
	I-17: Inability to recruit experienced workforce or site supplies
Project-related (α = 0.758)	I-18: Outdated building practices and/or tools
	I-19: Environmental and physical constraints
	I-20: Unforeseen incidents and issues such as earthquakes or floods
External (α = 0.856)	I-21: Excessive, confusing, and time-consuming office work
	I-22: Demand for kickbacks and non-standard procedures by officials
	I-23: Lack of coordination among government offices and the absence of order

$$\mathrm{FI}(\%)=\sum_{i=1}^{4}\frac{a_{if}\times n_{if}}{4\times N}\times 100 \quad (2)$$

$$\mathrm{IMPI}(\%)=\frac{\mathrm{FI}\times\mathrm{SI}}{100} \quad (3)$$

In Eq. (1), a_{is} and n_{is} denote the severity score of each item and the number of times that this score was selected from among all respondents; a_{if} and n_{if} denote the frequency score. Table 2 lists the questionnaire items as grouped by their corresponding factors.

The minimum sample size required for this study was determined as [43]:

$$n=\left(\frac{z-multiple}{B}\right)^2\times P_{est}\times(1-P_{est}) \quad (4)$$

where n is the sample size, B is 5% for a confidence level of 90%, z-multiple is the standardized normal distribution value for a 90% confidence level, and P_{est} is assumed to be 0.5. For the total population of 450,000 engineers, the recommended sample size at a confidence interval of 90% is 203 individuals. This has been fulfilled in this study.

The normality of the collected data was confirmed for each item in each factor using the Kolmogorov-Smirnov test. One-way ANOVA was used for normal variables and the Kruskal-Wallis test was used for non-normal variables. The results of each factor were compared in terms of frequency, severity, and importance. These results were then compared between the client, contractor, and consultant groups.

3- Results and Discussion

To assure proper classification of items, it was determined whether or not there was meaningful variation between the items of the different factors. ANOVA was carried out to determine probable violations of the null hypothesis for frequency, severity, and importance among the seven factors. Tables 3, 4, and 5 summarize the results of ANOVA for the three indices among the seven factors. Note that the term "cluster" in ANOVA the results refers to the factors. All data qualified for ANOVA after testing for normality and variance

Table 3. ANOVA results for frequency index of clusters

Variation type	Sum of squares	Degrees of freedom	Mean of squares	Test statistics	Significance
Intra-cluster	1074.95	6	179.16	2.680	0.054
Inter-cluster	1069.78	16	66.68	~	~
Total	2144.73	22	~	~	~

Table 4. ANOVA results for severity index of clusters.

Variation type	Sum of squares	Degrees of freedom	Mean of squares	Test statistics	Significance
Intra-cluster	681.209	6	113.535	2.721	0.051
Inter-cluster	667.709	16	41.732	~	~
Total	1348.918	22	~	~	~

Table 5. ANOVA results for the importance index of clusters.

Variation type	Sum of squares	Degrees of freedom	Mean of squares	Test statistics	Significance
Intra-cluster	1172.184	6	195.384	2.540	0.064
Inter-cluster	1230.780	16	76.924	~	~
Total	2402.964	22	~	~	~

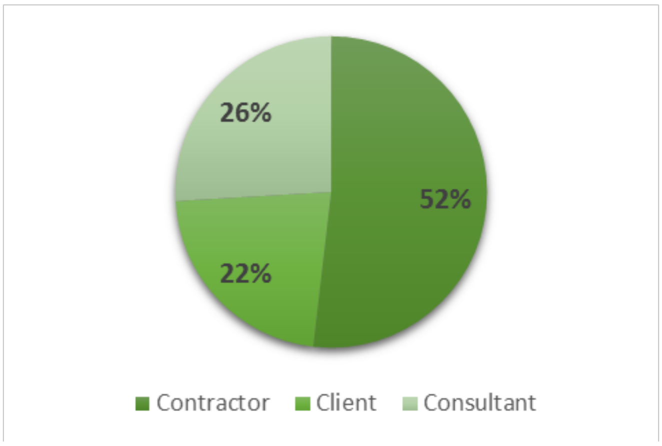

Fig. 2. Respondent composition in terms of field of engagement.

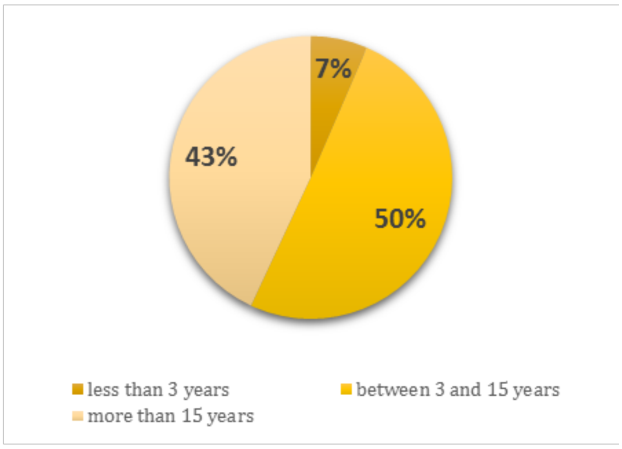

Fig. 3. Population composition in terms of experience.

homogeneity.

In Tables 3, 4, and 5, the significance of all indices was over 0.05, meaning that the null hypothesis for good clustering could not be rejected. In other words, there was no statistically meaningful relationship between the items of the different factors. In total, 216 persons (more than the minimum amount required) completed the questionnaire. Of these, 48 (22%) were clients, 112 (52%) were contractors, and 56 (26%) were consultants (Fig. 2). The overall composition of the population was 75.5% civil engineers, 9.3% architects, 4.6% mechanical engineers, 3.2% electrical engineers, and 7.4% in other fields (e.g., urban planners). Fig. 3 shows the level of experience of the respondents.

Fig. 3 indicates that 43% of respondents had more than 15 years of experience, which suggests that the data gathered can be considered reliable, for sufficiently experienced respondents constituted a major portion of the population. The field of engagement of the respondents was not significant in terms of academic background. In other words, the respondents were homogeneous in terms of academic background and the null hypothesis could not be rejected. In terms of experience, the population showed no significant, meaningful differences in the field of engagement. Here also, the null hypothesis could not be rejected, meaning

Table 6. Item rank by frequency, severity, and importance

	Rank By												Item Rank
	Important Index				Severity Index				Frequency Index				
	Overall	Consultant	Contractor	Client	Overall	Consultant	Contractor	Client	Overall	Consultant	Contractor	Client	Field of Engagement
Client	1	1	1	1	1	1	1	1	1	1	1	4	**I-1**
External	2	5	2	3	4	9	3	5	2	4	2	2	**I-22**
Contractor	3	2	3	3	3	3	4	4	3	2	3	3	**I-8**
External	4	8	5	2	6	10	5	2	4	5	4	1	**I-23**
External	5	3	6	5	5	4	6	3	5	2	5	3	**I-21**
Contractor	6	4	4	8	2	2	2	5	7	6	6	8	**I-10**
Contractor	7	6	8	6	11	5	9	9	6	6	7	6	**I-7**
Contractor	8	9	7	7	10	5	6	5	9	9	9	7	**I-9**
Project	9	7	9	9	12	7	10	11	8	8	8	8	**I-18**
Client	10	11	10	11	7	12	8	8	12	14	11	16	**I-2**
Consultant	11	13	11	10	17	17	17	12	10	11	10	10	**I-13**
Workforce	12	10	13	17	15	10	16	18	11	10	12	11	**I-16**
Client	13	15	12	15	8	14	11	12	15	13	14	16	**I-3**
Consultant	14	17	14	16	16	14	13	17	13	15	13	11	**I-11**
Workforce	15	14	16	12	14	16	14	14	14	12	16	13	**I-17**
Contractor	16	16	15	13	9	13	12	10	17	15	17	16	**I-5**
Contractor	17	12	18	14	13	8	15	15	18	17	19	14	**I-6**
Consultant	18	18	17	18	18	18	18	16	16	17	15	14	**I-12**
Client	19	19	19	19	19	13	19	19	19	19	18	20	**I-4**
Project	20	20	20	20	22	21	22	22	20	20	20	19	**I-19**
Workforce	21	22	21	21	21	21	21	20	21	22	21	21	**I-15**
Material	22	21	22	22	20	20	19	21	22	21	22	22	**I-14**
Project	23	23	23	23	23	23	23	23	23	23	23	23	**I-20**

that the respondents of different fields of engagement were homogeneous in terms of experience. This confirms the uniform distribution of experience among the respondents from different fields.

Each factor was ranked according to the frequency, severity, and importance indices from the perspectives of clients, contractors, and consultants. Because the score of each factor did not follow a normal distribution, the median score was used for data analysis using the Kruskal-Wallis test, a non-parametric equivalent of one-way ANOVA. A strong positive correlation was found during the analysis of the median for severity and frequency, meaning that the respondents more frequently chose factors of greater severity. Table 6 summarizes the results according to the rank of the factors and shows good agreement among the three engagement groups. The top five items in terms of importance

Table 7. Five most important items causing delays according to each engagement group (descending order).

Engagement group	Important factors
Client	I-1; I-23; I-22, I-8; I-21; I-9
Contractor	I-1; I-22; I-8; I-10; I-23
Consultant	I-1; I-8; I-21; I-10; I-22

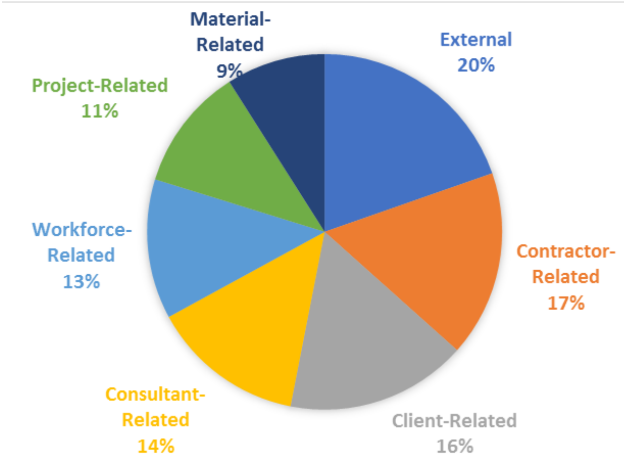

Fig. 4. Problem origins and relative importance.

index in descending order were:

Late financing by client

Demand for kickbacks and non-standard procedures by officials

Unrealistic and inappropriate planning and time scheduling of projects

Lack of coordination among governmental organizations and projects

Excessive, confusing, and time-consuming paperwork

A deeper analysis revealed the most important factors causing delays in building construction projects in Iran from different perspectives. Table 7 lists the five most important factors affecting the engagement groups in order of decreasing significance.

Simply judging by the results of Tables 7 and 6, which overemphasize certain causes, might be unrealistically narrow. A proper look at the problem from a broader perspective might yield subtle insights. Fig. 4 summarizes the problem origins causing delay and compares their relative importance.

Fig. 5 indicates that external, contractor-related, and client-related problems constituted the main causes of delay at 20%, 17%, and 16%, respectively. Table 8 sorts the items for each major group based on IMPI in descending order.

Fig. 5 compares the major factors by average importance, severity, and frequency indices. The results of Figs. 4 and 5, and Table 6 indicate that, although “late financing by the client” scored highest in terms of importance, it was not the sole item affecting the problem. Taken together, external, contractor-related, and client-related factors described most of the delay phenomena in the order of decreasing importance.

It was predicted that respondents might confuse severity and frequency; thus, the difference between them was explained in the introduction to the questionnaire. The results of Fig. 5 reveal a positive correlation between scores for SI and FI for each factor, especially for item 20, which was expected to be rare in frequency and high in severity. However, the scores for this item for both indices were similar. This indicates that respondents did not successfully distinguish between SI and FI and perceived importance (IMPI) holistically and not separately.

Table 9 lists the most important items as causes of delay in Iran derived from the results of this study. It also compares three main, pertinent causes of delay in developing countries that are similar to and near Iran for different projects. The first two letters correspond to the country and the second two letters after the dash correspond to the project type. Thus, IR, KU, EG, SA, GH, IN, ZA, UA, AL, ID, PK, HK, and JO, correspond to Iran, Kuwait, Egypt, Saudi Arabia, Ghana, India, South Africa, UAE, Algeria, Indonesia, Pakistan, Hong Kong, and Jordan, respectively. The letters C, B, OG, G, E, and I correspond to construction, building, oil and gas, groundwater, energy, and infrastructure projects.

Some of the main causes listed in Table 9 in Iran are similar and significant across countries for different projects. Specifically, the third factor of delay in Iran is common in many countries and is also the first reason for the delay in Iran and some countries. However, the second most important

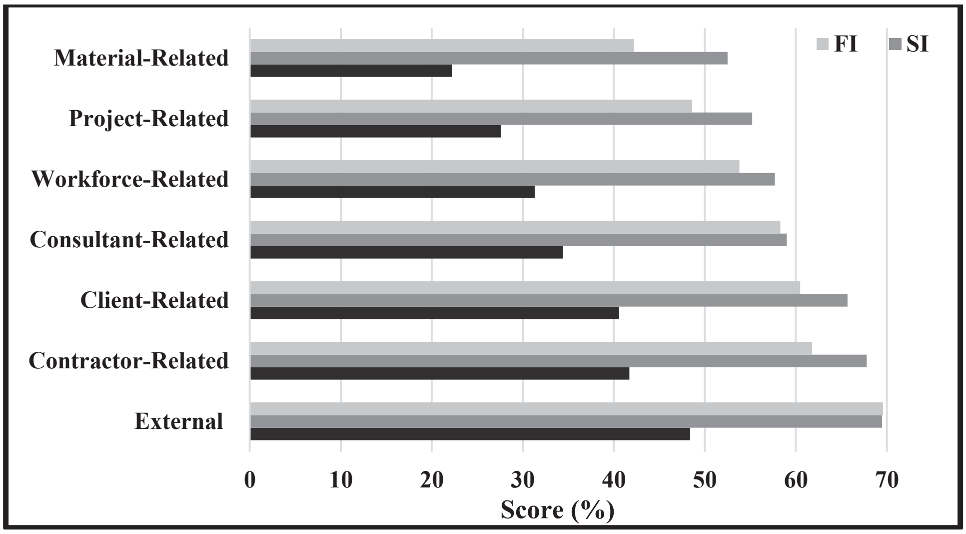

Fig. 5. Comparison of major factors by average importance, severity, and frequency.

Table 8. Most important items causing delays by group (descending order).

Engagement group	Important factors
client-related	I-1; I-2; I-3; I-4
contractor-related	I-8; I-10; I-7; I-9; I-5; I-6
consultant-related	I-13; I-11; I-12
material-related	I-14
project-related	I-16; I-12; I-15
workforce-related	I-18; I-19; I-20
external	I-22; I-23; I-21

reason for the delay in construction in Iran is the “demand for kickbacks and non-standard procedures by officials”. This has not been reported in any country other than India. As is evident from rows 4 and 5 of the table, as well as row 2 for Iran, administrative procedures and government bureaucracy, which were clustered in the external group, are clear causes of delay and have not been reported in other countries. This is a very important conclusion of this research and should be considered by the government.

4- Conclusion

In this study, the causes of delay that contribute to inefficiency in the building industry of Iran were investigated. After a thorough literature review, a list of the major and common factors identified by studies in different parts of the world was compiled. This data then was used to design a questionnaire that was distributed among experts with different levels of experience and areas of engagement (clients, contractors, and consultants). These experts were asked to rate items for the major factors in terms of frequency and severity.

Analysis revealed that late financing by the client was the main cause of delay for clients, demand for kickbacks and non-standard procedures by officials was the main cause of delay in the external factors category, and unrealistic and inappropriate planning and time scheduling of projects were the main causes of delay for consultants. However, clients, contractors, and consultants considered late financing by the client to be the most important item causing delays in projects. The fact that the clients themselves recognized the accuracy of this factor emphasizes its prevalence and significance.

Although the items mentioned above appear to be the top three causes, overall, those originating from external, contractor-related, and client-related factors contributed most significantly to the delays. In the external group, which includes the procedures, administrative and organizational processes of the government, there exists an unfavorable state of affairs that comprises a significant share of delays in Iran compared to other countries.

The lack of materials and an experienced workforce have not been significant problems in Iran. Although these factors have caused major problems in many countries, building projects in Iran are primarily hindered from completion by inefficient procedures developed by the authorities involved. This means that minor improvements in financial and procedural matters could reduce delays, improve project efficiency, and even increase eagerness to undertake such building projects. Such efforts, even though they could be considered minor, could yield high returns. This is an issue that requires future research and is an informative signal to policymakers and development planners.

Acknowledgments

This research received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors gratefully thank Mrs. Sarrafzadeh for her help and guidance in statistical analysis and all the respondents to the questionnaire for their time and effort.

Table 9. Most important causes of delay in building projects in Iran, by item, compared with causes of delay in different projects in developing countries similar to and near Iran.

I-1: Late financing by client	IR-C, KU-B, IR-OG, EG-B, SA-C, GH-G, IR-C
I-22: Demand for kickbacks and non-standard procedures by officials	IN-B, IN-C
I-8: Unrealistic and inappropriate planning and time-scheduling of projects	SA-OG, ZA-E, IR-C, UA-C, AL-C, IR-OG, ID-B, SA-C, IR-C
I-23: Lack of coordination among government offices and the absence of order	
I-21: Excessive, confusing, and time-consuming office work	
I-10: Inadequate financial versatility of contractor	PK-C, EG-B
I-7: Unfamiliarity with project management	GH-G
I-9: Poor site management	PK-C, IR-B, HK-C, IN-C, IR-C
I-18: Outdated building practices and/or tools	
I-2: Late decision-making and confirmation by client	ZA-E, HK-C, UA-C
I-13: Lack of consideration of interface among structural and service designs which then require mitigatory measures in practice	IR-B, AL-C, IN-C, UA-C
I-16: Non-professional, unskilled, and inefficient work force	ZA-E
I-3: Frequent change in client requests	IN-B, SA-OG, KU-B, EG-B, JO-I, SA-C, AL-C
I-11: Impractical designs that lack an implementation prospectus or complete design	SA-OG, IR-C
I-17: Inability to recruit experienced workforce or site supplies	
I-5: Adjustments to unclear contracts and conflicting terms	
I-6: Contractor inexperience leading to the need to redo or correct defective work	IN-B, KU-B, IR-B
I-12: Insufficient details or ambiguity about design	ID-B
I-4: Lack of incentives for avoiding delays and deterrents to delays	
I-19: Environmental and physical constraints	PK-C, JO-I, HK-C
I-15: Workforce deficits and/or absence of motivation	ID-B
I-14: Material deficits in the market	IR-OG, GH-G
I-20: Unforeseen incidents and issues such as earthquakes or floods	
Abbreviations are based on Table 1	Country- Field

Declarations

Funding

No funds, grants, or other support were received.

Conflicts of interests

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript. On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

[1] G. Silvius, Sustainability as a new school of thought in project management, Journal of cleaner production, 166 (2017) 1479-1493.

[2] R.K. Mavi, C. Standing, Critical success factors of sustainable project management in construction: A fuzzy DEMATEL-ANP approach, Journal of cleaner production, 194 (2018) 751-765

[3] A. Bahadorestani, N. Naderpajouh, R. Sadiq, Planning for sustainable stakeholder engagement based on the assessment of conflicting interests in projects, Journal of Cleaner Production, 242 (2020) 118402

[4] Bakar, A.A. Razak, S. Abdullah, A. Awang, Project management success factors for sustainable housing: a framework, in: International Conference Of Construction Industry, 2009

[5] M.O. Sanni-Anibire, R. Mohamad Zin, S.O. Olatunji, Causes of delay in the global construction industry: a meta analytical review, International Journal of Construction Management, (2020) 1-13

[6] P.W. Ihuah, I.I. Kakulu, D. Eaton, A review of Critical Project Management Success Factors (CPMSF) for sustainable social housing in Nigeria, International Journal of Sustainable Built Environment, 3(1) (2014)

62-71

[7] J. Kivilä, M. Martinsuo, L. Vuorinen, Sustainable project management through project control in infrastructure projects, International Journal of Project Management, 35(6) (2017) 1167-1183

[8] United Nation Development Program (URL: https://www.undp.org/sustainable-development-goals-old#sustainable-cities-and-communities)

[9] H. Battaineh, Information system of progress evaluation of public projects in Jordan, Department of Civil Engineering, Jordan University of Science and Technology, Jordan, (1999)

[10] H. Doloi, A. Sawhney, K. Iyer, S. Rentala, Analysing factors affecting delays in Indian construction projects, International journal of project management, 30(4) (2012) 479-489

[11] A.S. Faridi, S.M. El-Sayegh, Significant factors causing delay in the UAE construction industry, Construction Management and Economics, 24(11) (2006) 1167-1176

[12] L.M. Amusan, D. Dosunmu, O. Joshua, Cost and time performance information of building projects in developing economy, International journal of mechanical engineering and technology (IJMET), 8(10) (2017) 918-927

[13] S.A. Assaf, S. Al-Hejji, Causes of delay in large construction projects, International journal of project management, 24(4) (2006) 349-357

[14] A. El Sayed, E. Mamoua, A. Novalić, The Lack of Techniques Used in Management as a Factor Causing Delays in Construction Projects in B&H and Other Delay Factors Detected, in: International Conference "New Technologies, Development and Applications", Springer, 2019, pp. 728-735

[15] A.H. Al-Momani, Construction delay: a quantitative analysis, International journal of project management, 18(1) (2000) 51-59

[16] S.O. Ogunlana, K. Promkuntong, V. Jearkjirm, Construction delays in a fast-growing economy: comparing Thailand with other economies, International journal of project Management, 14(1) (1996) 37-45

[17] D.W. Chan, M.M. Kumaraswamy, A comparative study of causes of time overruns in Hong Kong construction projects, International Journal of project management, 15(1) (1997) 55-63

[18] A.M. Odeh, H.T. Battaineh, Causes of construction delay: traditional contracts, International journal of project management, 20(1) (2002) 67-73

[19] Z. Rachid, B. Toufik, B. Mohammed, Causes of schedule delays in construction projects in Algeria, International Journal of Construction Management, 19(5) (2019) 371-381

[20] M. Khoshgoftar, A.H.A. Bakar, O. Osman, Causes of delays in Iranian construction projects, International Journal of Construction Management, 10(2) (2010) 53-69

[21] M.A. Hossain, D. Raiymbekov, A. Nadeem, J.R. Kim, Delay causes in Kazakhstan's construction projects and remedial measures, International Journal of Construction Management, (2019) 1-19

[22] S. Lindhard, S. Wandahl, Exploration of the reasons for delays in construction, International journal of construction management, 14(1) (2014) 36-44

[23] L. Le-Hoai, Y. Dai Lee, J.Y. Lee, Delay and cost overruns in Vietnam large construction projects: A comparison with other selected countries, KSCE journal of civil engineering, 12(6) (2008) 367-377

[24] A. Senouci, A. Ismail, N. Eldin, Time delay and cost overrun in Qatari public construction projects, Procedia Engineering, 164 (2016) 368-375

[25] N. Al-Hazim, Z.A. Salem, H. Ahmad, Delay and cost overrun in infrastructure projects in Jordan, Procedia Engineering, 182 (2017) 18-24

[26] N.R. Mansfield, O. Ugwu, T. Doran, Causes of delay and cost overruns in Nigerian construction projects, International journal of project Management, 12(4) (1994) 254-260

[27] Y. Frimpong, J. Oluwoye, L. Crawford, Causes of delay and cost overruns in construction of groundwater projects in a developing countries; Ghana as a case study, International Journal of project management, 21(5) (2003) 321-326

[28] Statistical Center of IRAN (URL: www.amar.org.ir).

[29] A. ARDESHIR, ESHTEHARDIE SHAH BEIK, A. H. & RIAHIE DEHKORDI, E., Investigating Causes of Delay in Common Building Projects in Tehran, in: 11th International Project Management Conference, 2014

[30] F. Shaikh, Financial Mismanagement: A Leading Cause of Time and Cost Overrun in Mega Construction Projects in Pakistan, Engineering, Technology & Applied Science Research, 10(1) (2020) 5247-5250

[31] F. Tshidavhu, N. Khatleli, An assessment of the causes of schedule and cost overruns in South African megaprojects: A case of the critical energy sector projects of Medupi and Kusile, Acta Structilia, 27(1) (2020) 119-143

[32] S. Khan, M.S.S. Malek, S. Phugat, FACTORS INFLUENCING TIME AND COST OVERRUN IN CONSTRUCTION OF GOVERNMENT BUILDINGS: INDORE AS A CASE STUDY

[33] A. Bin Seddeeq, S. Assaf, A. Abdallah, M.A. Hassanain, Time and cost overrun in the Saudi Arabian oil and gas construction industry, Buildings, 9(2) (2019) 41.

[34] M. Golabchi, M. Mohammadi Ghazimahalleh, Ranking and Prediction Formula of Time Waste Causes in Residential Building Projects by LASSO Method, Industrial Management Journal, 9(1) (2017) 167-188.

[35] H. Samarghandi, S. Mousavi, P. Taabayan, A. Mir Hashemi, K. Willoughby, Studying the Reasons for Delay and Cost Overrun in Construction Projects: The Case of Iran, (2016).

[36] P. Koushki, K. Al-Rashid, N. Kartam, Delays and cost increases in the construction of private residential projects in Kuwait, Construction Management and Economics, 23(3) (2005) 285-294.

[37] M.H. Fallahnejad, Delay causes in Iran gas pipeline projects, International Journal of project management,

31(1) (2013) 136-146.

[38] M. Abd El-Razek, H. Bassioni, A. Mobarak, Causes of delay in building construction projects in Egypt, Journal of construction engineering and management, 134(11) (2008) 831-841.

[39] P.F. Kaming, P.O. Olomolaiye, G.D. Holt, F.C. Harris, Factors influencing construction time and cost overruns on high-rise projects in Indonesia, Construction Management & Economics, 15(1) (1997) 83-94.

[40] A. Aibinu, G. Jagboro, The effects of construction delays on project delivery in Nigerian construction industry, International journal of project management, 20(8) (2002) 593-599.

[41] M.N. Shah, S. Dixit, R. Kumar, R. Jain, K. Anand, Causes of delays in slum reconstruction projects in India, International Journal of construction management, 21(5) (2021) 452-467.

[42] S.C. Albright, W.L. Winston, Business analytics: Data analysis & decision making, Cengage Learning, 2014

[43] Central Bank of IRAN (url:www.cbi.ir)

[44] P. Ghoddousi, M.R. Hosseini, A survey of the factors affecting the productivity of construction projects in Iran, Technological and economic development of economy, 18(1) (2012) 99-116.

HOW TO CITE THIS ARTICLE

M. Rahmati, M. Rojhani, M. A. Raoof, Causes of Delays in Iranian Building Construction Projects, AUT J. Civil Eng., 5(4) (2021) 613-624.

DOI: 10.22060/ajce.2022.19293.5725